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STRATEGIES OF NEGOTIATION BETWEEN THE INDIVIDUAL AND NEW SOCIAL GROUPS

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***Abstract**: The social psychological theories that the paper drives on are parts of the sub-fields of socialization, personal relationships and religion. Another approach applied in this paper is of critical gerontology. The reader should bear in mind that the paper employs the concept of group status from the field of critical gerontology without addressing social issues pertaining specifically and solely to gerontology. From early on in life the individual is surrounded by groups of people. Throughout childhood, adolescence, and adulthood the individual is in a constant interaction with the social groups s/he is surrounded by and part of. The purpose of this paper is to examine how different social sciences/psychological theories explore the issue of interaction between the individual and the new social group that the individual encounters and to examine possible impacts of the discussed interactions on the individual's identity. Specifically, the impact of group-individual interaction on the individual's group identity will be touched upon.*

***Key words**: individual, social group, negotiation, socialization, personal relationships, group joining, group identity.*

The interaction between individuals and groups makes a significant contribution to the identify formation of the individual. This paper will apply several theoretical approaches to conceptualizing these interactions and will examine ways in which interactions contribute to, or shape, the group identity of the newcomer. Group identity is the fundamental dimension of the individual's social identity, it is as Stets shows, who one is (Stets, 2006). The groups that the individual chooses to socialize with are likely to have a deep impact on who one is, both in terms of perception of others as well as in terms of self-perception of the individual.

Critical gerontology focuses on four types of interactions between the individual and group, and offers several possibilities for the individual's self perceived group identity as a consequence of each particular interaction type.

Socialization theory emphasizes that the individual's self-concept is influenced by previous life-experiences, thus leading to the conclusion that the individual's present group identity is heavily contingent upon past groups belongingness.

Personal relationships theory, by means of investment model, will be employed in a rather innovative, unconventional way in order to see why individuals stay in social groups and why they decide to leave social groups. The implications for individual's identity of staying within a group are hypothesized upon.

The negotiation model will provide a deeper and more comprehensive understanding of the stages that a group and individual go through in order to establish group membership for the newcomer. The model provides fertile grounds for speculations on the group identity of the new comer.

Each theoretical approach will be critically analyzed for strengths and limitations. Comparing and contrasting these approaches leads to suggestions for future research.

1. CRITICAL GERONTOLOGY-GROUP STATUS

The group status approach offered by the field of critical gerontology leads to a good insight into what constitutes a group and what types of groups our contemporary society consists of. The group status approach offers also a good insight into where the individual can self- position in relation to a group. According to Dressel,, Minkler, and Yen (1999), researchers should distinguish between dominant and subordinate groups. The authors point out that many social scientists belong to dominant groups, namely to groups that hold material resources and have been for a long time willing and capable of constantly shaping and influencing ideologies. For instance, a social psychologist coming from a wealthy family of European –Americans and studying ethnic groups of Spanish or of Native Americans, will observe these ethnic groups according to a system of values that are very salient among wealthy European-Americans. The outcome of such research is likely to be that the ethnic groups studied are found insufficient and inadequate on multiple levels.

The tendency of social scientists to be members of dominant groups sheds a new light on possible individual-group interactions. One interaction situation, is that in which an individual is a member of a dominant class. People are likely to interact with other groups according to the ideology of their own particular group. Dominant groups have constructed social categories of race, gender, class, age, and ethnicity (Dressel, et al., 1999). Considering a context of a professional interaction, when a member of a dominant group considers interaction with a group that is categorized as subordinate, that individual's agenda/motivation is to a great extent shaped by the ideology of the dominant group the individual has been socialized by. Thus, the individual starts from the premise that the subordinate group is peripheral and tries to obtain as much personal achievement from that interaction as possible while contributing

as little as possible to the goals of the other group. This is likely to happen due to the perceived superiority of the individual, by both himself and the subordinate group whose members are aware of the class belongingness and SES of the individual compared to their own. Speculatively, one can say, taking into account the mutual class and SES awareness of the individual and group, that influenced by a number of contextual variables, which contribute to the perceived importance of the individual and of the interaction, the group members incline towards a lenient/obedient interaction style or that they tend to withdraw from interaction. For both parties, the interaction is likely to be a short term one, each party seeking a minimum of identity change during the interaction and a maximum of gains. The social identity of the individual is likely to remain what it was prior to the interaction due to class and SES differences and due to lack of interest in staying in the group.

A second interaction situation is different, namely, the individual comes from a group that is considered subordinate and seeks interaction with another group that is considered subordinate.The individual is likely to have a more egalitarian approach to the interaction with the group. Specifically, the individual might consider paying attention to more than immediate and personal needs to be fulfilled by the interaction with the group and may be willing to make allowances for the group goals. Speculatively, again, one predicts that, in this particular case, the group might consider more carefully its interaction with the individual. Considerations such as, what type of subordinate groups the individual has been previously socialized in, play an important part in the group's evaluation of the individual. Should these considerations not become obstacles in the incipient stages of the interaction, this type of interaction is likely to be a long term one, more so than the first interaction situation explained above. The individual is likely to become a part of the group and negotiate a group identity for her/himself that benefits the group as well as the individual.

A third individual-new group interaction situation is when an individual who perceives her/himself as belonging to a dominant group is interested in interacting with another dominant group. One might stereotypically refer to this situation as a business oriented interaction. In this case each party is interested in maximizing gains and minimizing input, namely the group is interested in obtaining as many benefits for the group as feasible without making too many allowances for the individual's needs and goals. The individual is interested in persuading the group to help her/him to achieve as many personal goals and address personal needs while maintaining as high as possible a status (based on the belongingness to other dominant groups) that will prevent the new group from negotiating an identity role that is detrimental to the individual. This type of interaction is likely to be long term, if both parties perceive aspects of their interaction to be of high interest, and if they can maintain negotiations that reinforce their dominant group belongingness. The length of the interaction depends on how well each party compliments itself by maintaining the interaction with what can be called a good enough company. The individual is likely to enrich her/his group identity by adopting new values that are not likely to conflict with her/his already extant dominant class values.

A fourth individual-new group interaction situation is when an individual from a subordinate class interacts with a dominant group. Speculatively, one can put forth that the interaction motivators are rather weak on the part of the group. The members of the group might assign roles to the individual that do not exactly flatter the individual, such as study subject, if the dominant group is interested in research, or other interests that set rigid premises for the individual's identity role. Therefore, in this case, there are constraints imposed by the group at the very onset of the interaction. The individual might be motivated to interact by a desire to accede to a dominant group and enhance self-esteem by obtaining and maintaining group membership, in which case prolonged negotiations are the norm.

Another motivator for the individual might be the desire to make a change in the group and modify the group's perception of the rapport between a dominant group and a subordinate one. In this case as well, prolonged negotiations are the norm. This particular type of interaction is likely to be long- term if the individual is very motivated and to lead to major changes in the individual's group identity.

If they are fortunate, the social scientists studying the interactions mentioned above are aware of the multi-layered inequalities found in each of the interactions. Therefore, Dressel, Minkler and Yen (Dressel, et al., 1999) propose several hypotheses on inequality that should be taken into account when researching individual-group interaction. Specifically, interactions might be influenced to a great extent by what is called the double jeopardy thesis, the situation which implies a member of a subordinate group entering another subordinate group, thus accumulating more than one subordinate role identity. For instance a working class individual who is aging is part of two subordinate groups: working class and aged. The implications of the double-jeopardy thesis are multi-levelled. For instance, the example mentioned above leads to the hypothesis of rather limited socialization possibilities of the aged, working class individual. The limited socialization is likely to lead to a poorly constructed group identity of the individual who feels that many of the groups of interest are out of reach.

A second hypothesis, described (Dressel, et al., 1999) applies especially to aging individuals and groups. The age-as-leveller theory puts forth that inequalities generated by race and gender tend to diminish over lifespan. For instance a non-Caucasian woman might find it easier to interact with all social groups once she begins to age. She is likely to be perceived as much more respectable and trustworthy due to her age. The group identity of individuals in this situation is likely to expand greatly if the individuals are willing to take advantage of the open doors to groups that are newly open.

The third hypothesis that this paper mentions is the hypothesis that considers income and income-related aspects (such as consumption patterns and socialization patterns) as interaction motivators, or deterrents respectively. For instance an individual that has previously socialized with dominant groups due to her/his high income is more readily accepted into any new social group than an individual with a low income who has budget limited consumption and socialization patterns.It would be interesting to see if/how this situation affects the identity of the individual.

The three hypotheses are useful when studying individual-new group interactions, as well as when studying inter-group interactions. However, as the researchers point out, the hypotheses do not address issues that pertain to ideology and ideology makers (Dressel, et al., 1999). Specifically, while the three hypotheses offer some insight on a small scale of interaction, they do not offer a solution to the dominant-subordinate groups dichotomy. For instance, when studying the interaction between an elderly individual and new social groups there are two types of oppression/inequality shapers that come into play: interlocking factors and intersectional factors (Dressel, et al., 1999). Interlocking inequality factors are represented by the macro-level of connections that create and link systems such as: class, race, gender, age, and ethnicity. The intersectional inequality factors are represented by the micro-level of connections that each individual and each group makes while processing its social position within the interlocking macro-structure. For instance, a macro level connection between race and gender situate an African woman in a certain social position that she must live with, due to the fact that her specific social position is reinforced by everybody in society. The micro level of the same race and gender connection for the same women is the way she situates herself within a group of African women and the group identity that she develops within that group. It follows that

each interaction between an individual and a social group is highly contingent upon the two types of factors mentioned above: the positioning of the group and of the individual, as well as the self-positioning of each, depend on a combination of factors that shape the perceived inequality.

The impact of the inequality factors on the individuals' and on groups' identities should also be considered. Interlocking as well as intersectional factors of inequality are, to a great extent, identity shapers. Individuals socialize within several groups throughout their lives. By the time one individual comes to interact with a new group, that individual has been part of several social groups in which the individual negotiated several social roles. The problematic issue with encountering new groups and interacting with them is that the self-perception of the individual (influenced by previous interactions) might be at odds with the new group's perception of that individual. For instance, a person might be perceived by a new group as old, or as aging due to grey/white hair. This perception is immediate to the very incipient stages of interaction and is likely to impact the interaction between that group and the individual. The individual might not see her/himself as old or aging and might not be willing to accept an identity role that the group members unanimously agree on because this role is not salient to the individual. In such a context the individual must reconsider how important interaction with the new group is, and to what extent the individual can influence the group's perception.

The situations described above do not address specifically the interaction *igniters*, namely who/what initiates and directly encourages interaction between a group and an individual and why particular individuals choose and are chosen to interact with specific new groups. Another aspect that the situations described in this paper do not address in detail is the positioning of the individual vis-à-vis a group and the positioning of the group vis-à-vis the individual, as subjectively perceived positions based on the complexity of interlocking and intersectional factors that percolate into context-specific variables that shape specific interactions.

2. SOCIALIZATION

Socialization theory is instrumental in understanding the individual-group inter-connection from an early age and throughout the life span. The way the individual is socialized influences the group choices made and the reasons for choosing particular groups to socialize with. Former interactions with other individuals and groups combined with overall life experience influence the individual's interaction with a group because, the individual is an *active participant* in socialization processes Luftey & Mortimer, (2003).

Socialization theory emphasizes that the individual develops a self-concept that is based on previous life-experiences and that plays an important part in the individual's present and future socialization choices (Luftey & Mortimer, 2003). It follows that the individual's choice of new social groups is heavily contingent upon former groups that the individual belonged to, or still belongs to. Thus, the more varied the individual's social groups, the more likely it is for the individual to have a rich self-concept and to want to verify this self-concept by interacting with new and varied groups. For instance, if the individual has socialized in inter-racial, inter-ethnic and sub-cultural milieus and if the socialization has been an egalitarian, meaningful and pleasant enough one (Hornsey & Hogg, 2000), then the individual is likely to seek interaction with diverse groups that are likely to verify and compliment the self-concept that the individual has developed during previous interactions. Consequently, the individual is likely to avoid groups that contrast with the group identity contingent upon the self-concept that is already extant.

Socialization today tends to be, to some extent, both normative and non-normative (Luftey & Mortimer, 2003). Specifically, socialization is more normative

during childhood, a period during which people are taught to behave as societat large expects them to (Corsaro & Fingerson, 2003). The individual has fewer group choices during childhood due to lack of variety of context and to reduced agency. Socialization tends to be both normative and non-normative during adulthood. By non-normative socialization one understands socialization with groups that the adult individual chooses and develops an interest in without any external pressure. For example, the individual interacts with groups that are occupation specific, these interactions qualify as normative, but the individual interacts with other groups that are new and that, as emphasized above, verify and complement the individual's self concept in ways that are not related to one's profession. One advantage of non-normative interaction is that there is more freedom for the individual, as well as for the group to create new negotiation strategies. However, this is a disadvantage as well, because both parties have fewer socialization guidelines and interaction might become confusing at times. For instance, within a group of colleagues at work (a context that implies occupation specific socialization) the individual is aware of behavior norms and rules that must be acknowledged. The same individual might interact with a group of new neighbours that are of a different ethnicity. The individual might intend to be neighbourly in a way that the new neighbours are not accustomed to (delivering hot brownies and introducing oneself might come across as friendly, yet not very salient, in some ethnic groups). Along the same lines of novelty in terms of non-normative group interaction, the individual might have interacted in the past with a specific subculture. A pleasant experience with that subculture may lead the individual to join a similar sub-cultural group. There are fewer behavior norms involved in this type of interaction; both individual and group have fewer restrictions as to how to interact. However, they do have expectations derived from a negotiation process that satisfies both parties, and this situation entails the elaboration of new, interaction specific, *ad hoc* created norms that facilitate the interaction between the two parties. Overall, the more variety in the individual previous choices of groups, the richer her/his group identity is likely to be.

While considering social groups that the individual seeks to interact with, temporal orientation might play an important role in the choice s/he makes. Future plans might include or exclude prolonged interaction between the individual and the group based on the possible selves of the individual, as explained by Marcus (as cited in Luftey & Mortimer, 2003). The set of possible selves is a way by which an individual knows her/himself and it consists of what the individual perceives as her/his potential and future. The possible selves is a continuum, namely it ranges from one's greatest fears and reaches out to one's greatest wishes and expectations. According to Marcus, this form of self- knowledge is an expression of long-term cognitive goals (Luftey & Mortimer, 2003). New interactions are thus motivated by the set of possible selves, which, in its turn, comes into being as a result of former interactions and experiences. Socialization theory, thus, shows that the individual's choices to interact with new social groups, is the result of a conflation of: biography, temporal orientation and context.

Socialization theory does not systematically and specifically account for interaction within an inter-cultural and inter-ethnic environment. Due to its emphasis on biography, socialization theory suggests that temporal orientations and context might be less important in an individual's choice of group and in the group's interest in an individual. For instance, a Caucasian woman who spent all of her school years in private schools where she interacted with other Caucasian women is not likely to easily develop an interest in interacting with a group of different race and with a different educational background. Arguably, fewer prejudices develop about women of different race and educational background, yet lack of prejudice does not necessarily lead to an increase in interest.

3. PERSONAL RELATIONSHIPS

Personal relationships theories focus on why people enter into, stay in and/or leave personal relationships. One of the theories pertaining to this group of theories, the investment theory, is employed in this paper to further develop the topic of interaction between the individual and new social groups.

Investment theory puts forth that an individual is most likely to stay in a relationship if that relationship brings her/him a high level of satisfaction, if the perceived quality of alternatives is low and if the individual has invested a lot in the relationship (Rusbult, Drigotas, & Verette, 1994). This theory emphasizes that commitment mediates the balance among the three elements mentioned above in a relationship. The idea of mutual commitment is central to this theory. Specifically, not only should one party feel committed to the interaction, but, the other party needs be similarly committed to it. It follows that an individual is likely to be interested in interacting with a new social group if s/he is dissatisfied with groups that s/he has been interacting, if new groups are perceived as interesting and attractive, and if the amount and quality of investment in familiar groups have not been high.

The group might reciprocate to some extent the feeling of insufficiency in terms of satisfaction and investment. However, the group might not consider forcing the individual to leave the group for any of the reasons mentioned above, because a group is by definition formed from several members, therefore the expulsion of one member might not be extremely pressing for the group. On the other hand, the expulsion of a member may not carry a heavy cost either, compared to ending a relationship between only two people. Interestingly enough, in the context of the individual interacting with new groups, the principle of mutuality applies differently from how it applies within a dyad. Specifically, it is more likely for the individual to be completely dissatisfied with the group for not obtaining enough support to achieve personal goals, than it is for the group to be completely dissatisfied with one individual group member. Therefore, this section of the paper focuses solely on the individual's choices of interaction and leaves the group's choices open for further research.

A key concept in the theory of investment is the balance between what the individual perceives as rewards and costs entailed by a relationship. This brings one back to the balance among the three elements conceptualized as central to a relationship: satisfaction levels, perceived quality of alternatives, and investment size. Influenced by the commitment level, the fine dynamics among the three elements are likely to determine the rewards and costs balance of an individual in a relationship. Several situations are worth exploring in order to better understand how the oscillation level of one element might influence the individual to feel more or less rewarded by present group interactions and act accordingly.

The first situation is when the individual's satisfaction levels are low. In this case, the individual engages in an analysis of the perceived quality of alternatives, namely what other groups are appealing, and of the investment size in the group he has been interacting with. According to investment theory, commitment level might still be very high, even if satisfaction levels are low. Perhaps, if the alternatives are very appealing, and the investments are not very high, the individual's commitment levels decrease and s/he initiates contact with a new group. If the investments are very high, the individual might perceive the alternatives as less appealing, maintain a high level of commitment and refrain from initiating contact with a new group.

The second situation is when the alternatives are perceived as very appealing, in spite of fairly high satisfaction levels and investment size. In this context, the individual initiates interaction with the new group without withdrawing from the group s/he has been interacting with. Commitment levels remain high toward the old group,

while new interactions and new negotiations emerge with the new group.

The third situation consists of very low investments on the part of the individual, fairly high satisfaction levels and fairly high perceived quality of alternatives. In this context the individual might not withdraw from the group, yet pursue interaction with the group that is perceived as appealing. Similar to the second situation, the commitment levels to the old group may remain rather high throughout the analysis process and interaction with the new group.

The investment model accounts very well for the complexity of the individual's group identity. The fact that an individual chooses to keep his connections with some groups while engaging in negotiations with new groups shows that the individual's group identity is a very elastic concept, that it is capable of including new elements without discarding old elements, thus reaching new and complex dimensions.

The investment theory does not account for the ways and the extent to which the three elements: satisfaction, alternatives, and investment depend on one another to the extent of modifying the commitment levels. Moreover, the three elements are conceived as rather fixed categories, not fluid, and not likely to be influenced by factors that are external to the relationship. For instance an individual's satisfaction levels might depend on comparisons with previous groups the individual interacted with. This satisfaction has nothing to do with the investment levels in the new group or with perceived alternatives. Similarly, one's satisfaction levels could be high enough to contribute to a low quality perception of alternatives and increase the level of commitment.

4. THE NEGOTIATION MODEL

One of the theories employed in researching individuals joining religious groups is recruitment as an interaction/negotiation situation based on the Moreland/Levine model of socialization to small groups (Richardson, 1993)

The Moreland/ Levine socialization model has three fundamental psychological and social psychological processes: evaluation, commitment and role transition. They are each equally important to any situation in which joining a group is considered by both individual and group members. All three processes take place continuously. Both the individual and the group evaluate the benefits of the individual's membership. Positive evaluations lead to stronger commitment, and ongoing role transition.

The first step of socialization to small groups is mutual investigation: the individual looks for qualities of the group that might help her/him achieve personal goals and meet personal needs, while the group is interested in the particular qualities that the individual has that would
benefit the group's interests and goals. If the findings are satisfactory for both group and individual, the next step, socialization, follows. Socialization consists of the group's attempts to direct the individual's efforts towards the benefit of the group. At the same time, the individual tries to involve the group members in activities that will match her/his needs and contribute to the achievement of her/his personal goals. If this negotiation stage is completed and both individual and group are satisfied, the relationship enters its maintenance stage, in which the group tries to place the individual in a position that would best fit the interests of the group and the individual looks for a role that would personally satisfy her/him. Not much group identity is involved in this incipient stage. If this part of the negotiation process brings satisfaction to both parties, this stage can be extended for an indefinite period of time with the expectation of ever more increased commitment of the individual who has found a comforting group identity in the group. However, if the individual or/and the group become dissatisfied with the result of this particular negotiation stage, then the individual is to be re-socialized. Re-socialization involves renegotiating a position for the individual that would please both group and individual. This stage is

critical to the individual's group identity The successful negotiation of the re-socialization stage takes the negotiation to the desired and balanced maintenance stage. If solutions that are mutually rewarding are not found during the re-socialization stage the individual leaves the group. In this case, the individual has not enriched her/his group identity at all. This stage is referred to as the remembrance stage, the stage of retrospective evaluation of each party in search of explanations as to why the individual left the group.

The model described above emphasizes the particular dynamic that is formed by the constant interaction between the individual and the group. Each of the interaction stages described by the Moreland/Levine model underlines that each party is involved in making decisions about the course of the interaction.

The model is very thorough, and accounts very well for each of the well-conceptualized stages of the interaction. The model also gives the group a sense of dynamism and identity. However, the model does not raise the question of suspended or terminated interaction before the stage of re-socialization. If either of the two parties consider that interaction is not rewarding enough or too demanding, it is likely that interaction is terminated before having progressed through enough stages to lead to the remembrance stage. The Moreland and Levine model does not address how the individual and the group would manage such a situation. For example, does remembrance take place when the relationship ends because of a failure to reach a maintenance stage?

5. INTEGRATION OF THEORIES

The topic of the paper is different interaction possibilities between the individual and a new group, and group identity implications for the individual. Most of the hypotheses made in the paper are possible areas for future research. All theories selected for the purpose of this paper, the interaction between the individual and a new group, and possible group identity impact of the interaction, address the topic from a slightly different angle. Thus, each contributes to a better and more complex understanding of the topic addressed. Group status addresses this issue on an ideological level, distinguishing between macro and micro inequality factors that, to a large extent, play an essential role in the positioning of the individual as part of a group. Naturally, the self-positioning of the individual is also contingent upon the macro and micro inequality factors. Identity salience for an individual is negotiated at the confluence of self-perception and perceptions that groups have of an individual. The approach offered by the researchers (Dressel, et al., 1999), though ideologically seminal, tends to shed a rather deterministic light upon the topic. Specifically, the individual is seen as caught within the complex net of macro and micro inequality factors. It follows that the individual is oppressed on multiple levels and all the interaction choices that s/he makes are pre-ordained by a specific combination of oppression factors that are likely to greatly influence the individual's group identity.

By contrast, the socialization theory gives way to a more flexible and less deterministic understanding of the topic by providing a theoretical framework that is equally rich as the one offered by the group status approach. The flexibility of socialization theory is its balance between former experiences that influence the individual's choices, temporal orientations, and context. This approach does not distinguish between dominant and subordinate groups. Instead it operates with the type of terminology (possible selves, non-normative socialization) that allows for an understanding of the individual as a possessor of agency, a creative interpreter of social contexts, one who acts influenced by biography, temporal orientation and context, but who is not entirely determined by them. According to socialization theory one's group identity is a world of possibilities.

What socialization theory does not address specifically is a micro-dynamic of elements that prompt the individual to

interact with particular groups. The investment model is the one that focuses on these elements and brings along a very useful terminology (commitment, satisfaction levels, perceived quality of alternatives, investments size).

The investment model helps explain why individuals seek new groups while sometimes maintaining their old ones. It also frames an individual's interaction efforts as motivated by the interdependence of rewards and costs, an idea that is employed by the negotiation model as well. The rewards can be seen as group identity gains of the individual.

Interestingly enough, the idea of commitment is central to personal relationships, while the negotiation model does not touch upon this notion. However, both theories address strategies that the individual engages in constantly, in order to obtain and maintain a functional interaction. The investment model refers to them as strategies to accommodate, while the negotiation model refers to them as negotiation. More than the other theories, the investment model is the approach that emphasizes the amount of agency that the individual has while negotiating group interaction.

One limitation of these theories is that they do not explicitly address the depth of the interactions between individuals and groups, and the relationships between the depth of the interactions and the duration of the relationships. Some relationships between individuals and groups may be casual, others more personal, and others quite intimate. Is it plausible to hypothesize that deeper or more intimate relationships would tend to last longer? Further research would be needed in order to answer this question. Another limitation of these theories is that they do not explicitly address the factors that may influence an individual becoming committed to some groups and withdrawing from other groups. For example, might shared goals be the *main* factor that increases the likelihood that an individual and a group would commit to each other? Of course, these are two broad potential areas for further research that would lead to many, more specific, research questions.

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SOUCES OF INFORMATION IN CAREER COUNSELING

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Abstract: *Counseling and career guidance services have evolved significantly in the industrial, post-industrial and informational society from several points of view – in what concerns the organization, methods, structure, policies and practices, the human resources which were considered, but especially in terms of sources of information which beneficiaries can appeal to. This paper has attempted to capture the range of these sources of information to which, at a certain time, not only the beneficiaries of school counseling services resort to, but also the providers - school psychologists in Brasov county.*

Key words: *counseling, career, education.*

1. THE CURRENT BACKGROUND

Counseling services and career guidance have evolved significantly in the industrial, post-industrial and information society from several points of view – in what concerns the organization, methods, structure, policies and practices, considered human resources and available occupational structures. Moreover, educational and vocational counseling and guidance supports the individuals to build their own careers and thereby, helps in conceiving an optimal path in life.

Currently, career counseling must meet the following categories of new situations and challenges: the globalization of the labor market, the extend of market economy in most of world's countries, organizational transformation of the workplace, the growing importance of knowledge, communication skills - not only verbal ones, but also the use of NTI, progressive learning, demographic growth and rising unemployment, the implementation of the policy of women emancipation, migration and border mobility for labor, and recently, the implementation of new government policies regarding the overcoming of the current crisis. These issues have already made considerable changes considering the expectations, micro and macro structures, and the task of counseling and vocational guidance is to properly appreciate the impact, to understand the phenomena in progress and to support individuals as they adapt to new challenges.

Therefore, under the aforementioned factors and the directions stipulated by the EU Council between 2003 and 2004 on strengthening policies, systems and counseling practices throughout life in Europe, it is emphasized the need of putting the individual in the center of counseling services. The key recommendation is the absolute need to facilitate access to career guidance services and continuous improvement of their quality. Given that in Romania there is an important increase in the use of NIT, it can significantly facilitate this effort.

Most of the specific content of counseling and career guidance can be operationalized by using advanced information technologies. Thus, the main challenges to be respond to by any system of career counseling are switching the focus from the direct assistance of school or professional decision, to the development of the individuals' ability to manage their own careers, and finding inexpensive ways to broaden access to counseling services for the beneficiaries (according to the reports compiled by the World

Bank and the European Training Foundation) (Laroche et al., 2006).

2. THE USE OF NEW INFORMATIONAL TECHNOLOGIES (NIT) IN CAREER COUNSELING

Using the new information technologies in career counseling is dependent on technological developments in Informatics (computers with large mnesic possibilities and therefore, able to maintain large databases, the development of information storage on CD-ROM industry, of multimedia systems, networking computers via Internet).

In 1998 Offer (Jigău, 2001, pg. 285-286) made a classification of types of software used in career counseling: "games and simulation programs (designed to be used as *commercial games*, for training in vocational schools with educational themes related to career); programs for " correspondence" for search and "choice" from a list of jobs of the "appropriate one" for a client according to his characteristics, personal profiles obtained through self-evaluation:

- programs that "accomplish" a psychological profile based on questionnaires;
- programs for searching information: programs for (re)finding stored data, by certain criteria, within database of different sizes and complexity, programs for providing information in order to increase awareness regarding certain opportunities; information programs regarding the network of schools and educational institutions and vocational training;
- programs to support decision making: programs which help individuals to analyze the factors that influence or to be taken into account in making a decision, also "proposing" ways or options to be taken; programs to support the development of a curriculum vitae, writing a letter of presentation or filling standard forms;
- programs for the development of skills search for jobs;
- cross-curricular applications;
- psychometric tests for measuring certain skills, personality tests etc;
- multimedia systems: complex programs incorporating several types of data (sound, image, text)."

Currently, the situation is different: due to the expansion of the Internet - it covers the whole world, it has the possibility of unlimited, permanent extending, and has a great potential for everything pertaining to human communication, information, documentation etc. (Lemeni and Miclea, 2004, pg. 108), many of the aforementioned computer products are now available to a wider public.

Some of the research findings undertaken by us in Brasov county on career counseling - impact on educational actors - come to support the above.

3. AN COMPARATIVE STUDY IN BRAŞOV COUNTY

The research was undertaken in Brasov, on a number of 1223 persons:

- 358 eighth grade students,
- 258 high school students (18-19 years old),
- 370 adults (parents of the children enrolled in the research),
- 172 class masters of the eighth and the twelfth grade,
- 65 school counselors.

One of the items with pre-coded response in the survey applied to the target groups aimed at identifying sources called upon by the respondents to inform themselves regarding career counseling and guidance.

Figure 1 represents the choices made by eighth grade students and highlights the preference for the Internet (77%), which is explained by the ease, speed and diversity of information that can be accessed by computer. The family ranks second (72%), and third-friends (47%).

The NGOs in the field rank last, although in Brasov county, this sector is well represented, we find that the information does not properly reach the target audience. 38% of the respondents say that they read the field literature and 28% of the children say they resort to the school counselor's office to inform themselves.

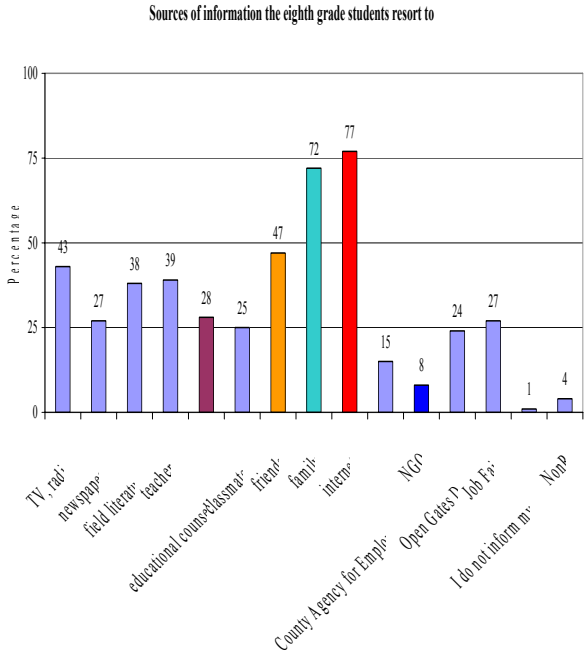

Fig. 1 Histogram representing the sources tohich the eighth grade students resort to learn about career

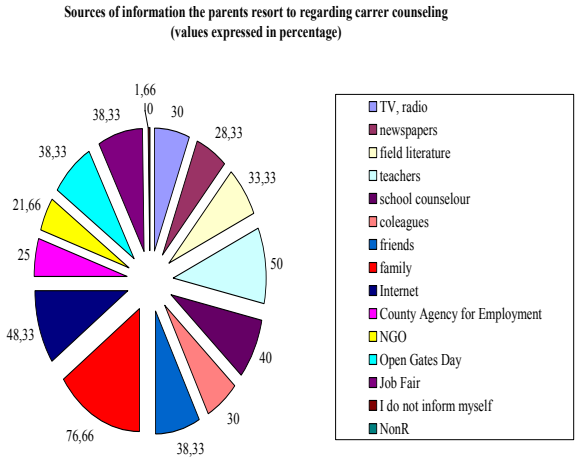

Fig. 2 Structure circle representing the information sources the parents resort to on career counseling

In the responses of young people between18-19 years old was revealed the same ranking of given alternatives: first is preference for internet (78%), the family ranks second (53%), and friends , third (48%).

Only 17% say that they appeal to the school counselor's office for information in the field, and the field NGOs rank last (9%).

From the analysis of the sources that the parent resorts to during this period in order to obtain information on career orientation (Figure 2), the Internet is the third, in percentage of 48.33%. The family has a percentage of 76.66%, and teachers - 50% of the respondents, the remaining percentage being equally split between the other sources: Tv, radio, newspapers, filed literature, school counselour, colleagues, friends, County Agency for Employment, NGO, Open Gates Day, Job Fair.

It is worrying that more than 38.00% of the parents to inform about career choice.

Regarding the sources the class masters resort to (Figure 3) in order to learn more about career counseling and guidance, the internet ranks the first (81%), and then the information provided by television, radio (57%) and friends (54%).

More than half of the teachers resort to field literature and to the support of school counselors and 43 - 44% of the respondents participate to job fairs and to other events organized by various educational institutions for promoting educational offers.

Comparing the choices made by students, parents and class masters, note that principals turn to counseling more than 53%. The same percentage received literature in the field. Noted that 16% of teachers say they even inform the students.

There are a number of teachers (6%) who say they do not inform at all about career counseling and guidance. This can be explained either by lack of time (teacher must make too many activities and weekly or monthly reports), either through carelessness over this area.

Noted that teachers resort greater internet (for information on counseling and guidance) to other respondents (81%).

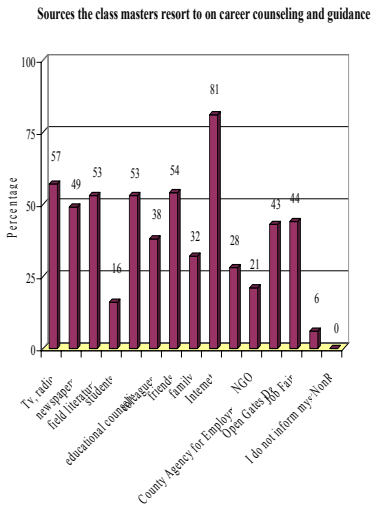

Fig. 3 Histogram representing sources that class masters of eighth and twelfth grades resort to on career counseling

Regarding the choices made by counselors from Brasov, a percentage of 79% of the respondents stated that they resort to the field literature, about half of them use the Internet and 33% inform themselves within the meetings with their colleagues, through trainings and Masters in the field.

Note that the information is obtained through informal channels and so is the personal effort to inform oneself (using the skills of NIT).

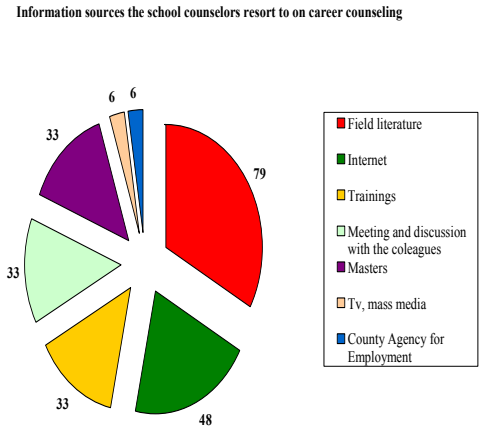

Fig. 4 Structure circle representing the information sources the counselors resort to on career counseling

4. CONCLUSIONS AND PERSPECTIVES

Educational and vocational counseling and guidance supports the individuals to build their own careers and thereby, helps in conceiving an optimal path in life.

More and more, new information technologies play a significant role in career counseling, as a genuine instrument of information, a vast electronic library or a complex means of assessment. This is what counseling, assisted by advanced information technologies represents in most European countries. The image of information technologies in counseling is fragmented, and so far, at the national level there isn't any uniform development in this area.

However, a constructivist approach and new ways of learning, together with new information technologies, open new possibilities of computer use in career counseling and one of the most important is a persistent and flexible assistance given to any person in its development throughout life.

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TELEVISION – SOURCE OF INCREASED AGGRESION IN CHILHOOD

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Abstract: *There have been many research to demonstrate why children are so hypnotized by the fascinating TV box. The results showed that although not the only one, it is definitely a major source of violent behavior in children. Studies also demonstrate once again that aggression and viewing programs with violent elements go hand in hand. The truth about the effects of violent TV programs has been demonstrated. Some attempt to combat it, others hope that it will change and others do not even seem to worry. However, facts are undisputed. The studies have been conducted and all the results aim to a single conclusion: TV violence determine children become violent and the effects might be on a long-term, if not endless!*

Key words: *counseling, career, education.*

1. TELEVISION – AGRESION INFLUENCING SOURCE

We see it on the streets, behind blocks, in school and even home. The last of those listed is a major source of violence. Why? Because in the homes of many people is a door wide open to violence, which often passes unnoticed. It is the television and the child watching it, is pushed in the pragmatic world of aggression scenes with devastating effects. In most Western countries has been found in the recent years, a pronounced increase in the number of murders, rapes and other major crimes. Regardless of how these figures are analyzed and commented on, their growth is real and must be explained. Is it really a mere coincidence, that lately we see more and more violence on TV? Is it a connection between the media and the increased incidence of serious violent crimes - is the link between cause and effect?

A large number of cases that had exactly this idea for a conclusion were published. Here are some relevant examples: in New York, a boy of 16 years old, breaks in basement; when the police caught him and asked him why he was wearing gloves, he answered that he learned to do so - not leave fingerprints behind - from television. In Alabama, a boy of 9 years old received a bad mark at school. In retaliation, he thought to send his teacher a poisoned candy, as he saw on television the night before. In California, a boy of 7 years old, scattered pieces of broken glass in the lamb stew which was to be serve at the family dinner. When asked why he fid so, he replied that he wanted to see if in fact the consequences will be the same as those seen in a movie on TV. In Romania, a boy of 13 years old, took hostage another boy of 6 years old and kept him hidden in a basement for several days. In the meantime, he was sending letters to the victim's parents demanding a ransom. Because he did not get any answer, he planned to suffocate the baby with a plastic bag held on the head. When he was caught by police he said he learned all the maneuvers performed from a movie seen on TV.

Here are, therefore, only a few shocking examples of how television can influence children's behavior. It should be underlined that all cases listed above are directly caused by the violence on TV viewing by children.

Many of us wonder why children like violence as they see it on TV? As long as the media violence is more vicious than what kids normally experience, of course, by comparison, the aggression from real life seems mild. TV violence is more entertaining and charming than

the violence that is normally seen on the streets. Instead of only seeing a police officer handing a fine to a speeding driver, on TV, a child can beat a robber till death or he may kill the bad guy immediately after the bad deed. However, children do not always realize that this aggressive way of solving a problem is not very handy in real life. They expect the challenging moment and if it does not come (or they would not see it), the world becomes too mild and they feel a strong "thirst" for violence, their imagination offering them the aggressiveness their mind is longing for!

The research have further shown that young people think it is fun and they are excited to imitate the violent characters on TV. They imitate the behavior models as presented, described in movies or other TV programs on the small screen. Children behave this way, because the ideas presented to them on television are more attractive than those that the viewer may think himself. Some researchers consider television to be an “assault” on children’s brain, a misleading influence whicg disturbs their moral balance (1). Others consider it an unhealthy intrusion in children’s education, replacing reading and concentration which requires will effort, with simple images which transforms thus the young viewer in a hypnotized non-thinking individual.

Many research have been made to demonstrate why children are so hypnotized by a shiny box and by the action taking place within it. The results showed that it is definitely a major source of violent behavior in children. Also, they prove once again that aggression and viewing TV violence go hand in hand

The truth about TV violence has been demonstrated. Some try to fight it, others hope that it will change and others do not even seem to worry. However, the facts are undisputed. Studies have been conducted and all results aim at a single conclusion: TV violence determine children to become violent and the effects may be on long term, if not endless.

The research undertaken wanted to capture the very relationship between TV violence and increased aggression in children (2).

2. RESEARCH DESIGN

From Bandura`s experiments, I conducted a similar research whose objectives were: a) underlining the degree of aggressiveness in children aged 13-14, after exposure to various images: violent images, prosocial images; b) finding the degree of aggressiveness in the two sexes. The hypotheses were: the subjects’ exposure to images on different topics (violent, prosocial) influences their degree of aggressiveness: 1. the children’s exposure to violent images increases their aggression; 2. the participants’ exposure to prosocial images reduces the children’s level of aggression; 3. aggression is manifested in a greater degree in boys than in girls. The experimental design: the *independent variables* selected for this experiment consisted of videotape recorded images shown previously on television, as follows: VI 1 - pictures from the movie *"Universal Soldier"* (film broadcast frequently on different TV channels and allowed to children over 12 years old), VI 2 - images with a prosocial message, campaigns to help the victims of the floods. The exposure time: 60 minutes. The aimed *dependent variable* was the *degree of aggressiveness* operationalized as follows*:* the number of lashes given to the villain of the story; the type of punishment given to the thief who stole the poor old man’s harvest. The sample: they were applied to a number of 156 children, students of the elementary school "Andrei Saguna" from Deva; two experimental groups of 52 children for every situation and 52 children as the control group. The development of the experiment: each experimental group was exposed to the set of pictures drawn by lot (violent, prosocial). After viewing, two tests were applied, highlighting the degree of aggression among children. Basically, the tests consisted of two projective stories without a fully-mentioned end, the subjects having the task of finishing them. The first story *(test number 1)* is focused on a negative character, who uses physical violence against others (whipping). Towards the end of the story, the child is transferred into the role of an unknown youth, who wants to punish the

villain applying him, in turn, as many penalty kicks as s/he wants. This test was intended to quantify the dependent variable. The second story *(test number 2)* places in the middle of the action a negative character, too, a thief that uses physical violence against an older person. In the end of the story, the subject should act as the person who makes justice, but this time in order to gradate the subject's aggressive tendencies, the child is asked to end the story giving the offender the kind of punishment s/he wants.

3. INTERPRETATION OF RESULTS

The hypotheses were confirmed. There is a telling difference between the situations of the case study. The children exposed to violent images are willing to apply the villain a number of lashes significantly higher than the other two groups. The statistical calculations support this hypothesis, highlighting a significant difference between groups especially between the aggressive group versus the control one and the aggressive group versus the prosocial one.

For the second test *"type of punishment given to the thief who stole the old man's crop",* where the lowest rank indicates a maximum rate of aggression, the situation is similar. The children who watched the movie "Universal Soldier" - representing the new genre of the super-violent cinema films, loaded to the brim with mutilations, tortures and killings - are much more aggressive than the subjects of the other two groups. This time, too, the comparisons indicate significant differences between the aggressive group versus the control group, and the aggressive group versus the prosocial group. The subjects' gender affects the degree of aggressiveness. Regarding the third hypothesis, the boys are ready to apply a greater number of strokes than girls. Social Psychology explains this phenomenon by the social learning theory [3]; during socialization boys are led, by more or less veiled techniques, to aggressive behaviour, to violent attitudes in relationships, to the nonchalant justification: *"you are a man only if you behave like that!"* In the second test *"What punishment would you give the thief?"* again boys will apply more violent penalties than girls, but this time the difference is not so great. Let's read some responses of the children who watched the movie "Universal Soldier": 13 years old, sex M: "I'd tie him to a tree and I'd whip him up until his blood would spill, then I would tie him by a car and I would pull him on a clay road until he dies!"; 13 years old, sex F: "I'd put him in a room full of rats to eat him alive because he deserves it!"; Sex M - 14 years old: "I will remove his heart from his chest."

4. CONCLUSIONS

In conclusion, the data shown during this experiment are more than eloquent. If a thief who stole the harvest of a poor old man (as the character of the story) is punished so cruelly by most children being exposed to violent images, I dare not imagine what kind of punishment could forge the mind of a child for more serious offences. I do not have the courage for that I would race with what hundreds of hours of television, thousands of violent images managed to make from the imagination of a child in search of sensational. And if we were to believe the statistics, then, during training, by the end of primary school, the children watching too much TV will have seen about 20,000 murders and more than 80,000 other violent acts, and before they become teenagers they will have witnessed more than 100,000 scenes of this type. And all these leave no trace in the children's way of behaviour? Research has shown that all forms of violence watched on the TV screen have three possible effects on children: children may become less sensitive to the others' pain and suffering; children may become anxious, frightened by the world around them; children may be more prone to behave aggressively or dangerously.

If researchers are convinced that young people can learn aggressive behaviour from TV, they are equally sure that adults - especially parents - may restrict some of their harmful effects on their children. For this, the specialists in the field make a number of recommendations, ideas that were also proposed to the parents of

pupils involved in the experiment presented in this paper.

The purpose of this paper was to show, once again, that the repercussions of violence consumed as TV images are not just allegations, some passionate researchers' barren ideas, but, unfortunately, they actually materialize themselves in frightening facts and circumstances that can checkmate any logical human mind.

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MEDIA AND PROSOCIAL BEHAVIOUR

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Abstract: *The pro-social behavior (as a current theme of psychosociology) is put in relationship with the media especially in what concerns the potential negative role of the latter, to facilitate the production of antisocial behavior. Less explored is the media potential as a facilitator factor of production aid acts, especially when it is combined with other steps designed to facilitate the development of pro-social behavior. The importance of media as a simulation factor of pro-social behaviors covered by this article, which refers specifically to the Romanian reality.*

Key words: *media, prosocial behaviour, education.*

1. CHARACTERISTICS OF PROSOCIAL BEHAVIOUR

In a relative chronological order, several ways to define the prosocial behavior can be delimited: in relation to antisocial behaviors; by listing its components; by reference to its consequences and in the integralist manner (1, pp.12-16). The reference to antisocial behaviors is associated with the early study of prosocialbehavior in Psychosociology. Peter Iluț (2, p.92) noted that the very term of "pro-social" had been originally proposed "as an antinomic reply to the term "antisocial", much earlier requested and examined by psychologists, sociologists, lawyers, psychiatrists and other specialists.

By listing its components, the prosocial behavior includes very different phenomena becoming thus easier to delimit it from selflessness, as a subspecies of prosocial behavior. Vanden Zaden (3, pp.299-300), included altruism among the forms of prosocial behavior manifestations, defining it as "a behavior held for the benefit of another person, without expecting an external reward". For Septimiu Chelcea (4, p.228) the term prosocial behavior has a greater extension, including many psychosocial phenomena in which "the help, protection and support for the development of others occupy a central position".

Prosocial behavior is currently defined most often by reference to its consequences (5, p.286), despite the fact that the delimitation of this type of behavior can not only be made by the certifying the presence of some *post factum* positive effects, which can also be caused by other types of behavior than those prosocial (unintentional or aimed at achieving material benefits). For a correct identification of prosocial behaviors, the consideration of positive effects has to be doubled by the application of the principle that "discernment eventually qualifies the behavior". This principle should be used as a criterion of discrimination of authentic prosocial behaviors, those that had been deliberately produced to determine beneficial effects for others, without pursuing other goals (more or less hidden).

In the integralist manner, prosocial behavior is approached from the perspective of theory of social action – Septimiu Chelcea (2003, 2008) – by taking into account a multitude of elements on which the social action depends: the concrete circumstances, the actual situation and its perception (how the social actors acknowledge

it). The integralist approach makes possible an accurate identification of prosocial behaviors and eliminates the possibilities of inclusion in this category - in an interpretive manner - only of the behaviors with important positive effects. From this perspective, the demarcation of such behavior becomes possible whenever we are dealing with an "intentional conduct, carried out outside the professional obligations and focused on supporting, preservation and promoting social values, without awaiting any moral or material reward from others" (6, p.86).

2.MEDIA AND PROSOCIAL BEHAVIOUR

Media played a key role in affirming the prosocial behaviour as a distinct theme in Psychosociology by addressing the famous case of Catherine ("Kitty") Genovese (victim of a robbery produced in 1964 in Queens, New York; she was attacked on a street over a period of thirty-five minutes and eventually killed). The subject (almost trivial, in an overcrowded city) became a sensational one when it was learned that no less than thirty-eight residents of the area had watched her agony from behind the windows of their apartments, without lifting a finger. This case was discussed extensively in the press, "highlighting the only explanation available at the time" (Cialdini, 1984 / 2004, 166) that is the others' "ignorance", apathy and indifference to human suffering caused by the exigencies of the modern life, especially the life lived in big cities. Starting from this case, a real press campaign was developed: more and more new cases of "public indifference" with tragic consequences were reported. The media campaign brought to psychology professors Bibb Latané and John Daley's attention this subject. They proposed an interesting explanation for such incidents ("the bystander effect"), being in contradiction with common sense. This incident and other similar ones, which happened in other socio-cultural contexts, stimulated the attempts to define a pattern of behaviour and certain personality characteristics contrary to the antisocial ones.

The media (especially the audiovisual) is routinely blamed for "selling" violence and providing models of antisocial behaviour that can be copied easily by people with limited discretion (mainly children). Although it could not be determined a statistically compelling connection between watching programmes with violent content and behaving anti-social, there are very many cases of people who have had antisocial, violent behaviour and have reported that they learned how to behave from mass media. Because of these cases, there is a prohibition against the content of the audiovisual programmes and the times they can be on.

3. FACILITATING THE EMERGENCE OF PROSOCIAL BEHAVIOUR

For the last decades several types of steps to facilitate the emergence of prosocial behaviour have been defined: presentation and explanation of theoretical knowledge about producing prosocial behaviour in crisis; stimulation of help given by children; promoting social norms adequately; providing real-operated models; creating an over-orderly identity; assuming individual responsibilities; "humanization" of various categories of victims; encouraging volunteerism and using media as an ally in prosocial education. The last mentioned way of encouraging the production of prosocial behaviour is probably one of the least used by our society, and that is because local media is usually associated with the production of another type of behaviour, the antisocial one.

Using the media (especially the television) in the children' prosocial education proved a complete success. The studies in which the aid granted in a film was successfully transposed into real life, based on a successful television series for children, *"Lassie",* are often cited (8, p.498) or (9, p. 310).

In Romania, the TV broadcasts (both the entertainment and the news broadcasts) that explicitly promote prosocial behaviour can be considered notable exceptions, while the media still prefers violent content, as a guaranteed recipe for success (measured, almost

exclusively, by the rating points). To counteract this trend, the Romanian Senate adopted (in June 2008) an amendment to the Broadcasting Act which required a balance between good and bad news within the informative broadcasts. The effect was not the expected one, the law arousing more controversy than having positive effects.

As it can not be directly related to the production of anti-social behaviours, the media can not directly induce behavioural responses of the prosocial type, requiring a joint action of all major sources of socialization (family first, and last but not least, the institutions of education).

For example, R. Coles (1997), *apud* (2, p. 82) stresses the importance of two aspects of parents' actual behaviour (both to their children and to other people) in the development of emotional intelligence: 1) parents' manifestations are much more effective than abstract moralizing sermons; 2) despite the growing influence of mass media, parental determination of the children's way of operation with emotions is crucial. The same author states that, although all childhood experiences on learning prosocial behaviour are important, only those from the elementary school period are crucial.

4. THE EMERGENCE OF PROSOCIAL BEHAVIOUR

Concluding on the research aimed to identify an "altruistic personality type", Septimiu Chelcea (10, p. 83) noted that as it does not exist a type of innate killer, nor there is an innate altruistic type: "selfless people do not represent this kind of individuals, but people differently socialized". In addition the investigations that have pursued to identify the key personality factors associated with prosocial behaviors, determined many applicative conclusions: a) the socialization of behavioral patterns associated to gender has to be improved (and) in what concerns the terms pro-social: without ignoring the importance of the increased natural potential for assistance (for emergencies concerning men and for the long-term assistance concerning the women), in the education of emotional intelligence should be included the full range of responses to requests for assistance, regardless of the educated person's gender; b) The current trend of urbanization is associated with increased difficulties of observing instituting the difficult situations of some individuals, because of the "urban overload". However, the frequency of assistance acts is higher when people do not forget to greet their neighbors or to change a few neutral lines on the bus. These daily contacts broaden the feeling of "us" (11, p. 267) and can counteract the effects of urban overload;

c) the family models of assistance, being the most compelling for children, numerous studies (applied in different cultures) recommend that parents give explicit active examples of selfless aid, which teach children to be empathetic and must also enhance child independence and nonconformity towards group pressure, if that pressure is exerted for the imposition of some reservations in providing assistance (11, p. 273);

d) Starting from the finding that people with strong religious convictions are more likely to give help, the trend is to promote a supra-ordinate identity both of the victim and of the one who can help her. In this sense, is called the "family of humanity" to conceive the message of some global fundraising campaigns to help victims of natural disasters, as was the case of the victims of the tsunami in Asia (in December 2004);

e) Increasing the competence feeling of providing assistance can be made directly through formal or non-formal educational approaches. For example, including the acquisition of skills for giving aid as part of education in Romania would contribute significantly to increased the frequency of helping acts for emergency situations. As the competence in providing assistance increases if we are familiar with the natural and social environment in which the action unfolds, knowing the key information relating to the environment in which assistance could be sought (eg, location of medical units with system call) can be achieved by educational approaches (including in non-formal framework), which may prove highly effective

in the community;

f) The provision of relief patterns can be made indirectly, mainly through television. Regarding this matter, certain television programs with explicit prosocial content may be designed or other shows that may include stories of prosocial behaviors (primarily, news reports). TV presentation of different types of situations in which people help each other "can lead to a social norm to guide behaviors to support social values, for charity" (10. p. 73).

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A STUDY REGARDING THE STUDENTS' MOTIVATION FOR CHOOSING THE MILITARY PROFESSION

BURSUC Cătălin, NEAGU Andreea

The accelerated rhytm of the science and technologies' development leads to a high professional dynamic structure for the nowadays society. The informational technologies' boom configurate the labor market in a profound and extremely mobile manner. Social researches must answer these challenges using flexible conceptual systems, proper programmes and rational scheduled objectives that could offer eficient intervention modalities.

The military organisation special characteristics raises complex issues regarding the attitudes towards the institution regulations and values, job motivation, career evolution desires etc.

Although the study doesn't offer intervention posibilities, it proves to be useful because it identifies and analyses the problems, it establishes the relations between the phenomena and the way they are mutual influenced.

The behaviour problems and precisely the behaviour at work are related to the motivation system. Motivation answers the question "why ?", and represents the cause which generates and modifies the individual behaviour.

To acknowledge the motivation, its conditions and types offers intervention posibilities which can revigorate the useful behaviours. To impose a specific behaviour in the military activity turns into a demotivating factor.

These are the reasons why we consider that the chosen theme is an important domain for the behaviour at work.

In the contemporary psichology, motivation represents the key of understanding and the explanation for different phenomena and process, individual or not(F. Sîntion, A. Papari, 1999.)

The work efficiency increment can be multi-level realised. The first intervention posibility could be the monitoring of the work performance. Work performance depends on multiple variables :

$$P=f(M,So,Ca)$$

Where :

M - motivation

So – specific solicitations

Ca – performance capacity

A profound analysis could lead to the observation of the reason as an intermediary variable. The reason turns into an internal mobile, an answer to an outside tension and which leads to specific behaviours. For the work relationships, the reason might be the person wish or need for earning money, for fulfilling his/her education, for being praised. The same stimulent may turns into different motivations and vice-versa.

The analysis of the motivational system characteristics is suggestive for identifying the relation between motivation and behaviour. The motivational system characteristics are the following (F. Sîntion, A. Papari, 1999.):

- Any human behaviour is stimulated, motivated and target orientated;
- Motivation is social-historical conditioned, and the motives satisfaction modalities follow the social-cultural transformations;
- The expression of the human reasons is individual because is the result of the person specific experiences;
- At the society level, there is a constancy of the commun motives;

- The motivational system has its own dynamic;
- The motivation-behaviour relation is not symmetrical;
- There are motives that act indirectly or appear in a disguised shape;
- There is a variety of motives that corresponds to the different forms of motivation and these are structured in a personality system.

The research was done in The NCO Naval Forces Military School "Admiral Ion Murgescu" in 2003 and its objective was to identify the attitude towards the military profession, the students'motivation and expectancies.

The instruments used in the research also allowed the comparison with the data obtained at the moment of recruitment and also the comparison between sexes.

The subjects of the study were 119 students.

For the interpretation of data and statistical analysis, the programmes used were Excel and SPSS 10.0.

A part of the data supplied by the questionaire were verified and completed by studying the personnel documents and by studying the application forms completed at the recruitment moment.[1]

Another objective of the research is the one related with the professional interests, motivation and students' expectancies regarding the military career.

The hypotheses established have a small level of generality, are work hypotheses and the variables don't have a directly causal interaction.

The hypotheses' veryfication is based on specific research types (I. Mărginean, 2000). During the research, the hypotheses were tested using corelation and semnification statistic formula.

The formulated hypotheses led to the questionaire construction.

The reasearch hypotheses were the following:

1. the motivation towards military profession is intrinsic;
2. the students apreciate as positive the military career and aspire after higher hierarchical position (fundamental issue in the military institution);
3. there are no significant differences related to the analysed characteristics between male and female students.

The research purpose was to identify the aptitudinal characteristics which are determined by professional interests, the motivation'structure and the attitude towards military career.

The research objectives were:

1. To identify the students attitude towards military career and the comparison between males and females;
2. To identify the factors which determined the profession choice and the motivation towards profession; comparison between males and females;
3. To identify the students' expectancies towards military career and the comparison between sexes;
4. To establish the corelations between students'aspirations related to the career evolution and the posibilities offered by the military institution.
5. To express some conclusions important for the students'counselling.

In the military organisation, the NCOs can fulfill many and diverse atributions, can do a lot of jobs, and knowing the professional interests and also the motivation is an important phase in the professional orientation and in the specialized assistance offered during the carrer evolution.

The questionaire was projected using the reversed funnel technique from particular to general issues. In the questionnaire construction the open questions alternate with the closed one.

The questionnaire is omnibus type and can detect many fenomena and the relation between them. The questionnaire is not an instrument for obtaining data, because these

[1] In the selection and professional orientation activities, the specialized personnel recorded data related with the motivational structure, aptitudinal structure etc.

can be obtained from the organisation documents.

The questionnaires were answered in no more than 30 minutes.[2]

The questions were formulated taking into consideration the military organisation specific terminology and in a easy to answer way.

According to its objectives, formulated hypotheses and instruments used, the research uncovered the following data:

A. *Factual data:*
- Regarding the subjects(year of study, sex, age);
- Regarding the socio-professional category of parents and grandparents;

B. *The degree of knowledge and the rewards system in the Army and in the Navy;*

C. *The characteristics which helped to choosing the career;*

D. *The military career motivation;*

E. *The expectations in the career evolution.*

Of the total of 119 students, only 90 of them took the questionnaire, because this was applied during classes, and the rest of them were absents.

A. The candidates situation is shown below:

Year of study	Total students		
	No. of students	Boys	Girls
TOTAL	119	90	29

Research participants		
No. of students	Boys	Girls
90	71	19

It is emphasized the fact that 75,6% of the total of students are boys, and the rest of 24,4% fare girls.

B. Regarding the way in which the students consider the activity in the military institution,(Items 1 and 2 from the questionnaire), the following results were obtained:
- 5,6% from respondents consider that in a military organisation, the activity is very stressful, 84,4% consider that it's stressful, but you have to cope with it, and 10% answered that the activity is not different from other activities;
- The responsabilities within the Navy are more difficult than other Army by 27,8% of the respondents, 43.4% consider that there are not much difficult and 28,9% consider that the responsabilities are easier.

Fig.1 Boys considerations for the activity in a military institution

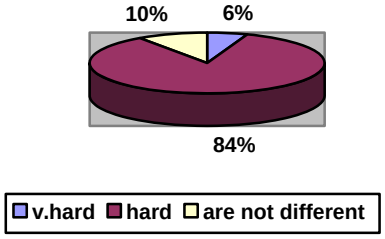
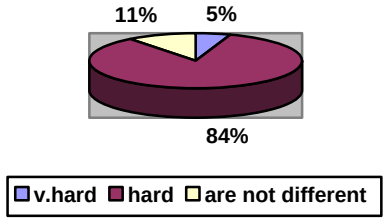


Fig.2 Girls considerations for the activity within the military



For detecting if there are significant discrepancies between the boys and the girls considerations, we used the variance analysis. Using the SPSS programme, we applied the F test and the T test.

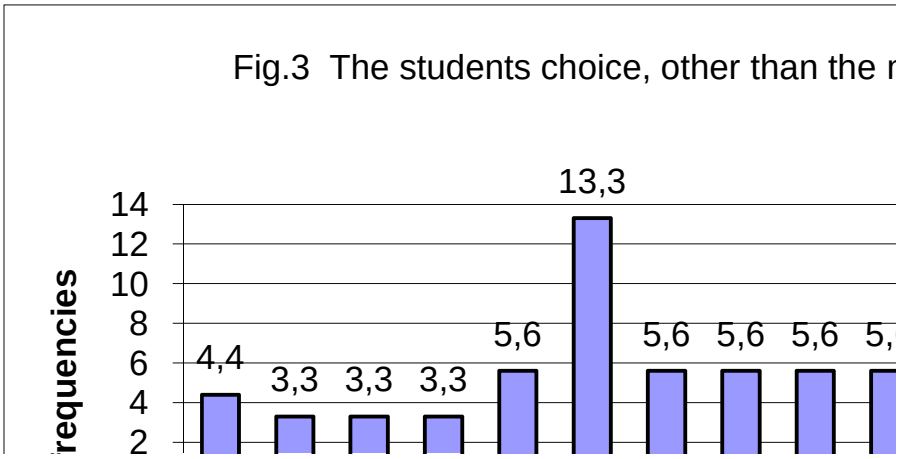
F Test		T Test	
Coeff	Semnif.	Coeff.	Semnif.
0,14	0,906	0,101	0,9

The statistics showed that there are no significant differences between the boys and girls regarding the considerations on the military institution activity (the value of F coef. is 0,14 and is smaller than the value from the table 1,75). The test T value of 0,101 (smaller than the tabelar value of 1,98), rejects the hypotheses that there are significant differences between sexes.

Related to the 3rd Item, in the chart below you can see the students'professional

[2] S. Chelcea and co.(1998), p.240, consider that for answering a questionnaire you need no more than ¾ h.

options if they wouldn't choose the military institution.



Job id. no.	Frequencies	%	Ocupation
0	4	4,4	No answer
1	3	3,3	Finance agent
2	3	3,3	Doctor
8	3	3,3	Coach
10	5	5,6	Proffesor
11	12	13,3	Engineer
13	5	5,6	Sportsman/Sportswoman
15	5	5,6	Lawyer
24	5	5,6	Commercial marine
27	5	5,6	IT
37	7	7,8	Psychologist
40	3	3,3	Electrician
44	3	3,3	Vet
47	3	3,3	Public servant
49	3	3,3	Economist
50	20	20,2	Others

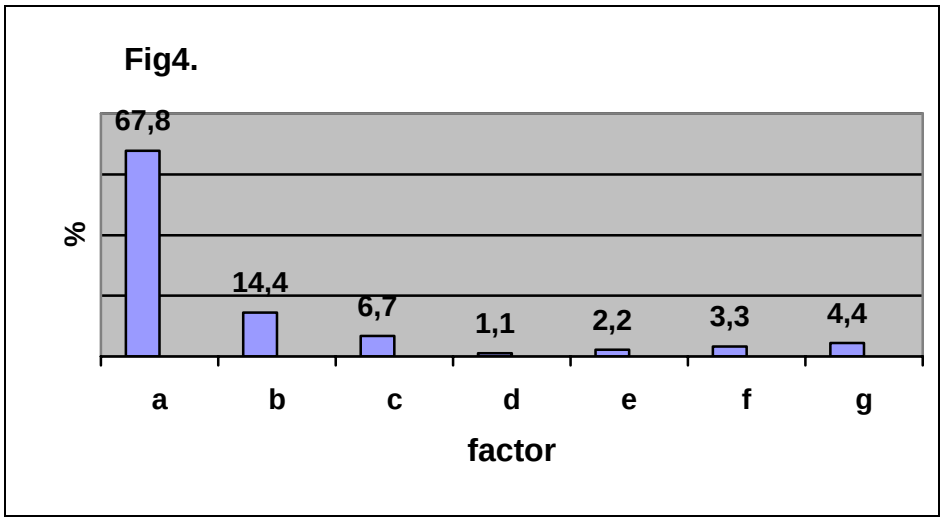
At the heading 50 were gathered all the jobs which got under 2% of votes. Jobs like: salesman, policeman, actor, technician.

C. Factors which led to choosing the military profession

In the questionnaire, the students had to choose from a list of 6 factors, the one which determined the choosing of the military profession. They could also complete the spaces with other situations which haven't been coded. The results are shown in the table below

Multiple choice	Frequencies	%	Answer description
a	61	67,8	Personal beliefs
b	13	14,4	Family
c	6	6,7	Friends

d	1	1,1	Information from media
e	2	2,2	Minister of Defense marketing programme
f	3	3,3	By chance discussions with the army persons
g	4	4,4	Other situations



It can be easily observed that 67,8% of the students admited that personal beliefs helped them choosing their profession, 14,4% were influenced by the family, 6,7% were inflenced by the friends.

For determining if there are significant differences between boys and girls, between the factors that contributed to choosing the profession, we used test F and test T. The SPSS delivered the following results:

Test F		Test T	
Coeff.	Semnif.	Coeff.	Semnif.
1,294	0,258	0,767	0,445

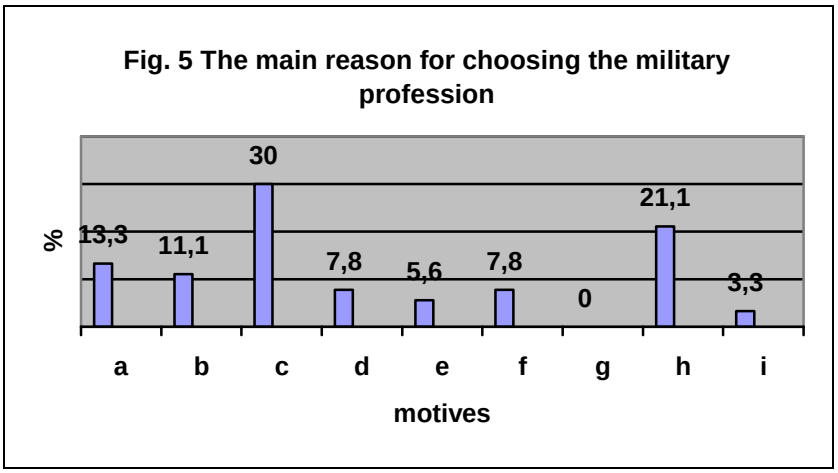
Comparing the obtaind coeff. F (1,294), with the tabelar value (1,75), it is visible that there are no significant differences between boys and girls.

D. The motivation for choosing the military career

For testing the hypothese according to which „ the students' motivation for choosing the military profession is intrinsic type", we added the item no.5 with 10 established answer alternatives. The answers are structured into 2 groups: intrinsic motivation and extrinsic motivation.

The results of this question are shown below:

Variant	Frequencies	%	Answer description
a	12	13,3	Salary
b	10	11,1	Economic independence
c	27	30,0	Professional safety
d	7	7,8	Family tradition
e	5	5,6	Family problems
f	7	7,8	Professional ideal
g	0	0	Institution'high reputation
h	19	21,1	The wish for working in the military field
i	3	3,3	Knowledge perfectioning



It can be easily observed that the alternatives which got high scores were variant c) proffesional safety (30%) and variant h) the wish for working in the military field (21,1%). Adding the first 5 categories you may obtain the extrinsic motivation group and represent 67,8%, whereas the intrinsic motivation group represent 32,2%.

We applied the T and F tests for determine if there are significant differences between boys and girls in terms of motivation for choosing the military profession. The SPSS delivered the following results:

Test F		Test T	
Coeff.	Semnif.	Coeff.	Semnif.
1,387	0,69	0,535	0,423

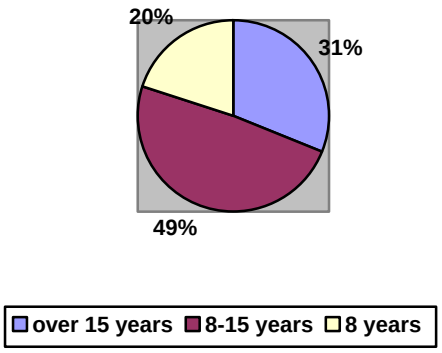
Comparing the value of F coeff. (1,387), with the tabelar value (1,75), we observed that there is no significant difference between girls and boys related to the motivation of choosing the military profession.

E. The way the military career is seen and the expectancies towards the career evolution

The students considerations regarding the estimated time spent in the military career are shown below:

Variant	Frequencies	%	Answer description
a	28	31,1	Over 15 years
b	44	48,9	Between 8-15 years
c	18	20,0	8 years

Fig. 6 Estimation of the military career



From the total of students, 31% of them appreciated that they'll have a long career in the military institution, 49% of them appreciated that they'll have an average career in the military institution, and 20% of them appreciated that they'll have a short career in the military profession.

The comparison between girls and boys related to the period of time that they believe that they'll spend in the military institution is presented in the graphics below.

Fig. 7 Boys consideration regarding the estimated time spent in the military profession

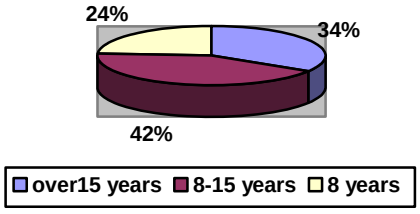
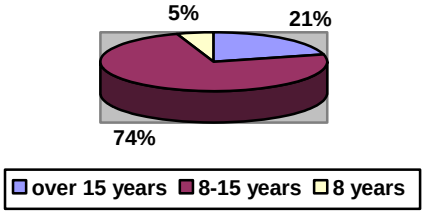


Fig. 8 Girls consideration regarding the estimated time spent in the military profession



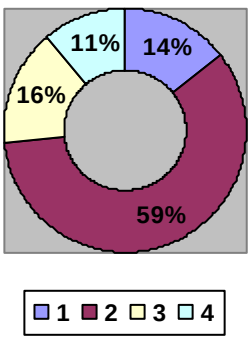
There are big differences between the girls and boys considerations related to the estimated time they'll spend in the military profession. A long time career was the option of 74% of the girls and only 42% of the boys.

82,2% of the students will continue their studies after the graduation, taking into consideration that this is a secondary school, 3,3% won't continue their education, and 14,4% didn't answer that question.

From the total of the responding students who will continue their studies, the following data were delivered:

Variant	Frequencies	%	Answer description
0	13	14,4	No answer
1	53	58,9	University of 4-5 years that will help me in my career
2	14	15,6	College that will ensure the perfectioning of the domains studied in school
3	10	11,1	To complete the studies in the military schools for officers and NCOs

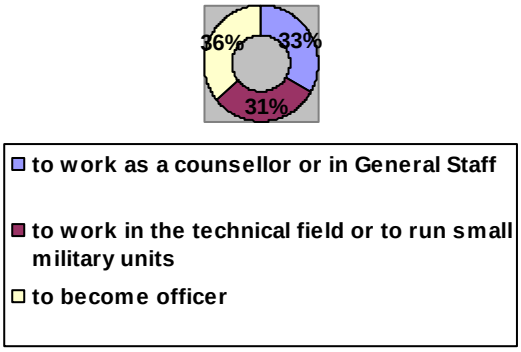
Fig. 9 Option to complete the studies after the school graduation



As is shown in the graphic representation, from the total of students who desire to continue the studies after the graduation, 59% of them want to enter a university and study a prefered domain or a domain that will ensure his/her carrer evolution.

Related to the objective that the students believe they must have in the military career, 33,3% of them consider that this is to be the comandant counsellor or to work in the General Staff; 31,1% want to work in the technical field or to run small military units, and 35,6% want to become officers even if this requires more effort and studies' completion. The choice's distribution is shown below:

Fig. 10 The objective set for the military career



The comparison between the boys and girls' objective followed in the military career is shown below.

Fig. 11 Boys'objective

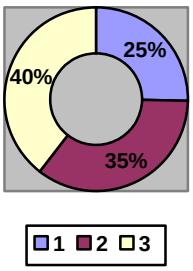
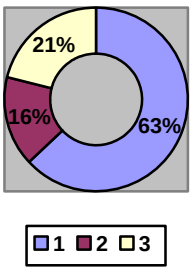


Fig. 12 Girls'objective



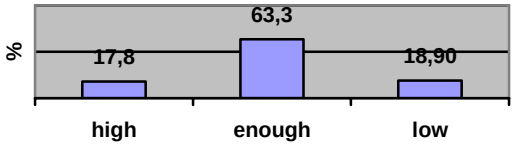
For fig. 11 and 12, the symbols from the legend are the same as in fig. 10.

It can be easily observed that the distribution of the objectives followed in the military career are different between boys and girls.

The self assessment of the students'posibilities and qualities for the military career evolution has the following distribution:

- 17,8% of the students estimate that they possess the qualities and have the posibilities to ensure a successful career evolution;
- 63,3% estimate they possess enough qualities and posibilities to ensure the career evolution;
- 18,9% consider that they don't have enough qualities and posibilities to reach high in the military career.

Fig.13 The self assessment of the students' posibilities and qualities for the military career



For determine if there are significant differences between girls and boys related to the self assessment of the qualities and posibilities needed for ascending the military career, the F and T test were applied. The SPSS programme delivered the following data:

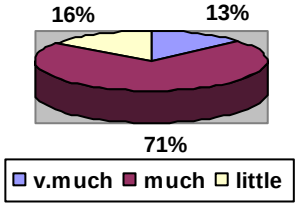
Test F		Test T	
Coeff.	Semnif.	Coeff.	Semnif.
0,10	0,91	0,75	0,45

Comparing the calculated F coeff. (0,10) with the table value (1,75), we can conclude that there is no significant differences between boys and girls related to that issue.

The students' considerations regarding the career model offered by the military institution are shown below.

Variant	Frequencies	%	Description
1	12	13,3	v.much
2	64	71,1	much
3	14	15,6	little

Fig. 14 The students' considerations regarding the career model offered by the military institution



As we observe 71% from the students consider that the career model offered by the military institution is in concordance with the posibilities and qualities the students have.

For determine what tpe of relation exist between the self assesment of the individual qualities and posibilities and the fact that the career model offered by the institution is according to these qualities, we analized the corelations between data colected from item 10 and 12.

We used the Spearman and Pearson corelation coefficients. The results are shown below.

For both methods r = 0,340 for a significant coefficient p = 0,001

Comparing the table value with the corelation coefficient, for 90 freedom degrees (value=0,21) it can be easily observed that the calculated value of the corelation' coefficient is bigger, it means that there is a relation between the analized aspects, and the students who consider that they have the needed qualities and posibilities to ensure them the career evolution, also consider that the career model which is offered by the military institution is according to their qualities and posibilities. The positive value of the corelation coefficient shows that both variables have the same direction. The semnification coefficient value is 0,001 and indicates that at one case out of a thousand we may be wrong when we consider that the statements from above are true.

For establishing the semnification of the calculated corelation coefficient, we used the Epsilon test, for N›30. The calculated value for ε is :

ε = 3,216

Comparing with the table value (1,96), we observe that the semnification coefficient value is bigger, and that means that the relation between the 2 studied aspects is significant.

CONCLUSIONS

The research hypotheses were confirmed.

We published only the factual data that we considered to be of high importance for the reseach.

Observing the factors which influenced the choosing of the military profession, the research showed that the students were influenced by personal convictions.

Regarding the motivation type, 67,8 % of the students are extrinsic motivated and there are no significant differences between the boys and the girls on this issue.

The students apreciate positively the military career model and the majority consider that the qualities and posibilities they possess are according to this model.

The statistical operations didn't emphasize significant differences of the analized aspects between boys and girls.

The comparison between the relative frequencies permitted the identification of some differences related to: the objective set in the military career and estimated time spent in the military institution.

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THE COUNSELLING AND PROFESSIONAL ORIENTATION' THEORIES. APPLICATIONS IN THE MINISTRY OF NATIONAL DEFENSE

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Psychology masters NEAGU Andreea

In order for the counselling activity to reach high quality standards, it is mandatory that it should be supported by accurate and elaborated theories.

The counsellor[1], as a practitioner, choose one of the existing theories or a group of theories, so as his action reach its objectives and to achieve the person integration into activity, to optimize the career „route" for the service beneficiaries.

The professional counselling theories try to answer some fundamental questions:

- What are the factors which determine a person to choose a specific profession? If there are such factors are there internal or external to the person?
- The human resources and the career planning are preffered instead of the person's liberty of choosing what he considers to be the best alternative regarding his/her own career? This planning activity doesn't constrain the work?
- There is a native „dowry" of the person related to his/her profession or it's all about chance and in this case the counsellor' intervention doesn't become useless?

Generally speaking, the theories and the conceptual approaches regarding the counselling activity and school and professional orientation are reffering to [1]:

- Factors which influence the choice of the school or profession;
- The personality structure which has the maturity to decide suitable regarding his/her career;
- The changing of the choice motives as a result of social learning and gaining experience;
- The counsellor' types of relations and behaviors towards the person;
- The mechanisms of the career dynamics.

An answer without any doubt is difficult to fiind, especially from the following factors perspective:

- The experts talk about a paradox of the vocational education – when someone has to choose his/her profession, he/she can't distinguish the best alternative, and when he/she has the ability to take the best decision, is too late, because he/she finds himself/herself in another profession;
- During his/her professional life, the person can become cultural accustomed and that will turn into the career culture;
- The cases when people discover themselves in a certain profession about they say is appropiate or no, are frequent, the family, the luck or the labour forces office[2] beingt the ones who chose for the person and not the person itself.

For developing a career and in order to integrate someone in various occupations, many theories can be identified.

[1] Mihai Jigău, *Career counselling*, Sigma Publishing House, Bucharest, 2001, p. 35.

[2] Ion Boboc, *Professional counselling*, Ecologic Publishing House, Bucharest, 2001, p. 32.

1. The theories of the personality features and factors

It is said that professional orientation can modify essentially the society, because the people are not structured in accordance with their abilities, this situation could lead to tensions.

The founders of this theory are considered to be Parsons (1909), Kitson (1925) and Hull (1928). A new orientation is born, based on the tests related to the vocational development. Two classical instruments appear, which test the key factors: professional interests – *Strong – Campbell Interest Survey/ Kuder Ocupational Interest* and special abilities – *Guilford – Zimmerman Aptitude Survey*.

The theories' main idea refers to the way in which the personality factors (interests, abilities) determine the individual career. These factors are the most important in choosing the profession and all along the career.

Here must be included[3] also the personality theory elaborated by Anne Roe, an american researcher. The first one was elaborated by Gardner Murphy, a psychologist, in accordance with who there is a relation between the family environment and children work values orientation, then the career for the teenagers, the parents being the ones who give value to the career choice. The second theory belongs to Abraham maslow (the needs theory). Choosing the career is determined by some socio-cultural and behavioral variables as: family cohesion, parents social mobility, children raised as independent persons.

Anne Roe and M. Siegelman elaborated an instrument (*Parent – Child Relations Questionnaire*) intended to help them demonstrate the family role in choosing the profession by the teenagers and the influence of the genetic factors.

The factors inherited from the family influence, the genetic ones and the factors of the need of self-esteem and self-achievement inherited from parents generate a unconscious pattern, being a cultural model of the professional life, which acts starting with choosing the profession.

Anne Roe appreciated that the people who work in services are overprotective with their children, and the family environment is warm, affectuos, whereas the persons who work in a scientific domain (mathematics, chemistry etc.) are cold and hostiles in the relation with their children. According to this theory, the affective atitude within the family set the bases for children'profession choice.

Anne Roe's considerations as well as Gardner Murphy's and Abraham Maslow's are found also in the psychoanalysis theory and in the dynamic social personality theories (Lewin).

2. Psychoanalythical theories regarding the career

Freud said that „the world of work is accompanied by two systems: the unconscious and pre-unconscious" without explaining this corelation, the psychoanalysis affirmed that the capacity of work and love is the fundamental objective of the humanist science [4].

A. Bril considers that choosing a profession is not random, it is based on unconscious motivation and is related to the need of satisfying a pulsion. Choosing a career is, for someone, related to the nevrotic mania phenomena.

The factors related to the abilities and interests are considered non-semnificative in counselling the individuals to follow a career or another.

Hendrik (1943) considers that satisfying the power instinct has a biological base and combine the neuronal processus with the intellectual ones.

The pleasure of work is a gratification of the power instinct, and the satisfaction in work is a function of the Self.

[3] Ion Boboc*, op. cit.,* p. 33.

[4] *ibidem*, p. 34.

R. Foser (1953) said that role playing is a technique of psychological intervention, close to the psychoanalysis, with a single condition, to identify specific unconscious motivations related to a person' career.

Studying the intervention parent-child is fundamental for the person development, including the work aspects. Malning (1967) and Neff (1968) talked about the role played by the family in a person professional orientation and about the role of the paternal challenge as a factor in choosing the career.

The problems related to the behaviour, including ones regarding the work are generated by unconscious process, and when they become conscious the symptoms dissapear.

The psychoanalytical intervention will eliminate the indecision, the lack of energy and the individual freedom constraints.[5]

Jean-Luc Placet considers that although the majority of jobs became more stressful, theu don't involve necessarily the psychoanalytic counselling; this is a method of treatment for pathological cases regarding the psychical sicknesses[6].

3. The psychological needs theory and personality values in the career.

This conception is based on the theories elaborated by Murray (1938) and Maslow (1954) known also as the needs'theories.

Darley and Hogenah (1955) tried to observe the relation between the professional interests, the occupational preferences, selection, on the one hand and the personality'characteristics on the other hand. They stated that a professional pattern varies from a person to another depending on the relation between the personality potential and the job requirements.

Stern, Masling, Henderson etc.. elaborated two measuring scales of the unconscious motivations and applied the Murray' theory during the school activities. The scales identified the motives which determine the students to be successful at school.

Happok enlarged the psychological needs determination at the individual career development. He considers that, if the person is adapting to the job requirements, then the job should be adapted to the person..

Blum identified the straight relation between the need of security and the occupation which satisfy this need. Diploye and Anderson discovered a straight relation between stereotype occupations and the people'needs to be in such positions.

Hall and Nougain enlarged the research regarding the psychological needs to their relation with the organisation which influence their career. They observed that people modify their individual needs according to the organisations that they are part of.

Wolf (1970) proposed a theory which combine Maslow theory of needs with Herzberg, Mausner and Sorgderman (1959)'s motivation in work theory.

Martin Katz (1963) considers that there is a tight connexion between the psychological and social forces.

The social forces, preferences for specific activities, the profession values are important in the decision of choosing a job.

4. Social systems theories

According to these theories the socio-cultural environment is fundamental for the person's career, because is controlling his professional options. The system was developed by C. Miller

This idea is based on two principles:

- The cultural determinism based on cultural anthropology;

[5] Sigmund Freud, *Psychoanalysis introduction*, Bucharest, 1992, p. 232.
[6] Ion Boboc, *op. cit.*, p. 36.

- Theories which establish the action of the historical and social accidents during the career.

The authors of this theory are considered to be C. Miller, W. H. Form (1951), T. Caplow (1954), M. Harmany (1964), W. H. Sewell and R. M. Hauser (1975), who tried to observe the influence of groups and social classes on career and social and organisational determinsm on the person.

Miller and Farm believe that there are 6 periods in a person's life when the socio-cultural models determine the contingency factors. The contingency factors appear in the 4th period and are the most important in the vocational development.

The main contingency factors are considered to be: father's occupation, intelligence, the educational statute of the family, the family financial position.

The cultural factors come from the model transmitted by the family, by the groups, by the social standard of the person and the inherited system of values. The education'sociology deals with inegality of chances problems in the teaching system and on the labor market, due to the contingency and socio-cultural factors.

The cultural theories on vocation and professional development consider that there is a total liberty in choosing a career, but the challengings in the labor world are inevitable, being present from the moment he gathers information on the society needs.

5. Self concept development theories

Theories had been initiated by C. Buchler (1933), in the Psychology Laboratoire from Leipzig. The non-directive theory based on Carl Rogers' therapeutical techniques, helped at developing the psychological counselling client orientated or non-directive counselling.

The most important researchers who studied these theories were E. Gingsberg and co. (1951), J. Samler (1953), R. Happock (1957), C. H. Miller (1974), who refer in their theories to G. W. Allport, D. E. Super, E. H. Erikson and P. Lazarsfeld ideas.

The Self concept is inspired from psychoanalysis, which divides the personality into 3 compartiments: Id (fundamental biological needs), Superego (social requirements got from the family environment, especially, and Ego (maximizes the gratification from different factors and minimizes, at the same time, the social punishment).[7]

The Self is a nonpersonal Ego. The Self is most of the time in conflict with the Ego. The Ego is rational, it hides the instinctual nature of the Id by controlling the instinctual requirements, by decisions related with the permission of fulfilling them, imposing the person to obey the moral rules.

E.D. Super proposed the self development theory. Individual options are influenced by self-image and by the information regarding the labor field. The option for a certain occupation is not just a moment of decision, but a process and a series of choices from the different moments of life, and which has a connexion with different development levels, learning and training of the abilities, in various situations of life and work[8].

For Super, the professional orientation represents the „process during a person is supported to develop and accept a complete and adequate image about himself or herself and about his\her role in the labor world, and is helped to test this role in the real life, in order to get the self satisfaction and for the society well-being"[9].

As a conclusion, the counselling and orientation servicies must be continuous

[7] Sigmund Freud, *op. cit.*, p. 21.
[8] Mihai Jigău, *op. cit.*, p. 36.
[9] Ion Boboc, *op. cit.*, p. 39.

during the person evolution, especially before making the important decisions, such as choosing the school, the profession, the job and before retirement[10].

Gingsberg and co. (Gingsberg, Gingsburg, Axelrad and Herma, 1975) sustained the idea that the process of choosing the career is influenced by 4 factors:

- The environment and every person's life are the most influent factor in choosing the career;
- The type and level of education and as well the professional training; any profession and any career'moments impose a lot of competences;
- The personality and affectivity characteristics;
- The types of values that the person want to achieve; the social values filter the other values of the person.

John Holland created a hexagonal model of hierachical development. He founded a career theory based on the identification of the existing patterns between the personality and profession types. Holland identified 6 types of personality with their correspondent – the 6 vocational orientations (RIASEC).

To each personality type belongs a specific profession, according to the answers given at the Professional Interests Inventory and GATB (General Aptitude Test Battery).

6. Career planning theories (professional career management)

According to these theories, the career of the organisation members is foreseen in the plans. Planning the career starts from the moment of hiring (distribution of the individuals in accordance with the tasks, the abilities stimulation).

Professional competences are also hierachical structured, some of them being more important than the others, according the organisation' values and requirements.

J. Drevilon supported the idea that vocation can be be seen as a monarchic character organisation in which roles are structured and subordinated so as to balance the personality. Vocation is a result of education and socio-cultural environment.

Labor resource planning is an activity different from planning an individual career. Labor resource planning is a strategic task of selecting the staff, training, promotion on dismissal of existing staff.

Synthesizing the various aspects of the theory in the field, we can distinguish some common elements:

- The importance of the information in the decision making, reffering to the career;
- Oscilations between rational and intuitive0affective style in choosing the profession;
- Multidetermination factor of the professional maturity and decision making process, regarding the career;
- The importance of the success or failure on the evaluation in the professional career.

The theories applications in the Minstry of National Defense

In the military institution, the human resource planning is a complex and centralized operation, which is done by specialized departments and aims the measures of promoting the profession among potential candidates, selection, specialization, training, retirement accompanied by retraining and other of social protection measures.[11].

The individual career planning is a process which aims the personal

[10] Mihai Jigău, *op. cit.*, p. 39.

[11] X X X , *Governmental decision nr.7,* 1998.

promotion, based on a set of rules established by a regulation framework[12].

Career evolution is based on some elements: performance in the previous jobs, competences for the actual job, career development potential.

Promotion is conditioned by concrete elements which can be measured, such as:

- Taking a course – ensures the necessary competences for the atributions of the new job;
- To fulfill the minimum mandatory period;
- To have as calification at least „Very good" in the last two years;
- The chief proposal (mentioned in the annual appreciation).

The counselling measures in the Ministry of National Defense respect the following principles:

- Evolution of the career is an institutionalized process and has predictible regulations. Any junior in the field can have many evolution screenplays and can anticipate the conditions established for fulfilling them.

The counsellor role is to orientate the person to the jobs which emphasize his\her abilities, experience and previous training.

This principle can be applied using the following measures:

- For military personnel, it should be written in the annual appreciation, the field of activity with which the person is compatible to, and the domains he/she can become specialist;
- For students, the specific abilities and the way they responded to the military requirements should be noted in the personnel files;
- For the courses graduates, the leader potential should be noted in the final characterization.

- Every job attributions and specific activities are completed periodically or everytime this action is required. That way, a job enrichment is realised, and that motivates the person and contribute to the continuous adaptation of the person with the job;
- During the training programmes, the importance, role and position of the personnel are emphasized;
- The human resources polices implement the job rotation process. In this way, a continuous specialization of the personnel is realised. According to the Military career guide, 4 years is the period (for the majority of the cases), in which someone can be in a certain job position.

Conclusions

As it was shown before, in the Ministry of National Defense, in the HR domain, the managerial theories are applied, the ones which refer to the organisation and to the institutional objectives fulfillment.

The personnel career evolution is an objective which ensures, at the top level of the hierarchy, the persons having the best abilities and competences related to the job requirements.

The balance between the individual needs and the institution needs are realised with the help of some social protection measures. For example: Law 80/1995 – regarding the military statute; Government decision. 7/1998-regarding some social protection measures for the civil and military personnel of the MOD; The common decision of the MOD and Ministry of Labor and Social protection – regarding some active measures of social protection for the personnel dismissed.

[12] X X X, *Law 80/1995 regarding the military statute*; X X X, *H.G.582/2001 –Military career guide Ghidul carierei militare.*

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METACOGNITIVE LEARNING STRATEGIES IN HIGHER EDUCATION

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Abstract:
Everyone involved in education and training needs to talk about thinking and learning. Frameworks for thinking can provide shared understandings which can help improve the quality of instructional design, course and lesson planning, teaching, learning and assessment. Recent research focus on the importance of metacognitive monitoring and control in the learning process. Metacognition is defined as the experiences and knowledge we have about our own cognitive processes. The predilect domain of metacogniton is education, but metacognition has applications across a number of different settings. This paper concerns how students apply their judgments to optimise their behaviour during learning.

Our research aim to highlight the importance of the use of some specific teaching strategies on the development of metacognition in higher education. The purpose of the current article is also, to suggest principles for embedding metacognitive support in instruction to facilitate metacogniton in first year student learners.

Key words: *metacogniton, monitoring, learning strategies, teaching strategies, cognitive functioning.*

1. LEARNING AND METACOGNITION - THEORETICAL FRAMEWORK

Metacognition is an important area of research, and its applications to education continue to grow. The topics covered in metacognition research include problem solving, reading, writing, self-regulation, technology, comprehension strategies, metacomprehension, metacognitive strategies.
Metacognition can be described as "a critical analysis of thought," "knowledge and cognition about cognitive phenomena" [3], or simply "thinking about thinking." Metacognition has typically been conceptualized as involving one or more of the following aspects of a cognitive process: knowledge about that process, the monitoring of that process, and the control of that process. When optimized, these aspects of metacognition can augment performance of the target cognition, including students' learning [1]. For this reason, many researchers have sought to train students to engage in metacognitive thinking to improve their learning. Most research on metacognition has focus on metamemory or metacomprehension, although the metacognitive processes involved in performing other tasks, such as problem solving, have also been studied. Additionally, researchers have begun to explore metacognition outside of the laboratory, extending research paradigms to the classroom and other applied settings. There has also been an increase in attention paid to the role of social influences on metacognition [9].

This theoretical framework focus on three main components of metacognition: knowledge, monitoring, and control. The second part of the paper suggests some ways to best incorporate accurate metacognitive strategies into learning and teaching.

Metacognitive knowledge is information that one consults when thinking about a particular cognition and it includes

information about the cognitive task, about one's ability to perform that task, or about potential strategies one might use to perform that task. Sera and Metcalfe consider that students who know more about how to study and about how learning occurs students who has more metacognitive knowledge) learn better than those with less metacognitive knowledge. For this reason, educating students about how they learn and identifying effective (and ineffective) learning strategies for them should not only improve the accuracy of their metacognitive judgments, but should also improve their self-regulated learning [4].

Metacognitive monitoring focuses on the progress of the cognitive process in which the person is engaged. During learning, it is important for individuals to assess how well they are doing on a task, and also to initiate a plan to correct any problems they may be experiencing. This refers at monitoring cognition. Thus, the process of learning implies the evaluation of one's level of understanding (''Do I understand what has been said/read up to this point?'') and the regulation of understanding. Monitoring has two components:

- evaluation of progress toward a cognitive goal
- regulation of activities through the use of appropriate strategies.

If a student is regulating his cognition, then he has already attempted to evaluate progress. However, many students fail to use strategies to repair comprehension problems because they lack the time or motivation to do so or because they do not known efficient strategies for learning [9].

Metacognitive control can be defined as the instance of cognitive control that is informed by metacognitive knowledge or monitoring. Control involves the choice of which items to study and the allocation of study time (e.g., devoting more study time to certain pieces of information than others) or strategy selection (e.g., choosing what is believed to be an effective way to study certain materials; changing a study strategy when an earlier choice proves inefficient [10].

2. PRINCIPLES OF METACOGNITIVE TEACHING STRATEGIES

Everyone involved in education and training needs to talk about thinking and learning. Frameworks for thinking can provide shared understandings which can help improve the quality of instructional design, course and lesson planning, teaching, learning and assessment. Recent research focus on the importance of metacognitive monitoring and control in the learning process. The predilect domain of metacogniton is education, but metacognition has broad applications across a number of different settings. This paper, like much of current metacognition research, concerns how students apply their judgments to optimise their behaviour during learning.

Since it has become increasingly clear that metacognitive awareness and skills are a central part of many academic tasks, a critical question for educators is how we foster the development of metacognition in students. McCormick (2003) suggested that successful interventions designed to improve metacognition can be grouped into two categories: those using an individual approach and those using a group-based approach [6]. We continue with a presentation of general recommendations for instruction and classroom practice.

The classroom context is favorable to interactions between learners which encourage the development of metacognitive thought. Some principles of metacognitive teaching strategies are:

- guiding learners to prepare and structure an effective learning environment;
- organizing instruction and activities to facilitate cognitive and metacognitive processes;
- using instructional goals and feedback to present student monitoring opportunities;
- providing learners with continuous evaluation information and occasions to self evaluate (Tab. 1).

These principles are guiding the election of teaching strategies adequate for higher education learners. These teaching strategies aim to introduce students to the important role of metacognition in cognitive functioning. They help students to use metacognitive strategies in order to emphasize the pivotal role of metacognitive monitoring to regulate effective use of learning strategies.

Table 1 Instructional Principles to Support Meta-cognition [5]

Metacognitive strategies	*Instructional support example*
Preparing and structuring the learning environment	Advise students how to arrange environments and cope with environment distractions
Organizing and transforming instructional materials	Give students partial outline that they complete
Keeping records & monitoring progress	Instruct student to keep a progress report recording completed activities
Evaluating performance against a standard	Review exam responses with student(s) item by item, why a response is correct or how to correct a response

3. GOALS AND METHODOLOGY OF THE RESEARCH

This paper aims to highlight the role of teaching strategies on the metacognitive learning.

The sample consisted of 80 undergraduate students of Faculty of Psychology and Educational Sciences, in an educational psychology seminary that utilizes metacognition as the organizing principle. The activities propped to students during the first semester aims to facilitate students' development in metacognition.

During the class activities, we utilized teaching methods such as concept map, self-evaluation, group reflection, note taking strategies, critical reading of scientific articles. We exemplify the demarche describing one technique – the concept map.

Concept mapping is a meta-cognitive tool used for representing knowledge structures in content domains. A concept map is a two-dimensional representation of knowledge as a semantic network. The map concept has several features such as hierarchy, dendritically, nodes (concepts, constructs) and labeled links. It can be used examples, cross-links or linking words. A concept map resumes the amount of conceptual understanding of a student, the quality of scientifically acceptable propositions, the number of correct cross-link connections, the appropriateness of the map's levels of hierarchy etc [7]. We used this method in order to facilitate the actualization or the retention of new content and not to evaluate the students' performances or use of metacognitive skills. The map concept was used as learning tool not as assessment tool. Concept maps were also used to introduce or summarize concept relationships within a module or chapter.

Other organizational strategies, such as outlining content or relating concepts within content, are among the cognitive learning strategies that individuals use to self-regulate and that usually result in a deeper understanding of the material. Strategies that organize content, such as concept mapping, schematizing, and structured over viewing have boosted achievement in several studies investigating the relationship between instruction and structural knowledge. Comprehension improves significantly with the use of visual organizers such as concept maps [4].

In order to assess the students' metacognitive strategies we used the metacognitive scales of the "Motivated Strategies for Learning Questionnaire" (MSLQ) developed by Pintrich, Smith, Garcia, and McKeachie (1993). The metacognitive scale is incorporated in the second part of the questionnaire and it represent a learning strategy scale. It is a self-report instrument using a 7-point Likert-type scale, 1 (not at all true of me) to 7 (very true of me) wich has 12 items, with a Cronbach Alfa of .79. Pintrich makes a clear distinction between cognitive and metacognitive activities. Cognitive strategies include rehearsal, elaboration, organization, and critical thinking;

metacognitive strategies include planning, monitoring, and regulating. Pintrich defines metacognition as the awareness, knowledge and control of cognition. He states that there are three general processes that make up metacognitive self-regulatory activities: planning, monitoring, and regulating. Planning activities such as goal setting and task analysis help to activate or prime relevant aspects of prior knowledge that make organizing and comprehending the material easier. Monitoring activities include tracking of one's attention as one reads, and self-testing and questioning: these assist the learner in understanding the material and integrating it with prior knowledge. Regulating refers to the fine tuning and continuous adjustment of one's cognitive activities. Regulating activities are assumed to improve performance by assisting learners in checking and correcting their behavior as they proceed on a task [8]. Examples of items:

- *If course materials are difficult to understand, I change the way I read the material;*
- *I ask myself questions to make sure I understand the material I have been studying in this class;*
- *When studying for this course I try to determine which concepts I don't understand well.*
- *If I get confused taking notes in class, I make sure I sort it out afterwards.*

Because the number of items was reduced, we computed only a global score for this scale, without differentiating between the three metacognitive self-regulatory activities: planning, monitoring, and regulating.

The design of the research was a cvasiexperimental design, using one group and two testing moments: pretest (at the beginning of the semester) and posttest, at the end of the semester, after the implementation of the metacognitive teaching principles.

4. RESULTS

Meta-cognitive strategies showed a moderate, positive relationship with academic performance. This means that students who planned their studying, monitored ongoing results, and regulated or adjusted their behavior in response to changing demands of the course performed better in terms of academic achievement. Academic achievement was concretized in the results of final test at educational psychology and the average points for the portfolio. Thus, the usage of metacognitve strategies is associated with better academic performances.

The difference between the two testing moments (pretest and posttest) regarding the use of metacognitive learning strategies was significant, we obtained a t test for two paired test at a $p<.001$ ($t(78)=2,34$, $p <.001$) This means that after the implementation of the metacognitive teaching principles during the seminary, students improved significantly their learning strategies.

5. CONCLUSIONS

Besides the techniques presented in this paper, they are other useful teaching methods that can promote metaognitive learning strategies. These techniques include introspection, on-line thinking-aloud protocols, and retrospective interviews or questionnaires.

Fusco and Fountain (1992) cited by McCormick provided a list of teaching techniques that they suggest are likely to foster the development of metacognition, including extended wait time, metacognitive questions, concept mapping, writing in journals, and think-aloud techniques in cooperative groups. They cautioned, however, that "unless these self-reflective strategies become a part of daily classroom tools, there is little chance that they will become students' strategies. Winograd and Gaskins (1992) cited also by McCormick emphasized that metacognition is most likely to be invoked when individuals are pursuing goals they consider important. They argued for authentic activities and thoughtful assessment in classrooms. In addition, they recommended a combination of teaching methods, including cooperative learning and direct explanation for strategy instruction [6].

Future research must focus also on other important aspects such as goals, self-efficacy, and intelligence as mediating variables

between metacognition and academic performances. Students' conceptions about learning are also important. The students enter a course with many prior conceptions that are often incompatible with the desired psychological perspective we are trying to promote. The best way to bring about this conceptual shift is to teach students more productive learning strategies. This conclusion was based on research in metacognition showing that students tend to use strategies that they believe to be effective [2]. If students use these strategies successfully, they should come to value them more, and the strategies should have greater personal meaning to them. They should, therefore, perceive the theoretical basis of these strategies as a more intelligible and plausible explanation of cognitive functioning.

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RETHINKING MILITARY ORGANIZATIONAL ARCHITECTURES FROM THE PERSPECTIVE OF INTERCULTURAL MATTERS UNDERLYING MULTINATIONAL MISSIONS MANAGEMENT

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***Abstract**: By definition, the military organization is a bureaucratic one. However, the question that arises is how such an organization can better cope with the asymmetric challenges that characterize contemporary warfare. Thus, the hypothesis investigated by this article is that when it comes to integrating the intercultural approaches into the operational framework of multinational missions a different vision and approach to the traditional military organizational architecture is needed. Hence, rethinking this concept through general systems' theory is proposed.*

***Keywords**: systems' theory, organizational architecture, bureaucracy, network organization*

1. INTRODUCTION

The concept of integrated defense resources management has long become a commonly used one at a discursive level within the Romanian armed forces. However, its full usage and commonalty in terms of practical issues still lies with a long-term transformation process undertaken by Romania as a direct consequence of its accession to the North Atlantic Treaty Organization and the European Union. Hence, since a system's status (in our case de defense system) is made up of the status of all its components [1], a clear-cut identification and description of these involves a complex approach heavily influenced by management strategies. In this respect, as underlined in the Romanian Armed Forces' Transformation Strategy [2], the remodeling of the defense system is a multi-staged process whose deadline is 2025. As part of stage II known as the operational integration in NATO and the EU (2008-2015) there are some objectives of interest to us. Thus, forces operationalization, military education system transformation, the implementation of some of the Force Objectives such as training and linguistic competence development for what has been earmarked as generation and regeneration forces are under the influence of several interrelated factors. The first one consists in fully understanding internationally upheld concepts such as effect based operations [3]. The second involves a coherent and comprehensive outlook on the methods and means through which to accomplish the goals emerging from broad concepts such as the one previously mentioned. Last but not least, such an outlook is achievable only through a thorough theoretical investigation underlying the formulation of the necessary methods and means to achieve Romanian armed forces' transformation.

The hypothesis underlying this article is that a successful transformation of the defense system can only be accomplished by adapting defense organizational design to concepts such as effects based operations, asymmetrical threats, network-based warfare. Thus, the ensuing goal is to investigate at a theoretical level the extent to which one specific component of this system, namely the human resource earmarked for operational purposes can be better managed by adapting organizational architectures to current environmental requirements such as flexibility and adaptability to changes within the national and international arena. Therefore, the outlook we suggest involves first understanding the

conceptual boundaries imposed by systems' theory upon integrated management in general. Second, we wish to suggest a possible organizational architecture that could meet the requirements underlying human resource management from an intercultural perspective, namely the network architecture. Inherently, we will try to underline its major benefits to the goal we undertake.

Before carrying out the aforementioned goals and objectives, some terminological delineation is necessary. Thus, by referring to organizational architecture we mean the members of the organization, communication channels and control among members and between the organization and its external environment, as well as the rules and regulations in place aimed at ensuring organizational information flow [4].

Moreover, when we suggest the network as a possible organizational architecture to be established and employed for improved human resource management in operational units from an intercultural perspective, we cover this term in terms of organization design and development and not of information systems management.

Last but not least, the human resource we refer to is the one belonging to operational units, and not all military human resource.

2. SYSTEMS' APPROACH: BASIC PRINCIPLES AND THEIR RELEVANCE FOR INTEGRATED MILITARY HUMAN RESOURCE MANAGEMENT FROM AN INTERCULTURAL APPROACH

We focus on systems' approach since the very concept of integrated management draws upon its basic principles. Thus, in order to better understand the latter and its implications for this article we first need to remind what the theory is grounded in.

A system is defined as the result of its interacting components, be them organizations, actions or individuals [5]. Hence, to fully understand the system is to fully understand the principles based on which these elements make up a coordinated and comprehensive whole. Thus, they are as follows:

a. The principle of integration and interdependence: the order in which the elements of the system are integrated in the system is given by their dynamic interaction. In this respect, there is no resemblance whatsoever between the way isolated elements behave compared to the integrated ones.

As far as we are concerned, we believe that for a better management of military human resource from an integrated perspective we first need to understand how the dynamism within the system works. Thus, even though the elements may be clearly defined, establishing their dynamics may prove a challenging task that can be investigated by resorting to the right organizational architecture, an issue that we will tackle later in this article.

b. The principle of wholeness: the whole is greater than its components. In other words, it is a matter of 1+1=3, or the sum of a system's elements is not given by their number, but by the outcome of integrating them.

If we translate this into intercultural and human resource terminology, we make the following assertion: the outcome of military human resource management from an intercultural perspective is given by the way the system's elements correlate to meet operational requirements in theatres of operations. Hence, the better they integrate, the higher their performance and the end their participation to the wholeness of the defense system.

c. Loop feedback: under the influence of a stimulus a message is conveyed to a receiver who, in its turn sends out the message to an entity that processes the message and sends out adjustment feedback to the receiver. Whether positive feedback (i.e. allowing for system improvement) or negative (i.e. allowing for system adjustments), this loop feedback ensures a self adjustment of the system.

If we are to apply this principle to the organizational architectures necessary to manage the intercultural issues pertaining to the human resource from operational units we must equal the receiver to the organizational architecture that should be in place in order to process the stimulus received from military top

management. Moreover, the entity in charge of sending out feedback and thus adjusting the system must be paralleled to the human resource from operational units which needs to take full charge of system adjustment in terms of specific requirements formulated in accordance with the experience gained in various theatres of operation.

d. The principle of multiple alternatives. Since systems' theory upholds the idea of open organizations, the same goal/output can be achieved in two ways: through different means or by starting from inputs that vary and processing them accordingly. Thus, an open organization and the efficiency and effectiveness of its undertakings can be studied in terms of the following equation: inputs-outputs-outcome. However, despite this common framework of analysis, the methods employed to solve the equation or the nature of inputs is organization specific.

In our opinion, this principle is of utmost importance if we are to understand how the defense system as an overall should be viewed and designed. If the framework of analysis has to be a common one for all NATO member countries and if the interoperability objective is to be met, the design has to be country specific. Hence, we highlight the importance of developing custom methods in accordance with custom situations. Thus, what we suggest is that the view on dealing with the medium-term goals outlined in the Romanian Transformation Strategy needs to be country specific and not a copycat. One solution is properly aligning organizational design to current realities. In this respect, we highlight once more that part of the view of organizations as open systems to which the Romanian military aligns through the concept of integrated defense resources management is organizational redesign.

In conclusion, an important take away from listing the above principles is that if one system element needs to be reviewed and upgraded, that involves an overhaul of the interrelated elements, as well. For example, if an entity's behavior is to be changed a concurrent change needs to take place at the level of the interacting entities. Thus, at the level of the human resource management, any change within the system must reflect the changes outside the system [6], namely: the necessity to anticipate large scale innovations (in our case the necessity to anticipate future security challenges and react appropriately not only through technological preparedness, but also through intercultural competence development); geographic and intellectual mobility (with a high impact for current and future conflicts and intercultural asymmetrical threats); accelerated activities life cycles (challenging operational troops' versatility and agility in terms of human interaction first and foremost); increasing requirements (in terms of performance mostly, we should add and emphasize); insufficient time for coordination and cooperation; emerging tasks that strain coordination and evaluation efforts.

All this considered, we propose a different outlook on the military organization design that could better account for the above challenges. We will call this outlook by the generic name of organizational architecture and at a specific level we will be referring to it from now on as the network structure.

3. NETWORK STRUCTURE FOR HUMAN RESOURCE MANAGEMENT FROM AN INTERCULTURAL PERSPECTIVE: ADVANTAGES AND CONSTRAINTS

It is a commonly acknowledged truth that the military organization is a bureaucratic one. That bears direct consequences in terms of the contemporary challenges human resource management must meet.

First of all, through its planning, control and motivation systems such an organization limits an individual's willingness to learn on a continuous basis while emphasizing a high degree of specialization. Moreover, the higher the degree of centralization, the slower the decision making process. However, vertically integrated structures are efficient ones.

On the other hand, the more decentralized a structure is, the more autonomous, responsible its members are. As a result, such an organizational structure favors continuous learning [7] on behalf of the individual, which

in the end is the trademark for contemporary society.

Moreover an organization's evolution is highly dependent on its architecture and the latter is strongly influenced by the type of knowledge necessary for a particular organizational entity [8]. As a result, as Marengo [9] underlines, any organization must consider a tradeoff between: low coordination costs generated by a highly centralized architecture alongside with inadequate knowledge dissemination and low learning capabilities on one hand and high coordination costs incurred by decentralization together with higher degree of specialization and increased learning capabilities of individuals. Hence, if acquiring and managing knowledge is the focus of an organization (which is our case since tackling intercultural issues for and within operational units involves knowledge management), we should further consider the advantages of horizontal structures in general and of network structures in particular which can be listed as follows [10]:

- The possibility of redesign in terms of its evolving mission and strategies. In the case of the military structure we want to emphasize that strategy flexibility and adaptability of human resource management is mandatory.
- Competitive advantage, which in the case of the operational units deployed in theatres of operations, translates into a need for development of skills necessary to deal with asymmetrical threats. In this case we need to highlight that cultural issues can be viewed as pertaining to the list of such threats.
- Innovative solutions generated through a learning environment.
- Focus on the human resource and its ability to adapt to change as a direct result of social learning strategies.
- A core of complementary competences which yields a general ability to cope with external challenges such as the volatility and uncertainty characteristic of contemporary environment.
- Innovative solutions based on group/team work
- Ongoing evaluation and self evaluation imposed by a continuous learning process
- An organic structure where power and authority are granted by competence and not by position

Derived from the advantages listed above we can identify three major constraints that need to be met if we are to design a truly flat structure. These constraints are: power derived from competence and not from formal position, equality among members and unanimous or majority consensus requirement for decision making. All this could represent appalling suggestions for the chain of command minded military unless we review once more contemporary requirements in terms of national and transnational security which require a rapid pace that cannot be delivered through a centralized architecture.

Therefore, on-time response to environmental challenges can only be achieved through this process of redesign that we have been talking about so far. The organizational architecture that we suggest to be built in order to provide for some of the training needs of the operational units that are to take part in multinational missions needs to refer to these units as its customer and beneficiary. As a result, there are a few more constraints [11] to be met if such a structure is to be a functional one.

The first one upholds the necessity for the positions within the structure to be interdependent. This aspect takes us back to the discussion on systems' theory and its relevance for an integrated outlook on system/element management.

A homogenous structure, namely the extent to which positions are more or less similar, is another constraint that should be met. Thus, in a flat structure, the general requirement is to have complementary specializations. As a result, when defining the positions we suggest naming them in terms of the competence to be ascribed to each of them. Such an approach can actually better contribute to a clear-cut information flow

within the structure, which in the end is mandatory for any organizational architecture.

Another major constraint is the time the people in this organization will spend fulfilling their tasks. In this respect, close attention needs to be paid to the mission formulation of this organization (which is actually defined in terms of the entire military organization vision and mission). Thus, if the structure's aim is to simply carry out some research in the field of intercultural issues underlying human resource management in and for multinational missions, than the specialists may carry out the tasks on a part-time, short-term basis. However, if continuous learning and development of this human resource is meant, then long-lasting, viable solutions need to be suggested. This is actually the aim for which we undertook this research and highlighted the importance of taking a systems' approach.

4. CONCLUSIONS

The network structure as a military organizational architecture can be a possible approach to managing the human resource from operational units whose major goal is to be prepared for rapid intervention in accordance with national and international requirements as the case may be. The basic reason underlying such a statement is the evolving security environment whose increasing uncertainty and volatility can only trigger a continuous effort towards better training the human resource in the military. Under these circumstances, the network structure is actually the answer to the need for innovative and adaptive methods [12].

For defense system-specific solutions a further investigation is needed. Thus, besides a theoretical overview of network organizations types (*e.g.* the shamrock organization described by Charles Handy, the interorganizational network, the intraorganizational network, etc.) highlighting their advantages and disadvantages, a practical approach is needed. In this respect, starting from a set of alternatives developed based on the theoretical background and assessed by using a SWOT analysis developed on measures of the network [13], a final workable solution can be suggested.

As a final thought, we wish to emphasize once more than only by designing and developing things from scratch (at the end of a thorough analysis and evaluation) the Romanian armed forces can fully adapt to the challenges encountered in nowadays security contexts. Therefore, adopting and implementing solutions developed for other organizational cultures (even though we may mistakenly argue that the military organizational culture is similar regardless of countries) is not a solution if our defense system is to align to NATO and EU requirements. As a result, what we aim to achieve through this article is to take a novel, "custom-made" approach to the armed forces transformation issues with which the defense system is currently dealing.

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PROFESSIONAL LINE IN BOLOGNA PROCESS

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Abstract: *The paper focuses on the issues of the application of Bologna process in Romanian higher education, respectively the mutations in curricula design and stakeholders qualification.*

Before implementing the Bologna process, higher education consider that master and PhD education represent the higher level in education and the final of career. After application of Bologna process (Joint Declaration of the European Ministers of Education - 19.06.1999), the university education implies numerous aspects: a new vision about curricula design (a good joint between license – master – doctoral studies, gradual development of knowledge, skills and abilities, transversal and longitudinal objectives, a.o.), development of distant learning and blended learning, involvement in education and attracting labour market.

In conclusion, license – master – doctorate must be perceived dynamical and adaptable to economical requirements: first as a unit, on the other hand, with a distinguished professional profile for each level, so that the graduate can option to continue or employ

Key words: *Bologna process, curricula design, labour market, transversal and longitudinal objectives*

1. ABOUT BOLOGNA PROCESS

It is widely recognized that 1999 was a turning point for European higher education by the adoption of Bologna Convention by ministers of education from 29 European countries. The Bologna Declaration and the following events (Communication Ministers in Prague in 2001, the Berlin Ministerial Communiqué 2003, Ministers in Bergen Communiqué 2005, Ministers of London Press 2007), focuses on targets for the harmonious and coherence development of education for 2010 year. These include: assurance of quality education, to adopt a system based on cycles, promoting mobility, implementation of credit system, recognition of degrees, promoting the European dimension in higher education, promoting the attractiveness of European Higher Education Area (EHEA), social dimension, lifelong learning, European Higher Education Area and European Research Area.

In Romania, the implementation of Bologna process involved changing the organization of universities, rethinking school programs, evaluation of academic activities in all its aspects, accepting the idea of quality education by both the self and external evaluation by the competent bodies. If at the system level aspects required by the Bologna process are relatively clear wishes, regarding issues of form, the professional conscience of teachers, students, researchers and beneficiaries of education, adopting a new mentality, its application and crystallize in the form of principles good practice in teaching is still in training stage. So, Bologna Process marked a series of changes that have launched a number of challenges for designing and implementing educational policy in higher education. A good implementation of the Bologna process depends on the understanding and applying of educational policies based on: training and professionalization needs differentiated from cycle to cycle,

personalized academic instruction through student centered, adapting to labor market needs which is expressed in the public space of the European Qualifications Framework (EQF), define appropriate qualifications in relation to three cycles of university studies (bachelor, master, doctorate), curriculum design tools.

2. DESIGN OF PROFESSIONAL LINE

According to law 288/2004, bachelor's degree is the first cycle of university studies which must ensure an appropriate level of qualification for the labor market integration, through general and specialized knowledge. Masters is the second cycle of university studies aiming to deepen the knowledge and skills acquired in the first cyclic of study (L). Master studies can be followed in licensing studies or in near area or to obtain additional skills when undertaken in an area other than the license. Doctoral studies are higher cyclic university studies (third cycle of university studies) and is organized in accordance with Government Decision no. 567 of June 15, 2005 regarding organization of doctoral studies. PhDs goal is to develop knowledge through original research in the two components: training program based on advanced university studies and scientific research program.

Fig. 1 Ideally desired professional path by implementing Bologna (www.unsr.ro)

The organization of LMD is based on two aspects: one which takes into account the unity and continuity of three cycles of students training, on the other hand the autonomy of each level of university studies.

In Fig. 2 it can be seen the design of academic line for students starting from license and finished with PhD study.

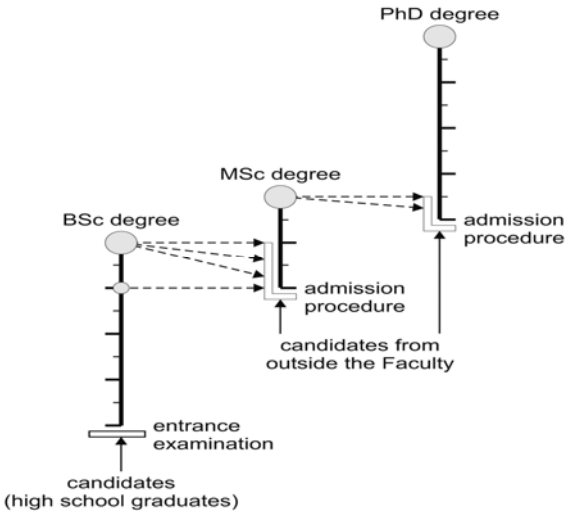

Fig. 2 Study structure of the three cycle: license, master, doctoral study (Krasniewski, 2008)

In terms of professional skills, first cycle provides a general foundation in preparing students, curriculum subjects containing general and specialized domain in the three years of study. Who needs graduates of license? The big companies with financial possibilities to support specialization of staff are looking for bachelors (3 or 4 years).

Master is designed to deepen a certain degree. Under EU rules, there may be master classes in the university's logistics capability and last but not least correlated with labor market requirements. There are two type of master: professional master and scientific (research) master. Master of deepening (additional) training focuses on skills required for socio-economic environment. This type of master can run as long as there is demand on the labor market. The scientific master prefigures PhD research and is designed for training skills needed in scientific research. The two professional lines oriented by professional master and scientific one differ by discipline, approaches and the most important thing – qualification gained. Who needs graduates of master? Small and medium business need trained personnel in their profession, firms not having own financial

support for staff training. Doctorate cycle is to raise skills of university researcher, bringing extra knowledge. The PhD study represents a normal professional line for graduates of scientific master. There are two types of doctorates - the vocational and the research. Although seemingly university would end at this level (the doctorate), lately increasingly speaking lifelong learning as a requirement of the present times which are characterized by change. Generally, graduates career path is relatively simple and are based on own option to follow a certain path and the labor market requirements. Harmonization between qualifications, number of graduates, specialization and viability depends on realistic vision of academic staff.

3. Aspects from Romanian Higher Education in statistics terms

ARACIS, within the ACADEMIS Project, performed a statistical study regarding *The State of Quality in Romanian Higher Education (Vlasceanu, 2009).* One of the approaches of this research was related to the employment of graduates. In accordance with this report, the statistically data show that optimum level of students training for integration on labour market is master, in eyes of students and 91% of students want to continue the academic study at master. Preference of employers to hire graduates of old system of higher education, as statistics shown, is an alarm regarding the proper implementation of Bologna process in our country.

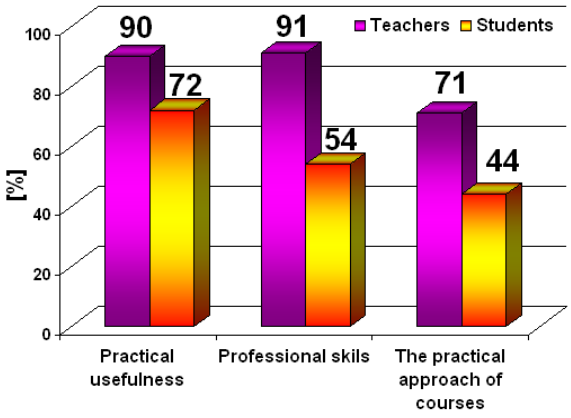

Fig. 3 Comparison between teacher and student's response of assurance a practical courses

Concerning the teachers versus students confidence in easy of finding a job, the chart displayed in Fig. 4 relieve that the students are quite optimistic, but the perception of teachers is unrealistic, as the report authors noticed.

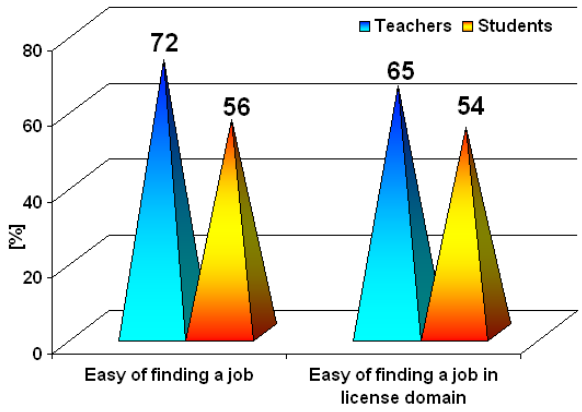

Fig. 4 The perception of teachers versus students concerning the easy possibility of graduates to find a job

One of the problems is the stakeholder implication in professional education. Responsibility to obtain the skills and competencies necessary on labour market belongs to all those involved in education from teachers to students and employers.

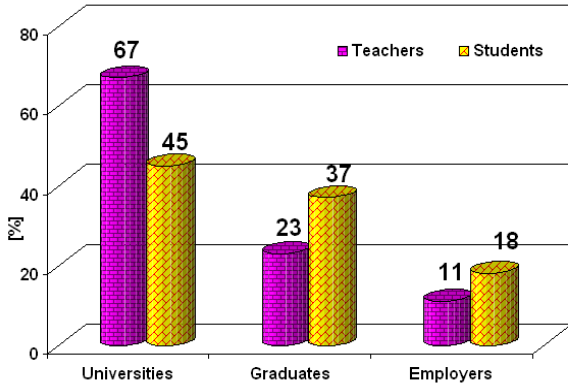

Fig. 5 Responsibility to obtain professional skills and competences

In Fig. 5 is presented the comparisons between the teachers and students response. From this chart, it can be noticed that teachers consider the university as the most responsible for professional training of students compared with them who believe that all stakeholders in education have the same responsibility. It is important to know the perception of teachers,

students and employers about the higher education from all points of view and the most important thing is to adopt an attitude in sense of assurance quality and improving the educational system.

4. NOTES

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The statistical data underlying the charts were taken from the report of project ACADEMIS, *The State of Quality in Romanian Higher Education 2009, Vlasceanu, L., Hancean, M. G., Voicu B., Tufis C., published by ARACIS.*

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ADVERBIAL PAST PARTICIPLES IN ENGLISH AND ROMANIAN

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Abstract: The paper aims at comparing English and Romanian adverbial constructions which contain past participial verbal forms. The examples we provide attest to an unexpected flexibility in terms of temporal interpretation. Contrary to certain grammarians, who argue in favour of a uniform anterior temporal interpretation of past participles in both languages, the paper shows that non-anterior readings are also available, function of the aspectual properties retained by past participles from the base verbs.

Keywords: past participle, temporal interpretation, aspect, English, Romanian

1. INTRODUCTION

An extensive number of linguistic papers deal with the temporal interpretation of past participles. On the one hand, there are linguists who argue in favour of a [+perfective] nature of past participles, which leads to an anterior temporal interpretation. On the other hand, more recent studies point to the fact that past participles retain the aspectual features of the base verbs [6,7]. In other words, past participles are either [+perfective] or [-perfective], which allows them to obtain a variety of temporal interpretations: anteriority, simultaneity or posteriority.

The aim of the current paper is to examine the temporal readings available for English and Romanian past participles used in adverbial constructions, to see which of the two theoretical possibilities is confirmed. The article is organized as follows: section 2 deals with anteriority readings of adverbial past participles in English and Romanian, section 3 illustrates simultaneous temporal relations, whereas section 4 points to the availability of posterior temporal readings. Last but not least, section 5 summarizes the findings of our study.

2. ANTERIORITY

The current section points to the fact that anteriority readings are available for past participles derived from any situation-type.[1] We begin by presenting examples with telic situation-types, whose [+perfective] nature is undoubtedly compatible with an anteriority reading, and then examine contexts in which atelic situation-types also obtain an anteriority interpretation, although they are [-perfective].

Firstly, the examples in (1)-(2) below show that adverbial past participles of English telic situation-types, (i.e. accomplishments and achievements) may obtain an anteriority reading either in the absence of any introductory element (as in (1a.) – (2a.) below) or in combination with a variety of introductory elements: 'once', 'after', 'with', 'when':

(1) a. **The issue settled**, we took off for our first walk in the woods and were back with enough time to bathe in the river before supper.[2] (accomplishment)
Problema rezolvată, am pornit în prima noastră plimbare prin pădure şi ne-am întors la timp ca să ne scăldăm în râu înainte de cină.
b. **Once settled**, we walked down the street to the Museo Internazionale della Marionetta to

complete our Sicilian marionette education.[3] (accomplishment)
Odată rezolvat [acest aspect], am mers în josul străzii spre Museo Internazionale della Marionetta pentru a ne desăvârşi cunoştinţele despre marionetele siciliene.
c. **After settled down**, I wish you goodnight from Polydrosso...[4] (accomplishment)
Odată instalat, îţi urez Noapte bună din Polydrosso.
d. **With the issue settled**, she simply wanted to move ahead with her completion of the IB program.[5] (accomplishment)
Odată rezolvată problema, ea nu dorea decât să-şi termine studiile, obţinând o diplomă de Bacalaureat Internaţional.
(2) a. **Our northern-most point reached**, we'll turn SW, following a narrow, steep-sided fjord that leads us into the interior of Apusijiik Island.[6] (achievement)
Odată atins punctul cel mai de nord al călătoriei noastre, ne vom îndrepta spre Sud-Vest, de-a lungul unui fiord abrupt care pătrunde în interiorul Insulei Apusijiik.
b **With the sixth peak conquered**, it now remains for Noel to scale the heights of Mt Vinson in Antarctica to clinch this awe-inspiring new world record, and a place in climbing history.[7] (achievement)
Odată cucerit cel de-al şaselea vârf, Noel nu mai trebuie decât să escaladeze înălţimile Muntelui Vinson din Antarctica pentru a deveni posesorul acestui nou record mondial şi pentru a câştiga un bine-meritat loc în istoria alpinismului.
c. **After reached** the campus area, the SLU building is located in the east by the forest next to IKSU athletic centre.[8] (achievement)
Odată ajuns în campus, veţi găsi clădirea Universităţii de Ştiinţe Agricole din Suedia care se află la est de pădure, în apropiere de complexul de atletism IKSU.
d. **Once reached**, the hotel seems to be snuggling down for shelter and, although it has limited views, there is a shift of emphasis to the comforts within, a feeling reinforced by the cosy atmosphere of the original building […].[9] (achievement)
Odată ajuns, hotelul pare un stabiliment primitor şi, în ciuda priveliştii mai puţin impresionante, clădirea veche întăreşte impresia de atmosferă călduroasă pe care ţi-o face confortul din interior.

The examples above show that English adverbial constructions evince a greater flexibility than their Romanian translations, in that the latter may surface with or without the introductory element 'odată' (once), no other introductory element being allowed. Similar examples are attested in Romanian below:

(3) a. **Acestea zise**, a încheiat discuţia. [2: 168] (accomplishment)
This said, he/ she ended the discussion.
b. **Odată semnat** contractul, tot echipa va achiziţiona materialele […].[10]
(accomplishment)
Once the contract signed, the team will continue to acquire the materials.
(4) a. **Ajuns ministru**, Silaghi i-a întors favorul lui Vlasov […].[11] (achievement)
Becoming a minister, Silaghi returned the favour to Vlasov.
d. **Odată ajuns ministru** va "uita" de profesori. Nu ar fi primul şi nici ultimul.[12] (achievement)
Once become a minister, he will forget about the teachers. He would be neither the first nor the last one to do so.

On a par with telic situation-types, past participles derived from English activities allow a variety of introductory elements, as shown in (5) below. Moreover, Romanian past participles allow only 'odată' (once), as illustrated in (6) below:

(5) a. Kristen Stewart ran away **when asked about** dating Robert Pattinson.[13] (activity)
Odată întrebată despre relaţia cu Robert Pattinson, Kristen Stewart a fugit.
b. **Once asked**, we can try to find it, either online or even manually.[14] (activity)
Odată pusă întrebarea, putem să încercăm s-o găsim fie online fie chiar manual.
c. **After asked to** do so, save the setup exe file to your PC (for example, to your desktop).[15] (activity)
Odată cerut acets lucru, salvaţi fişierul setup exe în calculatorul dvs (spre exemplu, pe desktop).

(6) a. **Întrebat** despre ziarsitul care l-ar fi amenințat la telefon, preşedintele a spus […].[16] (activity)
Asked about the journalist who supposedly threatened him over the phone, the president said….
b. **Odată întrebat** de ce plâng femeile, Dumnezeu a răspuns […].[17] (activity)
Once asked why women cry, God answered….

Past participles derived from statives may also obtain an anteriority reading in both languages. However, due to their durative properties, past participles of statives may obtain an anteriority reading only in combination with an anteriority adverbial such as 'inițial'/ 'initially' or 'înainte'/ 'previously' illustrated in (7)-(8) below:

(7) a. **Initially admired** by a sliver of the music-business community, she could hardly have known that the disc would wind up a multi-platinum favorite, making her a superstar and a symbol of the era's R&B.[18] (state)
Inițial admirată doar de câțiva reprezentanți ai comunității de afaceri muzicale, n-ar fi avut de unde să știe că discul ei avea să devină un candidat la multiple Discuri de platină, ajungând ea însăşi o super-vedetă şi un sombol al muzicii R&B contemporane.
b. The American constitution was derived from Cicero. […] This 'mixed' constitution, **previously admired** by the historian Polybius (to whom Cicero's debts were extensive), reappeared again and again in early discussions of the constitution of the United States of America […].[19] (state)
Constituția americană îşi are rădăcinile în opera lui Cicero. Această constituție 'mixtă', admirată inițial de istoricul Polybius (căruia Cicero îi era foarte îndatorat), a reapărut de multe ori în discuțiile preliminare privind Constituția Statelor Unite ale Americii.
(8) a. Surphace, **cunoscut înainte** şi ca Sphere, este o aplicație excelentă pentru bloggeri […].[20] (state)
Initially known as Sphere, Surphace is an excellent application for bloggers.
b. Sony Ericsson Satio, **cunoscut inițial** sub numele de Idou este disponibil în magazinele online internaționale.[21] (state)
Sony Ericsson Statio, initially known as Idou, is available in international online shops.

To sum up, this section has pointed to the availability of anteriority readings for adverbial past participles derived from all situation-types. In English, non-statives allow a variety of introductory elements, whereas statives obligatorily combine with an anteriority adverbial of the type 'initially' or 'previously'. In Romanian, non-statives allow only 'odată' (once) as an introductory element, while statives also require an anteriority adverbial such as 'inițial' or 'înainte'.

3. SIMULTANEITY

The current section deals with anteriority readings available for both English and Romanian adverbial constructions containing past participles. Such readings are constrained by the situation-type of the base verb.

To begin with, English past participles derived from activities and states can be simultaneous with the main clause verb, as illustrated in (9)-(10) below. In addition, there is variation with respect to the introductory element, as adverbials may be introduced by 'while' or 'when':

(9) a. **While asked about** potential deficiencies in their health care institutions, the most important identified by respondents in all localities was a perceived lack of financial support for these institutions.[22] (activity)
Întrebați în legătură cu eventualele deficiențe ale instituțiilor sanitare, respondenții din toate localitățile au indicat drept cea mai importantă deficiență lipsa de sprijin financiar pentru aceste instituții.
b. **When asked about** her birthday, a young woman gives the following information […].[23] (activity)
Întrebată despre ziua ei de naştere, o tânără dă următorul răspuns…

(10) a. **While admired for** his ability to manage two large grant programs, Norvell was respected even more for his character.[24] (state)
Admirat pentru capacitatea sa de a conduce două programe de cercetare complexe, Norvell era şi mai respectat pentru caracterul său.
b. A woman, like a diamond, sparkles **when admired**.[25] (state)
O femeie, ca şi un diamant, străluceşte când este admirată.

Romanian adverbial constructions may also obtain a simultaneous interpretation when the past participles are derived from non-telic situation types. As evident from (11) below, activities are interpreted as on-going events. In addition, the examples in (12) below point to the fact that durative atelic states may also be perceived as simultaneous with their main clause verbs:

(11) a. **Plimbată** de colo-colo, rafinăria a ajuns în acest moment să nu aibă conducere executivă şi să nu mai fie operabilă.[26] (activity)
Passed to and fro, the refinery has no management at this moment and is no longer operational.
b. […] frumoasa Italiei […] a păşit în Hiltonul londonez, **alergată** de o armată de fotoreporteri care o strigau din urmă […].[27] (activity)
Italy's beauty entered the Hilton Hotel in London, chased by an army of reporters who were calling out her name.
(12) a. Declarația aparține premierului italian Silvio Berlusconi, **cunoscut** drept o sursă inepuizabilă de glume […].[28] (state)
The declaration belongs to the Italian prime-minister, Silviu Berlusconi, known as an inexhaustible source of jokes.
b. **Cunoscut** drept "Whitey", şeful mafiei din Boston se află în topul zece al celor mai căutați criminali din America […].[29] (state)
Known as Whitey, the head of the Boston mafia is in top 10 most wanted criminals from America.

Unlike past participles derived from activities and states, past participles derived from accomplishments and achievements cannot obtain a temporal simultaneous reading, in either language. In English, they can obtain non-temporal interpretations, as illustrated by the concessive readings in (13b.,d.). For an accomplishment or achievement to obtain a simultaneous reading, they must combine with the 'be…ing' morpheme, i.e. the adverbial must contain a present participial form, as 'while being built'/ 'while being obtained' in (13a.,c.) above. A simultaneous reading may not occur with a past participle of accomplishments and achievements since they are telic situation-types and a past participle highlights the resulting state component. A present participle, on the other hand, highlights the event component of building or obtaining, respectively:

(13) a. This nonfiction story is about the infamous sinking of Titanic in 1912. **While *(being) built**, it was considered the safest luxury ship.[30] (accomplishment – time clause)
Această poveste inspirată din realitate este despre nefericita scufundare a Titanicului din 1912. În timp ce era construit, vaporul era considerat cea mai sigură navă de lux.
b. I've got one of the earliest Hotplates, **while built** a little better than newer ones, it lacks a switch to turn the bulb off.[31] (accomplishment – concessive clause)
Am un model mai vechi de cuptor electric: deşi fabricat mai bine decât modelele mai noi, îi lipseşte un comutator cu care să inchid becul.
c. No more scrambling for periodic statements and creating tedious spreadsheets; no more screen scraping of client data that is outdated even **while *(being) obtained**.[32] (achievement – time clause)
Nu mai este nevoie să vă agitați să intocmiți declarații financiare periodice sau să creați foi de calcul greoaie, nu mai e nevoie să vă obosiți să triați datele despre clienți care devin învechite chiar de când sunt obținute.
d. The information contained herein, **while obtained from** sources believed to be reliable,

is not guaranteed.[33] (achievement – concessive clause)
Informațiile din acest document, deşi obținute din surse considerate de încredere, nu sunt întru totul verificate.

As for Romanian past participles derived from telic situation-types, they will only obtain anteriority readings, as evident from (14a.-d.) below. In exceptional situations, a simultaneous reading is triggered by the context. Thus, in (14e.) the punctual achievement deonted by 'observat' (noticed) happens against the background of an ongoing state like 'se afla' (was):

(14) a. **Construită cu bani puțini**, casa arăta prost. (accomplishment)
Built with little money, the house looked badly.
b. **Astfel construită**, casa are intrarea prin față […].[34] (accomplishment)
Thus built, the house has the entrance in front.
c. **Obținută** cu greu, permisia l-a bucurat pe soldat. (achievement)
Obtained with difficulty, the leave made the soldier happy.
d. **Atins** de dragoste, orice om devine poet[35] (achievement)
Touched by love, any man becomes a poet.
e. **Observat** abia pe 29 aprilie, […] asteroidul […] se afla în apropierea orbitei lui Marte.[36] (achievement)
Noticed only on April 29, the asteroid was near the orbit of Mars.

In short, this section has shown that adverbial past participles in English and Romanian may obtain a simultaneous interpretation provided they are derived from non-telic situation-types. On the contrary, telic situation-types do not obtain a simultaneous reading.

4. POSTERIORITY

This section illustrates the fact that adverbial past participles in English and Romanian may also obtain posteriority readings, irrespective of the aspectual properties inherited from the base verbs. Unlike above, the range of introductory elements is restricted to 'before'/ 'until' for English and 'ulterior' for Romanian:

(15) a. **Before asked** to do this research study, you already knew that white southerners and freedmen (former slaves) were strongly divided in the Southern states.[37] (activity)
Înainte de a fi rugat să efectueze acest studiu, ştiai deja că în statele din sud există disensiuni între albii din Sud şi sclavii eliberați.
b. **Until asked** to investigate, they may operate as if the invariance principle applies.[38] (activity)
Înainte de a fi rugați să cerceteze, s-ar putea comporta ca şi cum s-ar afla sub incidența principiului invarianței.
(16) […] la sfârşitul lunii septembrie 2005 a avut loc […] vernisajul expoziției Art Nouveau şi Arhitectură Românească Contemporană, **vizitată ulterior** de peste 300.000 de iubitori de artă […].[39] (activity)
At the end of September 2005 the exhibition Art Nouveau and Contemporary Romanian Architecture was inaugurated, later visited by over 300,000 art lovers.
(17) a. The teachings also explain that women have two Arc lines […]. One of the Arclines, **before known** as the Halo, goes from ear to ear […].[40] (state)
Cursurile explică de asemenea că femeile au două nimburi. Unul dintre nimburi, cunoscut anterior ca Halo-ul, se întinde de la o ureche la cealaltă.
b. You have never been loved, **until loved** by Rachael.[41] (state)
N-ai fost niciodată cu adevărat iubit până nu te-a iubit Rachel.
(18) a. Alphonse Capone, **cunoscut ulterior** ca Al Capone sau Scarface – "Cicatrice" s-a născut în Brooklyn […].[42] (state)
Alphonse Capone, later known as Al Capone or Scarface, was born in Brooklyn.
b. […] am făcut singură un glosar financiar-contabil în trei limbi […], **foarte apreciat ulterior** de toți traducătorii din proiect […].[43] (state)
By myself, I made a finance and accounting glossary in three languages, very appreciated

later by all the translators involved in the project.

(19) a. However, **before built** the model, the classification of Kabupaten/ Kotamadya was done based on the proportion of labor force which is working in agriculture, industry, service sector, and the proportion of unemployment labor force.[44](accomplishment)

Totuşi, înainte de a fi construit modelul, clasificarea Kapubaten/ Kotamadya se realiza be baza raportului dintre forţele de muncă angajate în agricultură, industrie şi servicii, pe de o parte, şi forţele de muncă aflate în şomaj, pe de altă parte.

b. The purchaser shall be personally liable for the taxes, penalties and interest **until paid by** the former owner.[45] (accomplishment)

Cumpărătorul va fi personal răspunzător pentru taxe, penalităţi şi dobânzi până ce vor fi plătite de fostul proprietar.

(20) a. [...] în incintă se afla şi o clopotniţă, avariată la Focul cel Mare, **reconstruită ulterior** […].[46] (accomplishment)

On the premises there was a belfry, damaged by the Great fire, later rebuilt.

b. […] turnul nu putea fi ridicat în lipsa pronaosului, **zidit ulterior** în secolul al XVIII-lea […].[47] (accomplishment)

The tower could not be erected in the absence of the vestibule, built later in the 18th century.

(21) a. transmitted to state **before completed**[48] (achievement)

transmis statului înainte de a fi completat

b. An entity will need to repeat the Add Row function to make additional adjustments, **until completed**.[49] (achievement)

Pentru a face ajustări, nu este nevoie să repetaţi comanda Adăgaţi rând înainte de a fi executată operaţiunea în curs.

(22) a. Această taxă (**percepută ulterior** şi la "Mitropolitul Nectarie"-Rarău), a provocat nemulţumiri […].[50] (achievement)

This tax, later levied at the Rarău Monastery Archbishop Nectarie, brought about discontent.

d. Greşeala mea, **observată ulterior**, era că […].[51] (achievement)

My mistake, noticed afterwards, was that…

In sum, this section has illustrated the fact that past participles derived from all situation-types may obtain a posteriority reading in adverbial constructions from both languages under consideration.

5. CONCLUSIONS

The aim of the present article has been to examine the temporal readings available for adverbial past participles in English and Romanian. Our examples pointed to the fact that in both languages these non finite verbal forms may obtain a variety of temporal interpretations, function of the aspectual properties inherited from the base verbs. In a nutshell, simultaneity readings are available only for non-telic situation-types (i.e. ongoing activities and durable statives). Moreover, anteriority and posteriority readings are available for all situation-types, being restricted by specific introductory elements.

6. NOTES

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THE ROLE OF THE NEW TECHNOLOGIES IN CAREER COUNSELING

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Summary:The use of the new technologies in career counseling as a supplement and an extension to the human potential, rather than a substitute, represents a great challenge. The consequence on the counseling process will be the necessity to meet the quality standards, which will optimize the professional development of humans.

„The issue is the quality of the counseling act, and not the specific nature of counseling, by employing the new communication and information technologies." (Offer, 2003)
Key words:New technologies, career counseling, information manager, personal growth

Owing to the technological evolution in the computer science field (computers equipped with a bigger memory, various CD-ROM for information storage, multiple media systems) the use of the new technologies in the career counseling process has become compulsory. In Romania, the increase in the usage rate of the websites that provide information on career counseling can be underscored by the growth in their number as part of the services offered to inform, counsel and guide those interested in career development.

In the past, no Center for Psycho-pedagogical Assistance made use of the new technologies to enhance market visibility and promote offer of services. Presently, there are several such centers with their own webpages (www.edu.botosani.ro/cjap, www.cjap.braila.net, www.geocities.com/cjappcluj, www.cmap.home.ro, http://cjapp.satmat.ro), discussion forums: cjapp@yahoogroups.com, as well as Centers for Career Information and Guidance that work at the higher education level (http://cipo-gate.uaic.ro, http://www.unibuc.ro/ro/centrul_de_informare_orientare__i_consiliere_profesional, http://www.snspa.ro/p/centrul-de-consiliere-si-orientare-profesionala, http://www.grupscolarauto.ro/Resurse-Educationale/centru-de-instruire-si-consiliere.html, http://www.uoradea.ro/romanian/topic/123/CentruldeConsilierePsihologicasiOrientareinCariera.html,http://www.umftgm.ro/consiliere/centru_consiliere.pdf, http://www.uad.ro/ghid/ro/Centrul_de_consiliere_si_orientare_in_cariera, http://cariera.wordpress.com/cipo/, http://www.unitbv.ro/Portals/0/Carta%20si%20Regulamente/R28.pdf.)

In the future, the private offer of information necessary for career counseling will become increasingly dynamic. Among the new technologies that will play a role in the dynamics of the counseling process, the following will be present:

- Self-assessment profiles: Career directions inventory CDI, Jackson vocational interest inventory – JVIS, Kuder occupational interest survey KODDD/PC, Ohio Vocational interest survey – OVIS II, Self directed search – SDS Holland, Strong – Campbell Interest inventory – S II;
- Psychometric tests: ACT – Career planning program – CPP, World of work inventory – WOWI, California psychological inventory – CPI, Myers – Briggs type indicator – MBTI, differential aptitude test – DAT;
- Information search programs: Information system on education and employment – I-SEE, MAXI – DUE (Denmark),ORIEP (Belgium), COBER

(Germany), SIOF (Portugal), TAP (The Great Britain);
- Correlation programs: Cascaid, Paws in Jobland, Kudos Multimedia, Adult Directions, Career Scape, Gradscope, JIG-CAL;
- Decision - aids: Decaid and Planit;
- Regional programs and multimedia systems: COMPAS, KURS, CHOICES, SEMM, ELE, INTEROPTIONS, BTPA, EDUC 2000, CNROP, PLOTEUS.

The pre-requisite in using the new technologies for career counseling is that the information acquired as a result of their being put into practice will match the customer's needs. However, interactive counseling systems cannot substitute the counselor. The role of the technologies is vital in the context of the ongoing evolution, yet the customers do not always have access to them. It is important that the customer be warned about the potential risks by delineating an unrealistic self image, and by providing a technologically-performed interpretation, which can become rigid, and schematic. Thus, the counselor is compelled to become the manager of both the information significant to the counseling process, and the resources that allow the customer to self-assess and make the appropriate decisions for personal career development.

The arguments lying at the basis of using information technologies in career counseling are both social and economic in nature:
- The reduced number of counselors;
- The access of an increasingly numerous public to the offer of services in a context characterized by the increase in number of personal computers, the high availability of Internet connection, as well as the spectacular growth of the career counseling programs developers;
- Objectivity, accuracy, stability, effectiveness. (Jigău, coord., 2002)

Consequently, the advantages of using the new technologies as part of the career counseling process are, as follows:
- The reduction of the costs resulting from the counseling process;
- The customer's autonomy in the decision making process;
- The customization of the time for access to information;
- The flexibility in the information presentation.

Since technologies also have specific vulnerabilities, it is important to present the drawbacks which can surface during the counseling process as well:
- the program's inability to empathize with the customer;
- the absence of the counselor's psychological qualities;
- the programs' relatively low sensitivity to the customer's individual differences;
- the lack of power or other resources which impede the optimum functioning of the counseling programs.

To mitigate the aforementioned deficiencies, the specialists in the field from the National Association for Career Development in the U.S., as well as other experts, have emphasized the counselor's role by endowing them with techniques for program maneuvering to actively respond to the customer's needs. Counselors are responsible for ensuring the optimum conditions of technology usage in the counseling process, and they respect the ethical principles, as well as the legal aspects pertaining to the use of these systems. The counselor's duty is to recommend the customer the most efficient websites by indicating their drawbacks, and the way in which the results are interpreted. The International Committee for Education in the 21st Century (Delors, coord., 2000) is encouraging debates revolving around the topic of integrating the new technologies into the counseling activities, and is launching programs aimed at promoting modern technologies under the patronage of UNESCO. The investments in this direction could enhance the effectiveness of the counseling process, by assuming the repetitive side of the counseling activity, as well as the application

and interpretation of some of the customer's evaluations.

The new technologies are continually evolving. The counselor needs to be trained so as to be capable to adapt to the new requirements. According to Watts (2000), the evolution phases of the application of modern technologies are, as follows:

- the centralized information phase, characterized by numerous computer-assisted counseling programs;
- the micro-computer phase, when simplified counseling programs were provided;
- the Internet phase, which fostered inter-connections;
- the numerical phase, in which the television, the computer, and the telephone merge within an integrated unit.

The analysis of the new technologies' evolution phases in the counseling process has pointed to a series of tendencies:

- the accessibility of career counseling services;
- the variety of information devices, which has led to a significant development of the activities in the private sector with consequences on the public policies.

Nowadays, an ongoing development and increase in the quality of the technology-assisted counseling programs can be ascertained. With regard to this, Tractenberg (2002) makes reference to the significance of the simulating games and workplace database systems. Their role is increasingly important since they inform the customer on what is demanded on the labour market and what the customer can offer. According to Mitrofan (2001), the processing of information is carried out at a higher level of difficulty, instantaneous answers are provided, close-to-reality analyses of the counseling-related psycho-social phenomena are carried out, and psychological reports, including recommendations and predictions for the customer are drawn up. Plant (2002) supports the necessity of using the new technologies in the counseling process, regarding them as career development tools.

The unrestricted access to information has eradicated the information monopoly on career opportunities. The approach of offering the customer novel ways of professional development is in accordance with the new European standards. At the end of the counseling process, the client is provided with a set of customized information which both motivates and determines him to contribute to the implementation of the career development plan.

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HEMISPHERIC DOMINANCE AND TEMPERAMENT IN NON-VERBAL COMMUNICATION

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Abstract:

It is well known that, as a function of their temperament, people are more or less verbal communicative (extraverts and introverts). The dynamic-energetic component of personality also influences the dynamic of non-verbal messages transmission. What is the measure of the differences between temperamental types or hemispheric dominance regarding the encoding and decoding of these messages? The main objective of the present research is that of identifying the relations between hemispheric dominance, temperament and non-verbal language at 20 – 25 years old persons. After processing, analysing and interpreting the data the main hypothesis was confirmed (there are significant differences regarding the encoding and decoding of non-verbal messages as a function of temperamental type and hemispheric dominance). The results of the investigation were used in order to improve the content of the Professional Communication discipline, which should not be followed only by engineering students.

Keywords*: hemispheric dominance, temperament, non-verbal communication*

1. INTRODUCTION

The literature of the area mentions that people with right hemisphere dominance are predisposed to nonverbal communication, while persons with left hemisphere dominance prefer verbal communication [7]. The dynamic and energetic component of personality influence, as well, the dynamics of transferring the message – in verbal communication the choleric and sanguine are both extraverts while the phlegmatic and the melancholic are introverts, in nonverbal communication the first two temperaments are dynamic (seen as movements and not messages frequency), the other two are more static ones. The present paper is based on a research aimed to identify the existing differences between encoding and decoding nonverbal messages as a function of hemisphere dominance and temperament.

2. TEMPERAMENT AND HEMISPHERE DOMINANCE

According to some authors [1], personality is the dynamic organization of those psycho-physiological systems which determine thinking and characteristic behaviour, while other authors [9] consider personality to be the human subject regarded in his three hypostasis – homo faber (the pragmatic subject), homo sapiens (the epistemic subject), and homo valens (the axiologic subject). Although they form an independently set, the three sides of personality (the temperament – the dynamic and energetic component, the aptitudes – the operational and instrumental component, and the character – the attitudinal and valoric component) have very well delimited characteristics. The temperament is the most accessible and evident side of personality as a consequence of significant behavioural cues [9]. According to Hypocrates

and Galen model, temperaments are still classified today in: choleric, sanguine, phlegmatic, and melancholic.

The temperamental structure is represented by the integration of dynamic and energetic characteristics and traits of psychological processes and motor acts, like intensity, significance, acuity, means, balance, etc. These dynamic-energetic traits are innate, their integration in the psycho-behavioural plan produces in the ontogenesis. Because these bio-energetic traits imprint themselves on the behaviour, the temperamental structure is also innate representing, therefore, the hereditary element in the internal organization of personality, along with predispositions [4].

Regarding hemisphere dominance, biologists introduced the term hemisphericity in order to designate the functional specificity of a hemisphere. Brain hemisphere's characteristics are [7, 2]:

Left hemisphere is the headquarters of language, word (name, define, and describe), it involves the linguistic aspects of writing, it is the headquarters of logical calculation, numbers, reasoning, analysing ability (it uncovers things step by step, element with element), and abstracting ability (extract and information and uses it in order to represent the hole).

The left brained person communicates with exterior on a logical-analytical code, prefers dictionaries, vocabulary, is attentive at naming objects and classes, prefers details, presents facts in a logical way, prefers unilateral causal relationships, and has the ability to structure phrases. The inexplicable for this person is consider to be a weakness, he uses symbols instead of things, he respects time, organizes things in a sequential manner, execute them in order, concludes based on facts and reasoning, uses numbers, and thinks in intercorrelated ideas.

The right hemisphere is the headquarters of non-linguistic thinking, of non-verbal understanding, forms recognition and spatial perceptions. It is responsible for voice's tone and intonations, for rhythm, music, imagination, colours, reverie. The right brained person prefers to use many analogies and schemata in approaching the universe, synthesizes and expresses the results of knowing into images. Imagination and intuition have their location in this hemisphere which is the headquarters of artistic and musical competence.

The person with right hemisphere dominance develops her visual-spatial memory, prefers an intuitive, interactive approach, synthesizes relations between objects, uses ideas associations, and reconstitutes information in a holistic ensemble. The person judges dependent of context, places things together in order to form the whole, relates herself at things as they are, sees the relations between things, understands metaphors, has no sense of time, does not need facts and reasoning, manifests the tendency of not judging everything, sees objects as being in relation and as parts of a whole, bases on impression, feelings, visual images, makes a decision in jumps, perceive the whole and the association between parts.

3. NON-VERBAL LANGUAGE

Language represents the way in which codes are assimilated, function, and are integrated at individual level [12]. It is subordinated to the communication process and activity, to the semiotic behaviour. From the psychological and psycho-physiological perspective, the semiotic function is expressed through the human ability to use signs and symbols, significants as substitutes of objects and to make mental combinations and transformations with them [4].

In other words, language is the function of using codes in human relationships. It establishes indissoluble relations with the other functions, especially with the intellectual and motor ones [3].

Gesticulation is a global activity of the human body, in which particular gestures of body agents are coordinated or/and subordinated to an overall project that is unwind simultaneously. While instrumental gestures can lose their semantic significance, the rhetoric

gestures have the purpose of convincing the interlocutor, inducing him a certain affective state.

The non-verbal way of communication is much more used than the verbal one (we communicate verbal only 10%, 20% we communicate paraverbal, and 70% non-verbal) [8]. Personality factors determine, during communication, the option for one of these communication means. It is important, while communicating, to correlate gestures with body movements and to subordinate them to the idea we transmit.

Gestures and words are the environment of communication. When words are hermetically or can not be heard, gestures either help or replace them. Emblems [8, 10] are some of the gestures intended to determine or facilitate accessibility. They have the property of holding precise and constant meanings; they are nothing more than symbolic gestures, different from others. They have a direct verbal translation, precise meaning well known by the entire group which use them with the intention of transmitting a message to another person who can read it. However, most gestures are determined by conscious or unconscious affective states.

4. METHODOLOGY OF THE REASEARCH

Objective. The general objective of this research was that of identifying the relations between hemispheric dominance, temperament and non-verbal language at 20 – 25 years old persons. We also investigated possible significant differences regarding encoding and decoding non-verbal messages between subjects with different temperament but the same hemispheric dominance.

Instruments. We used four instruments: a questionnaire for identifying the non-verbal language expressivity, a questionnaire for identifying the dominant hemisphere, an inventory for establishing the temperamental type (Belov), and a role-play for establishing the ability to encode and decode non-verbal messages.

The questionnaire for identifying the non-verbal language expressivity had 27 items, 22 of them aimed opinions, attitudes, decoding, and description regarding the expressivity of non-verbal communication, 5 items investigated the demographic data.

The role-play for establishing the ability to express and decode non-verbal messages was effectuated in random pairs. Each subject had to write 10 messages on a piece of paper and, using non-verbal language, to transmit them to his partner. The partner wrote the significance of the 10 received messages. The roles were shifted afterwards. The partners were not allowed to check their responses or to communicate the possible interpretations of the emitted message. Each subject received two scores: one for transmitting the message, the other for receiving it (for transmitting the message: 0 – incorrect, 1 – partially correct, 2 – correct; for decoding: 0 – incorrect, 1 – partially correct, 2 - correct).

The sample. The participants at the study were 80 students – 58 were students at Faculty of Psychology and Educational Sciences and 24 at Faculty of Electrical Engineering and Computer Sciences in Brasov. 72% of the subjects were females and all were between 20 and 24 years old.

The research hypotheses. There are differences regarding the encoding and decoding of non-verbal messages as a function of temperament and hemispheric dominance.

1. There are significant differences regarding encoding/ decoding nonverbal messages as a function of the temperamental type.

2. There are significant differences regarding encoding/ decoding nonverbal messages as a function of the hemispheric dominance in the same temperamental type.

5. RESULTS

The distribution of research participants according to their temperament and hemispheric dominance is presented in table 1.

Table 1 –
Subject distribution after temperament and hemispheric dominance

Dominance Temperament	LD	RD	DLM	RMD
Choleric	5	7	4	3
Sanguine	8	11	3	2
Phlegmatic	4	5	7	4
Melancholic	5	7	4	1

LD – left hemisphere dominance, RD – right hemisphere dominance, LMD – mixed left hemisphere dominance, RMD – mixed right hemisphere dominance

1. The hypothesis is confirmed. Analysis of variance revealed significant differences between the four temperamental types regarding the encoding and decoding of non-verbal messages: $F(3, 58) = 3,6$; $p < .05$.

The differences of means between choleric and phlegmatic is 4,77, the difference is significant in favour of choleric ($t = 2,84$; $p<.05$). The differences of means between choleric and sanguine is 4,59, significant in favour of sanguine ($t=3,05$, $p<.05$). The difference of means between melancholic and phlegmatic is 4,83, significant in favour of phlegmatic ($t=3,13$, $p<.05$). The difference of means between sanguine and phlegmatic is 4,83, significant in favour of phlegmatic ($t=2,96$, $p<.05$).

2. The hypothesis is confirmed. The statistical procedures used to compare the ability to encode and decode non-verbal messages at the same temperamental type as a function of hemispheric dominance revealed the following differences: between LD choleric and RD choleric the differences is very significant ($t=5,12$, $p<.01$), RD choleric have the higher scores; between LD choleric and LMD the differences is very significant ($t=14,05$, $p<.001$); between RD choleric and LMD the difference is very significant ($t=14,27$, $p<.001$); between RD choleric and RMD choleric the difference is significant ($t=2,97$, $p<.05$). Significant differences were obtained at all temperamental types, according to hemispheric dominance.

6. CONCLUSIONS

Based on obtained results, we can say that there is a significant relation between temperament and hemispheric dominance regarding encoding and decoding non-verbal messages.

The extravert temperaments (choleric and sanguine) seem to be more communicative under the aspect of non-verbal communication, but it is known that more than 63% of body movements are the expression of body dynamics and not non-verbal messages (for example, a choleric persons rise his left hand 12 times in 4 minutes while drinking a glass of tea). These temperaments revealed a very significant difference between encoding and decoding messages ($t=4,71$, $p<.01$); both choleric and sanguine, despite their hemispheric dominance, are more preoccupied with the message they want to transmit and less preoccupied by want others transmit.

The introvert temperaments (phlegmatic and melancholic) are more predisposed to decode non-verbal messages, 72% of them being able to do than about the group mean, they are more capable to identify others emotional and affective states based on the posture, mimics, and gestures. They are less preoccupied to encode non-verbal messages, even though 68% of them succeed to transmit the messages with scores above the means.

In general, the means for transmitting and receiving non-verbal messages are pretty low (10,2 for transmission, 8,7 for receiving), which could mean that there is a deficit in knowing the significance of body moves. These results suggest the necessity to modify the content of

Professional Communication curricular area, even the extension of this discipline to the socio-humanistic profiles.

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LEARNING STYLES - THE FACTOR IN INFLUENCING STUDENT ACHIEVEMENT

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Abstract: *The way we learn things in general and the particular approach we adopt when dealing with problems are said to be dependent on a somewhat mysterious link between personality and cognition. This link is referred to as cognitive style. When cognitive styles are related to an educational context, they are generally referred to as "learning styles". Identifying student learning styles helps educators understand how people perceive and process information in different ways. Garger and Guild (1984) described learning styles as "stable and pervasive characteristics of an individual, expressed through the interaction of one's behavior and personality as one approaches a learning task".*

Key words: *learning styles, cognitive styles, teaching strategy*

1. INTRODUCTION

Teaching and learning styles are the behaviors or actions that teachers and learners exhibit in the learning exchange. Teaching behaviors reflect the beliefs and values that teachers hold about the learner's role in the exchange (Heimlich and Norland 2002). Learners' behaviors provide insight into the ways learners perceive, interact with, and respond to the environment in which learning occurs (Ladd and Ruby 1999).

The way we learn things in general and the particular approach we adopt when dealing with problems are said to be dependent on a somewhat mysterious link between personality and cognition. This link is referred to as cognitive style. When cognitive styles are related to an educational context, they are generally referred to as "learning styles". Identifying student learning styles helps educators understand how people perceive and process information in different ways. Garger and Guild (1984) described learning styles as "stable and pervasive characteristics of an individual, expressed through the interaction of one's behavior and personality as one approaches a learning task".

In theory, there exist as many learning styles as there are learners, and practical implications of learning styles for teaching-learning interaction are numerous. Literature on learning styles suggests that field-dependent learners tend to approach a problem in a more global way, are socially oriented, prefer collaboration, and are extrinsically motivated (Miller, 1997a). FI hinges on the perceptual skill of "seeing the forest for the trees". A person who can easily recognize the hidden castles or human faces in 3-D posters and a child who can spot the monkeys camouflaged within the trees and leaves of an exotic forest in coloring books tend toward a field independence style. The "field" may be perceptual or it may be abstract, such as a set of ideas, thoughts, or

feelings from which the task is to perceive specific subsets.

In contrast, field-independent learners tend to approach a problem more analytically, rely on self-structured situation, prefer competition, and are intrinsically motivated. Field dependence is conversely, the tendency to be "dependent" on the total field so that the parts embedded within the field are not easily perceived, though that total field is perceived most clearly as a unified whole. (Brown, 1994)

Field independent learners easily separate key details from a complex or confusing background, while their field dependent peers have trouble doing this. Garger and Guild (1984) emphasized that both field-dependent and field-independent learners make equally good learners. Several studies have shown that field-independent learners tend to outperform field-dependent learners in various settings.

Differences in learning styles do not indicate differences in learning ability or memory. Learning styles indicate the preference an individual has for perceiving information, not the ability to learn the material. Thus students with equal learning abilities but different learning styles may experience different degrees of success in the same environment.

To make ESL learning/teaching successful, educators must understand and respect individuals' diverse learning styles and make efforts to create optimal learning environments for learners.

A knowledge of one's own learning styles is essential in "learning to learn". Teachers should help students discover their own preferences and provide constructive feedback about the advantages and encourage their development, while at the same time creating opportunities for students to experiment with different ways of learning. Educators should employ instruments to identify students' learning styles and provide instructional alternatives to address their differences. As a result, students can enhance their learning power, by being aware of the style area in which they feel less comfortable and working on their development, thus providing avenues to foster their intellectual growth (Eliason, 1995). Similarly, teachers can use the survey results to identify dominant styles patterns in their classes, which they should consider when designing learning tasks. In other words, teachers should plan lessons to match students' learning styles.

In this study, the learning style is not the effective factor in influencing student achievement. Field-independent students do not differ significantly from field-dependent students in their achievements. In conclusion, students with different learning styles and backgrounds learn equally well and do not differ much in their use of learning strategies. As it is difficult for learners to change their learning styles, many of the learning style studies had similar implications or recommendations that various teaching methods should be used to meet the needs of learners with different learning styles (Cano & Garton, 1994a; Whittington & Raven, 1995).

Using various teaching methods to meet the needs of students with different learning styles, as most of the learning style studies recommended, might not be the best solution to help students learn better. Teaching and learning not only require two-way communication but also efforts. In addition to employing various teaching methods, educators should help students learn how to learn by providing guidance for using appropriate learning strategies in different learning situations and environments.

In considering learning and how to improve student learning, one needs to understand the way(s) in which an individual learns. It is widely accepted that while it is possible to identify common constituent elements, the learning process varies at an individual level. Students will develop a way or *style* of learning, and refine that style in response to three groups of factors: unconscious personal interventions by the individual, conscious interventions by the learner themselves, and interventions by some other external agent. The term *learning style* only began to appear in the learning literature in the

1970s. One of the reasons put forward for the emergence of the term is that learning style has a practical application, particularly in education and training. Riding & Cheema (1991) suggest that it appeared as a replacement term for cognitive style, and cognitive style is only part of an individual's learning style. The term learning style indicates an interest in the totality of the processes undertaken during learning. A learning style is: "A complexus of related characteristics in which the whole is greater than its parts. Learning style is a gestalt combining internal and external operations derived from the individual's neurobiology, personality and development, and reflected in learner behaviour" (Keefe & Ferrell 1990, p. 16). Learning style therefore relates to the general tendency towards a particular learning approach displayed by an individual.

2. LEARNING STYLE INSTRUMENTS

Despite the lack of clarity and agreement surrounding the concept of learning style, a significant amount of the literature has been devoted to the development of a range of instruments claiming to measure an individual's learning style. If it is possible to assess the learning style of an individual, then one would be in a more favourable position to educate them in a more appropriate manner. It is unclear whether learning style is amenable to measurement or assessment. While it is accepted that students do exhibit different approaches to the acquisition of material (see Emanuel & Potter 1992, Gregorc & Butler 1984, O'Brien, 1992), it is not clear whether one can quantify those differences, or whether those differences constitute different learning styles. It is also unclear whether these differences are conceptually different, or simply variations on a single theme.

However, if one does assume such differences in material acquisition are learning styles, by what means is it appropriate to measure those styles? For any assessment of learning style to be considered valid, the learning style of an individual would need to be consistent over time. If learning styles were subject to significant change over time, then any assessment of style would be valid only at the time the assessment was carried out. Research into the relative stability of learning style as a construct remains both confusing and confused. Cornett (1983) considers while there may be qualitative changes in the learning style of an individual, the essence of that style will remain unchanged over time. Claxton & Ralston (1978) suggest that learning style is stable in describing it as a *consistent way of responding to*…. In a three year longitudinal study of forty students, Geiger & Pinto (1991) found only weak and inconclusive evidence that individuals' learning style preferences changed over time. Pinto et al (1994) in a later study found the learning style preferences of students to be susceptible to change over time, reinforcing the earlier and similar findings of Price (1980).

These studies indicate it is not clear whether changes in learning style would be significant in terms of how effectively an individual would be able to learn following a change in learning style. Is the learner simply tampering with their learning style to meet the specific needs of a single task, or is it a significant developmental change? Given the lack of agreement over the nature of learning style, and whether learning style is a stable characteristic, it is surprising there exists a relatively wide range of instruments claiming to measure learning style. Bohrnstedt (1970) suggests that in attempting measurement, one should always use the most refined measure available, together with well-defined terms so not only are you measuring what you claim to be measuring (the instrument has validity), but also the measurement is accurate (the instrument is reliable). In the case of the measurement of learning style, there is some doubt whether many of the instruments used satisfy both of these requirements. There is an implicit assumption that the relative preference of an individual for one style over another can be measured, and there is a

significant lack of agreement over the nature of the construct of learning style.

3. THE RIGHT LEARNING ENVIRONMENT

It is possible to attempt to create what is viewed as an appropriate environment for learning through the design of a course structure. In practice however, this theoretical ideal may become subsumed beneath a learning environment which subsequently develops during the course of a programme, as a result of the composition of a particular group of students. Each group of students will produce a unique pattern of circumstances, values, learning styles, pressures and opinions that will interact in complex ways to generate a new and unique learning climate (Hammond & Collins, 1991). The role of the lecturer in this situation is not to then attempt to overcome this climate in favour of their own ideal-type environment, but to adapt the programme to meet the needs of that particular group.

A rigid educational structure that is imposed upon individuals may satisfy the course requirements, but it may also act as a development block for people whose learning attributes do not match that structure. Although it is likely that a programme that does not have as a prerequisite that participants will be required to self-direct their learning, will be unsuccessful in achieving greater learner control. The achievement of greater self-direction requires the development of a co-operative learning environment, which the learner perceives as being democratic, flexible, challenging, and most importantly, non-threatening. This will require that the lecturer breaks down barriers to learning and self-direction that may be present. This covers: those barriers created by the student during the course (wrong choice of learning approach, poor motivation, lack of confidence), those barriers that the course itself may indirectly create (lack of flexibility, lack of direction and guidance, poor structure), and those barriers that the student brings to the course (reason for attending the course, poor learning skills, previous bad learning experiences).

It is also important that this process of breaking down barriers is not perceived by students and lecturers as a one-off activity. The learning environment is dynamic in nature, and new barriers to effective learning may subsequently develop during the running of a programme, independently and also arising from the three areas identified above. In the initial stages of a programme, the lecturer will need to ensure the existence of an appropriate control structure, as students undergo the transition from being other-directed in their learning by external influences, to being self-directed. This transition is achieved by providing a scaffold structure that allows students to progressively take control of their learning, but that also offers sufficient guidance and direction in the early stages to prevent individuals from becoming lost. This structure revolves around providing clearly communicated and understood aims and objectives for the students at regular intervals. These aims and objectives should also be accompanied in the beginning with evaluation exercises, to ensure that individuals are progressing, and to identify at the earliest opportunity current and potential problems.

The difficulty for the lecturer arises in achieving a balance between allowing sufficient flexibility for the individual to determine what is an appropriate structure, and providing enough support to keep the programme and the students on track. A situation that will be further complicated where there is conflict between such an open, flexible philosophy, and the desire for a more prescriptive and dogmatic approach, that may be demanded by organisational requirements to meet specific targets. As indicated previously, the role of the lecturer in self-directed learning is a flexible one that may require a degree of spontaneous adaptation in the lecturer. As the student begins to assimilate and apply new skills and knowledge associated with self-direction, their needs will alter as they

gradually shift from one end of a control continuum at which the lecturer dominates, toward self-control.

The primary question however, will be to what extent will students be capable of fulfilling this role. The traditional position occupied by many where pedagogical delivery to an audience of essentially passive recipients is the key function, may not be effective. This ineffectiveness will be particularly evident in situations where the lecturer has opted for a mismatch between the instructional style used, and the learning style(s) of a particular group. Within this scenario, the lecturer should adopt the role of group facilitator. But, as the level at which students are able to self-direct their own learning rises, the position of group facilitator may become inappropriate as individuals progress at different rates. By definition, those individuals who are approaching self-directing status require a facilitator, or indeed any formal external intervention, to an increasingly reduced extent. Whether lecturers who have typically conducted structured education programmes from a lecturer-controlled perspective, will be able to effectively operate under such conditions remains unclear. There is also an implication that to be able to progress others along the path to self-direction requires that the lecturer themself should also be an adept self-directed learner.

4. CONCLUSIONS

This paper began by arguing that in order for learning to be effective in achieving desired outcomes, educators need to have an awareness and understanding of individuals' learning styles. Although it is possible to identify the learning styles of individuals, it is questionable whether such an approach is valid. Using existing inventories of learning styles, individuals are simply allocated to a narrow range of categories, containing a limited number of learning activities to which they are, in theory, best suited. The suggestion here is that this a fundamentally flawed approach. Higher education teaching should seek to move beyond the enhancement of performance within a narrow spectrum of activities, and consider the development of foundation skills, such as self-directed learning. An able self-directed learner may still choose to use a particular learning style that is relatively narrow in nature, but they are consciously taking that decision, in view of their perception of the needs of a particular situation. There is also a need for further research into learning styles to establish whether they are temporally stable. Longitudinal studies of groups of students during their degree studies would help to identify how learning styles may change.

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MEDIA AND EDUCATION-INTERACTING AND MUTUAL CAUSALITY

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Abstract: *The media culture has its own contents and values, languages, structures and its specific effects. As a cultural phenomenon it is full of spiritual values and goals of a living really, a culture produced (contents,program structures, language, etc.) and also from a real one, assimilated more or less active. In literature some authors identify the media culture with a culture of mass. The media tries to satisfy the interest that students, young people express it for the knowledge of the great problems which the contemporary societies is dealing with.*

Key words: mass media, media culture, behaviour, education, mass communication

The media culture has its own contents and values, languages, structures and its specific effects. As a cultural phenomenon it is full of spiritual values and goals of a living really, a culture produced (contents, program structures, language, etc.) and also from a real one, assimilated more or less active. In literature some authors identify the media culture with a culture of mass. T. Huseni and H. Culea make although a distinction between these. The media culture would be a specialized culture for different media channels, but it all falls into mass culture. The type of media culture reveals itself as one of the most crowded of contents loaded with a lot of different meanings and significance and communications of millions of people through new media. Although, it is truth that the opinions about values and effectiveness of the mass media are extremely divided and contradictory.

Some researchers see more harmful effects that could result from a frequent contact with television and cinema. If, for example, FR. Barlett, reffering about cinema admits only the existence of some superficial influence on behaviour, which would only maintain the level imitation, a imitation of a simple pass, other researchers belive that the media would lead to weight loss phenomena of the will, of depersonalization, following passive consumption, undifferentiated of different movies and shows. D.J. Boorstein claims that the action of the media would be harmful for the moral unit, because it would lead to imitating models of some pseudo-personalities.

Children, young people, are sensitive to images and repeating some of them, when they are extremely traumatic for their imagination, they result in a complete reversal of the hierarchy of moral values, considers A. Todorovici. So, from a social perspective, what is the most important is not the direct effect of the mass media, as sometimes thought, but the form in which the young people represent their values or models whoch they associate different values. Special problems raise, after the happy-end meaning all those movies that depict all sorts of vices, so at the end the purity above the vices

will triumph. There are lots of movies made in our country and abroad, full of atrocities, sadism, pornography and robberies but the positive hero always comes out to be the winner and life returns to normal. Of course, the happy-end is not something harmful, as long as it comes from the real facts and events and it also brings and presents the viewer a sense of satisfaction, of optimism, of confidence in the triumphy of good over the evil. But quite different is its value in the movies created expressly for the concept of a imposed happy-ending by fireworks and following other purposes than the educational, cultural and humanized one. It brings many critics of the mass communication and for the fact that they have cultivated a social conformism that would inevitably lead to homogenization, and standardizing of the behaviour. The main problem that arises is :the media that facilitates the effort of the young people over the social integration of young people and its effort, or on the contrary it create or deepen a gap between them and society.

The media tries to satisfy the interest that students, young people express it for the knowledge of the great problems which the contemporary societies is dealing with. Analizing the preferences expressed by the sample of the students submitted researches show the interest (at least at certain ages) for knowledge of various news, news about current events social, political, economic, cultural) national and international. From this point of view, there are no other means more rapid and more effective than mass communication, audio-visual techniques, especially, to play with more authenticity. To the evolution of social and political life, the events and facts of every day life, of the country, including historical events. There are also a number of radio and television shows, films, headings in the pages of the magazines and newspapers, posters etc., of educational and professional guidance. A number of researchers belive that between the media and moral deterioration of social life there is a close connection. To support these claims, the researchers highligh a series of antisocial and antimoral acts which children, teenagers and youth would be excited. It takes into account particulary those manifestations of conduct that by itself their evolution, from a certain age may be imposed on their lives.

A set of empirical data or scientific study of reality, gives us the opportunity, as G.Cohen-Seat notes, referring to the phenomenon of cinema, to assume by extension. The entire social life of the individual is affected by the influences exerted by the media. A certain precocity is likely to occur and in this, regard to children, because children's systematic contact with audio-visual messages tend to submit it to social and political life issues. This can be useful to a certain point. The information is useful but not to excess. Through audio-visual messages the sensibility of a person is also cultivated in H. Culea view, media helps to socio-cultural integration of the auditor, especially its ability to facilitation skill of civic roles, family, cultural, reinforces a sense of social responsibility, the sense of dedication, the need of communication, cultivate goals and ideals. Jean Rousselet however, brings other data regarding the effect of media on children and young people, not very promising. He says that some disappointed children discover with the age a very different world from the screen, and seek to extend it in every day life the fictions that they have been accustomed. Refusing to integrate into society, they are working hard to shape it after the image they had and inevitably they conflict with all those who are not sharing their romantic views.

The researchers carried out, I met parents and teachers that have noticed that the media creates tension, controversy and conflicting feelings between children and parents, young people tilting to adopt attitudes that are contrary to the concepts, mentality-established in family, only to be in contradiction with parents and to imitate the models presented in the media. There are criticized the mass media means because it would help to enhance the exaltation of eroticism and sexuality, would encourage the violence and

would be responsible for incrising crime and even the juvenile crime, or to encourage addiction. Media is considered responsible for corruption and moral decay of teenagers.

After 1989, with the increasing flow of international children, teenagers, were faced with a choice. Unfortunately, not few choose violence, crime, pornography, all presented in detail in the mass media. Since then , there are over 30 television programs, young people no longer spend time reading. Should this be the society of nowdaysor more-of the future? Exposing children and teenagers to media influences is an undeniable fact. Aware or not many of them leave impressed by displaying the frequency and intensity of eroticism and violence on screen. What does the school do? Most of the times-nothing. School cannot forbid, but do not seek either, other means to replace the pupils concerns or change their ideas about their preferences not quite Orthodox and the proposals came from the audio-video means (especially). Edgar Morin, H. Blumer, Hanser support the idea that the media, and especially movie, plead for eroticism. The first sociology surveys of the cinema made in 1930 by H. Blumer, revealed that love-making of the teenagers was mimed by such behaviour of the films. On the other hand, stars maintain themselves such models through the roles they play in movies, but also by their way of life. From promoting the eroticism and to increaserd the sexuality is only one step. Media is held responsible for increased violence and brutality to children. Movies, series, emphasis on action, violence, aggression, fight, murder, theft, robberies, etc. his can be found in issues of television news. The socking the better, and it also has a greater impact. Such images cause at children a strong overdraft, incite them to violence and brutality. Violence in fiction is easily to implement in real acts of the violence. J. Cazeneuve says that the greatest evil is not what it shows-what is seen in the scenes of violence, but what interference is created between fiction and reality that leads to mental and moral confusion for the child, the difficulty of separating the fiction by reality. The true meaning of indifference towards violence, so violence in fact, violence in action, is depreciating the idea of humanity.

Most researchers have concluded that the origin of violence, aggression and immorality at children, should be seek first of all in their personal relationship with their parents, family the groups they belong and not at least with school and society. These were the main factors, the media came only strengthen. Thus, incentive media reprehensible acts should become effective only when he found conducive to a dull subject and other influential subjects can create state of imbalance. R. Blehei, a psychiatrist researcher from Columbia says that for young people and teenagers with problems, television is likely a preparatory school for delinquency. As I tried to show up here, the media is not a negligible factor in raising children. In this context, what is the role of schools and what is the relationship between it and the media? Quantitative the global information distributed by the school is balanced by that which comes from other channels and from qualitative aspect the information in the media type is offered in very different contexts.

For an effective education, schools and the mass media should be in a very close connection, to complete each other, to cooperate as much as possible. School can find a very precious support in contents published on new techniques of communications in terms of the whole information, stimulate motivation of teaching. Reciprocal relationship between school and media is completed even more if as a reference is the student. The student of today is different than the 5 years ago student. The teacher should try to capitalize the instructive and educational potential resulting from the contact of the student with the media. The lesson has been and remains in the best correlation of the recived information through mass media. It must not be ignored the fact that media includes both students and teachers. He has many possibilities to make from the

infomation recived through the media reasons of inciting the student media to new forms of action and behaviour.

Although speculations have been made, considering that media appearance leads to usurping the prestige and the authority of the teacher that endangers the student confidence in schoolmaster, researches has shown that none of this does not happen. In a society dominated by media, school will have increasingly more functions not only of transmitting information, but the selection, structuring and the sistematization of information. School also must find means and ways that young people are keen to employ counter information for antisocial purposes. School must develop in students a critical spirit, to promote the ability of discernment and the trial, compare to a language so clear as is the the audio-visual, not to accept without critical examination everything they read, they hear, they see, to help them aquire the assessment criteria, ranking and selection of evaluation and synthesis of what is quality of informational avalanche. As long as school keep track of the influence that the mass media have on children, the situation is under control.

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POSTMODERNIST FICTION: THE WAR DISCOURSE

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***Abstract**: It is generally accepted that the roots of Modernism are European rather than British, and indeed the determination to take European culture as a model was one of the hallmarks of the Modernist movement, going back to Ancient Greece in its quest for archetypes and models in what we have come to see as the mythic method. What seems to be the most debated issue is the problematic relationship between World War I and Modernism. World War I was essentially, as critics claim, the consequence of arrogance on the part of the ruling groups in European society.*
In German Expressionism, French Surrealism and Dadaism, and even in some tendencies of the English Modernism, particularly as manifested in the writings of Ezra Pound and Wyndham Lewis, Modernism and then Postmodernism gave validity to cruelty, accepting cruelty not as something to be simply resisted, but as a human act that was to be understood as an inseparable part of life.
The paper's attempt is to present few war novels such as Hemingway's A Farewell to Arms, or Vonnegut's Slaughterhouse-Five, trying to establish common features of both Modernist and Postmodernist fiction.

***Key words**: modernism, postmodernism, war, novel, fiction, hero.*

Starting from a common division of the 20th century, one can distinguish between two distinct periods: one characterized by the Modernist movement and the other by Postmodernism. Some believe that Postmodernism was a response to Modernism and hence consider them as two aspects of the same movement. But the distinctions between the two make clear the basic difference in the ways of thinking that led to these movements. As shown by an important number of critics, the difference between Modernism and Postmodernism highlights the difference in the approaches towards life.

Modernism describes a collection of cultural movements of the late nineteenth and early twentieth century and it was characterized by a dramatic change of thought, whereby human intellect sought to improve their environment. There was a trend of improving every aspect of life by involving science and technology into it. Modernism brought about a reform in all spheres of life including philosophy, commerce, art and literature, with the aid of technology and experimentation. It led to progress in all the aspects of life by changing the approach of mankind of looking at them.

Postmodernism was a reaction to modernism and was influenced by the disenchantment brought about by the Second World War. Postmodernism refers to the state that lacks a central hierarchy and one that is complex, ambiguous and diverse. The developments in society, the economy and the culture of the 1960s were impacted by Postmodernism.

Modernism began in the 1890s and lasted till about 1945, whereas Postmodernism began after the Second World War, especially after 1968. Modernism was based on using rational, logical means to gain knowledge while Postmodernism denied the application of logical thinking. Rather, the thinking during the postmodern era was based on unscientific, irrational thought process, as a reaction to Modernism. A hierarchical, organized and determinate nature of knowledge characterized

Modernism. But Postmodernism was based on an anarchical, non-totalized and indeterminate state of knowledge. Modernist approach was objective, theoretical and analytical while the postmodernism approach was based on subjectivity. It lacked the analytical nature and thoughts were rhetorical and completely based on belief. The fundamental difference between Modernism and Postmodernism is that modernist thinking is about the search of an abstract truth of life while postmodernist thinkers believe that there is no universal truth, abstract or otherwise. [1]

During the modernist era, art and literary works were considered as unique creations of the artists. People were serious about the purpose of producing art and literary works. Most of the works were inspired especially from the cruel reality of war and therefore they were believed to bear a deep meaning, a number of novels and books produced in those times predominating over society.

Modernist writing, however, takes the reader into a world of unfamiliarity, a deep introspection, a cognitive thought-provoking experience, scepticism of religion, and openness to culture, technology, and innovation. In his writings, Peter Childs showed concern with the theoretical and philosophically intrigues of modernist literature and how it consists of the belief in time as cyclical and not chronological, the belief in free will, the cognitive exploration of the subconscious, and the questioning of the universe with and without a God. [2] This belief in a cyclical time also brings about free will and a cognitive exploration of the subconscious because the reader can climb inside the mind, away from the body and feel free to explore the inner working of one's mind and one's subconscious.

Critics' reinscription of the First World War presents the ideological implications the earlier war literature necessarily carries. Although presumably driven by formal rather than ideological motivations, Findley's formal strategies disrupt the assumptions on which First World War writers based their texts. Being a highly self-conscious writer, Findley could no longer use the earlier narrative strategies without also questioning them. He does so primarily by foregrounding the *mediated* status of literary texts which his precursors tried hard to conceal or naturalize. Instead of insisting on the referential axis of description, he draws attention to the mediating presence of an interpreter and to (inter)textual interference in the process of representation. [3]

This self-conscious contestation of literature as a transparent window onto the world is reinforced by the treatment of the photograph as a documentary source. Findley confirms the instability of language which disrupts the totalizing gesture of both the documentary writers (a transparently selfpresent reality) and of modernist writers like Hemingway (a transcendentally unified higher order). [4]

Ernest Hemingway's *A Farewell to Arms* was considered a semi-autobiographical novel first published in 1929. Much of the novel was written at the home of Hemingway's in-laws in Piggott, Arkansas. Considered by some critics to be the greatest war novel of all time, the novel is told through the point of view of Lieutenant Frederic Henry, an American serving as an ambulance driver in the Italian army during World War I.

Hemingway's tendency of using heroes in *A Farewell to Arms* is done in some unheroic ways. At first the hero may seem obvious, but later on it is discovered that the true hero is not who he seems to be. Hemingway uses the true hero to guide the main character into becoming a hero, but fails miserably. Hemingway characterizes his heroes as people with strength, courage, and bravery, but even heroes have their flaws. [5]

Hemingway demonstrates that although one of Frederic's men dies, he is still courageous in that his escape was successful. Frederic Henry's potential as a hero is shown by Hemingway's illustration of events that depict Frederic's use of his strength and courage. [6]

Frequently throughout Hemingway's use of heroes there are two behaviors or types of heroes that he uses, these are the "Hemingway Hero" and the "Code Hero". The Hemingway hero is usually a masculine man who drinks, loves hunts and bullfights, and has war

injuries. He is also almost always defeated physically, but never looses because his victories are moral ones [7]. One critic says, "Hemingway's heroes are in a sense, winners who take nothing, they are winners and the manner of their taking is individually self generated." [8]

The code hero is the character that shows the Hemingway hero how to conduct himself; this person is very different from the Hemingway hero and makes up for what the Hemingway hero is lacking. [9] Although the author's use of Frederic Henry seems heroic at first, he later makes him out to be more of an anti-hero than an actual hero.

Deep into the novel *A Farewell to Arms*, Frederic points out that he, is in fact, not the hero. [10] In his narration, Frederic states, "The world kills the very good and the very gentle and the very brave impartially. If you are none of these than it will kill you too but there will be no special hurry." He identifies himself as one that the world is not in a hurry to kill, and therefore, not as one of the very good, the very gentle, or the very brave. He is not, then, one of the heroes. [11] Even though he has some characteristics of the traditional hero, several of his most important actions (or inactions) lead us to conclude that he might be better designated as an anti-hero, a protagonist who significantly lacks key heroic qualities.

The madness and absurdity that accompany war are present in both Hemingway's *A Farewell to Arms* and Joseph Heller's *Catch-22*. The similarities are often striking and echoes *of A Farewell to Arms* are occasionally found, intentional or not, in *Catch-22*.

In *A Farewell to Arms* many of the pragmatic Italians argue that nothing is worse than war. Passini, one of the drivers, comments upon the subject of the war: "When people realize how bad it is, they cannot do anything to stop it because they go crazy".[12]

Heller's *Catch-22* was considered a hilarious and moving novel set in Italy during the Second World War and the phrase 'catch-22' has entered American English, used to describe an absurd and no-win situation. *Catch-22* is a brilliant satirical critique of a number of modern social phenomena. It is generally referred to as an antiwar novel, but Heller's criticisms extend beyond the absurdity of war to capitalism itself and the social relations that arise from it. Nonetheless, *Catch-22* stands as a strong protest against the conditions of modern society.

The novel focuses on a bombardier named Yossarian who, after flying 60-some bombing missions, is sick of the war and afraid of death, and desperately wants to go home. There is a set number of missions required before discharge, but every time Yossarian comes close to completing his duty, the number is raised, and he has to fly again. Within this context, Heller creates a number of memorable characters – from the petty and vain officers, whose only aim is to advance through the ranks, to Yossarian's roommate Orr, who crashes every time he goes on a bombing run to practice for his planned escape to Sweden. [13]

Yossarian himself seems to embody in many ways Heller's political outlook. Yossarian wants to get out of the absurd situation in which he finds himself, but he can't. He is trapped in the war – and in modern society in general – by 'catch-22', which in the narrow sense, it is the "catch" that keeps Yossarian and the others in the war. More broadly, catch-22 is a metaphor for the ordinary person caught up in the madness of war or modern social life in general. Yossarian cannot go home because the people who run the war won't let him, and it makes no difference what justification they might give for making him stay. [14]

Catch-22 stands as a symbol for relations of power, relations that exist even if they are nowhere put down in writing, and it is these relations that are responsible for the misery and senseless death of millions and millions of people. In the end, when faced with the choice of both ceasing his protest and accepting the way things are, or else going to prison, Yossarian chooses to run away. And this seems to be done for the simple reason that as a single individual there is nothing else for him to do to protest against catch-22. He feels helpless and powerless to do anything to change things for the better.

Another novel inspired from the cruelty of war, but this time World War II, is Kurt Vonnegut's *Slaughterhouse Five*, considered by critics a novel written in troubled times about troubled times. As the novel was being finished in 1968, America saw the assassinations of Martin Luther King, Jr. and Robert Kennedy.

The United States was involved in a costly and unpopular war in Vietnam. 1968 saw the psychologically devastating Tet Offensive, in which the Viet Cong launched a massive offensive against American and South Vietnamese positions all throughout South Vietnam. Although the Viet Cong took heavy casualties, the offensive was the true turning point of the war. To the South Vietnamese people, the offensive proved that the Americans could not protect them. To the American people, the offensive showed that the war in Vietnam would be far more costly than the politicians in Washington had promised. The country that had defeated the Axis powers just over two decades ago was now involved in a morally dubious and costly war in a Third World country.

In the U.S. opposition to the war grew, but in Vietnam the killing continued. The Americans would eventually suffer fifty thousand dead, but the Vietnamese would pay a much heavier price. Millions of Vietnamese died, many of them from heavy bombing. The U.S. dropped more explosive power onto Vietnam than all of the world's powers had dropped in all of World War II put together, including the two atomic bombs and the bombing of Dresden and Tokyo. Vonnegut's novel about the bombing of Dresden was written while American policy makers and pilots were implementing one of the most brutal bombing campaigns in history.

Vonnegut's despair of being able to stop the war (he likens being anti-war to being anti-glacier, meaning that wars, like glaciers, will always be a fact of life) gives *Slaughterhouse Five* the anti-war novel 'air'. Vonnegut's own war experiences turned him into a pacifist. Like his protagonist, Vonnegut was present at Dresden as a POW when American bombers wiped the city off the face of the earth. The bombing, which took place on February 13, 1945, was the most terrible massacre in European history. Therefore, the novel seems disjointed and unconventional. Its structure reflects this important idea: there is nothing you can say to adequately explain a massacre. Part of Vonnegut's project was to write an antidote to the war narratives that made war look like an adventure worth having. [15]

Billy Pilgrim, the main character of the novel, actually seen as a rather unconventional protagonist for a war novel, is weak, passive, and often ridiculous. He is totally unsuited for war, and he nearly dies wandering behind German lines during the Battle of the Bulge. He is also a prisoner of war in Dresden during World War II, and his later life is greatly influenced by what he saw during the war. After the war, he becomes an optometrist, marries a rich girl, and comes to believe that he has been abducted by aliens called Trafalmadorians. He is "unstuck in time," meaning that he experiences the events of his life out of order again and again.

Vonnegut's writings elsewhere intend to satirize the idea of fatalism. However, in the main body of the book, the belief that war is inevitable is clearly represented. Their hapless destruction of the universe suggests that Vonnegut does not sympathize with their philosophy. To humans, Vonnegut seems to say, ignoring a war is not an acceptable choice when we actually do have free will. Illogicality of human nature is brought up with the climax of the book. Ironically the climax occurs not with the bombing of Dresden, but with the execution of a man who committed a petty theft. In all of this horror, death, and destruction, so much time is taken on the punishment of one man. [16]

In Vonnegut's view, war is not heroic or glamorous. It is messy, often disgusting, and it robs men of their dignity. The problem of dignity comes up again and again in the novel, as we see how easily human dignity can be denied by others. But Vonnegut also questions some conceptions of dignity; he sees that they have a place in creating conventional war narratives that make war look heroic.

As a representative postmodern text, the novel is metafictional. The first chapter of the book is not about Billy Pilgrim, but a preface

about how Vonnegut came to write *Slaughterhouse-Five*. Vonnegut apologizes for the fact that the novel is "so short and jumbled and jangled" and explains that this is because "there is nothing intelligent to say about a massacre." In a similar way to *Mother Night*, but much more extensively, Vonnegut plays with ideas of fiction and reality. [17]

One can also argue, however, that Billy Pilgrim, the main character, lacks sight completely. He goes to war, witnesses horrific events, and becomes mentally unstable as a result. He has a shaky grip on reality and at random moments of experiences overpowering flashbacks to other parts of his life. His sense that aliens have captured him and kept him in a zoo before sending him back to Earth may be the product of an overactive imagination. Given all that Billy has been through, it is logical to believe that he has gone insane, and it makes sense to interpret these bizarre alien encounters as hallucinatory incidents triggered by mundane events that somehow create an association with past traumas. Looking at Billy this way, we can see him as someone who has lost true sight and lives in a cloud of hallucinations and self-doubt. Such a view creates the irony that one employed to correct the myopic view of others is actually himself quite blind.

Kurt Vonnegut's *Mother Night* is a novel first published in 1961. The title of the book is taken from Goethe's *Faust*. It is the story of Howard W. Campbell Jr., an American, who moved to Germany directly after World War I and then later became alternately a well-known German language playwright and a Nazi propagandist. The action of the novel is narrated (through the use of metafiction) by Campbell himself. The premise is that he is writing his memoirs while awaiting trial for war crimes in an Israeli prison. Howard W. Campbell also appears briefly in Vonnegut's later novel *Slaughterhouse-Five*.

Throughout the novel Vonnegut uses metafiction devices to blur the line between pretence and reality and one of the most interesting things about *Mother Night* is the way the book reflects both the World War II era and the author's personal reflections and opinions.

Mother Night's historical content includes the usage of characters that actually once existed and events that actually took place during the war. Vonnegut's personal reflections are exhibited through his satiristic view of life and his use of sarcasm in the novel. Vonnegut expresses himself primarily through satire. As pointed out by literary critic Clark Mayo about his writing, "Vonnegut continues to satirize science, religion, politics, sex, man's understanding, nationalism, and love". Vonnegut has a lot to say about the world; and this verifies true in *Mother Night*. [18]

Vonnegut wishes to stress one specific point in his novel. In the introduction of *Mother Night* Vonnegut writes, "We are what we pretend to be, so we must be careful about what we pretend to be". [19] Vonnegut introduces this as the moral of his book. This novel was most likely Vonnegut's outlet to comment on war. This, however, is not a typical anti-war novel. Vonnegut's unique style allows the reader to learn historical information from World War II and see inside the mind of the author at the same time.

Norman Mailer's *The Naked and the Dead*, the American novel since the Second World War, is a fiction that moulded itself to post-atomic ideas and responses and reached out to become something new. It is more than a body of work in chronological sequence. This is an era of American Modernism characterized by abstract expression in all the art form. In all its diversity, post-war novel has striven to defamiliarise the familiar, to make the reader reinvent the world. [20]

Norman Mailer was the American heronovelist who saves the meaning of America by seeing through the evil of technology, corporate and military power. In his novels he challenges those who would turn her into a "dowager" and exploits the moral psychology which challenges the Americans. Mailer explores the conflict between the individual will and established power in *The Naked and the Dead*, which focuses on a fourteen men infantry platoon that leads the invasions of a Japanese held island in the Philippines during World War II.

In *The Naked and the Dead*, war is the most schematic, allegorical of human activities. This is strikingly borne out in the ranks assigned to the three men who most explicitly define the spiritual metaphysical limits of the novel's vision. Cummings, the general is in absolute control of the invasion of Anopopei, and therefore in control of the lives of everyone else in the book. He is the first and perhaps the most disturbing of those self conscious, naturally intelligent, horrifyingly soulless capitalists and controllers who are the permanent features of the Mailer landscape. Cummings is an evil man, and his evil consists, more than in anything else, in the dance of power and death, all the while knowing it to be a crime against the very sources of the human spirit. [21]

However, Mailer's novel, even though seemingly anti-war is not free from warist ideological baggage when it comes to imagery, metaphor or representations of conflict or gender roles. This is reminiscent of a similar blend in Hemingway's novel, and the connection is not irrelevant, as Mailer was one enthusiastic disciple of the great Modernist master.

The personal contribution of each producer of discourse, modernist or postmodernist, represents the comprehensive reality of culture and life, reflecting in this way current developments and influencing the future authors.

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THE 'AUTHOR' ACORDING TO BARTHES AND FOUCAULT

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***Abstract**: One of the most controversial concepts in (post)modern literary theory, the idea of 'death of the author' has been continuously debated ever since Barthes came up with the term at the end of the 60s. Foucault's related concept of 'author function' is acknowledged to be a lot better clarified, yet, it has hardly managed to put an end to the various misconceptions related to the issue. This paper engages the source of the matter, that is, the two original texts, and tries to place them within the theoretical paradigm that provided the framework for their appearance.*

***Key words**: death of the author, scriptor, author function, discourse.*

1. INTRODUCTION

The debate on authorship generated by the two essays that became known to the public at the end of the late 60's (*The Death of the Author* by Roland Barthes in 1967 and *What is an Author?* by Michel Foucault in 1969) has proven to be an issue at the crux of postmodern literary theory. Especially Barthes', with a provocative title and it's publication coinciding with the student revolts, had the impact of a manifesto (Burke,11-12; Bennett, 11,14). Indeed, since the questioning of the author, hence, the existence of a central subjectivity that conveys meaning, so much characterizes poststructuralism, *The Death of the Author* has become more or less analogous with this trend of theory, meant 'to stand for the whole iconoclastic project of poststructuralism'. As Andrew Bennett points out: *„'Poststructuralism', which involves, in this context, a radical scepticism towards the integrity of a subject's thoughts, meanings and intentions, or of a subject's ownership of those thoughts, meanings and intentions, was often interpreted as an assertion of 'the death of the author'. And the weaknesses of Barthes's essay, including its tendency towards unfounded generalizations, its neglect of academic or scholarly precision, and its wayward way with literary history, were often seen as the weaknesses of the project of poststructuralism itself"(* Bennett, 10).

Yet, the existence of these essays is a logical consequence of their immediate predecessors in literary theory (New Criticism – the concept of intentional fallacy or Russian Formalism – the bakhtinian concept of poliphony of the novel) and the context of their appearance: high structuralism turning on poststructuralism that claim the primacy of a system (Browitt, 95 – 106).

2. ROLAND BARTHES: DEATH OF THE AUTHOR

Barthes' argument unfolds from an example of the conventional 'omniscient narrator' in a text by Balzac after which – answering the question "Who is speaking thus?" – he states his hypothesis: *"Writing is the destruction of every voice, of every point of origin. Writing is that neutral, composite, oblique space where our subject slips away, the negative where all identity is lost, starting with the very identity of the body writing"* (1466).

The moment when the 'author enters his own death' and 'writing begins' is that of language taking over and asserting itself over the 'voice' of the author as point of origin, his intentions or his life experience. Van Gogh's work isn't about his own madness, Tchaikovsky's isn't about his own vice. Instead, Barthes proposes 'body writing', a kind of textual no man's land (like the negative support of a picture) that has infinite potential for meaning because of the very absence, emptiness that characterizes it.

As Bennett suggests, the radical concept of 'death' heralded by Barthes has on one hand a practical explanation:*„One of the fundamental*

differences between speech and writing is that, unlike speech,writing remains, that it lasts after the person that writes has departed. " (Bennett, 10). Written text, regardless of the writer's intention or of its characteristics becomes autonoumous of its originator, it 'develops a life of its own'; while speaking can only 'survive' in the space and time in which the one producing the utterance exists.

Barthes seeks to present 'the death of the author' as an event of much greater significance prepared by some avant-garde predecessors like Paul Valery or Mallarmé as a response to the authorial importance affirmed by the Enlightenment. In the traditional way of reading, the text was a 'line of words releasing a single 'theological' meaning: the message of the Author-God (1468). The task of the critic was to find the Author in the text, to *decipher* it and assign a 'secret' to the text. By creating the analogy of Author/God, Barthes doesn't only underline the textual function of '*omniscience and omnipotence over the text's meanings'* (Bennett, 15), but renders historical dimension to it. The denial of the Author's significance equals an 'anti-theological activity'. It is '*an activity that is truly revolutionary since to refuse to fix meaning is, in the end, to refuse God and his hypostases – reason science, law'* (1469). As Sean Burke states: "*The death of the author might be said to fulfil much the same function in our day as did the the death of God for late nineteenth-century thought. Both deaths attest to a departure of belief in authority, presence, intention, omniscience and creativity. For a culture which thinks itself to have come too late for the Gods or for their extermination, the figures of the author and the human subject are said to fill the theological void, to take up the role of ensuring meaning in the absence of metaphysical certainties. The author has thus become the object of a residual antitheology, as though the Satan of Paradise Lost had suddenly redirected his rebellion against the unsuspecting figure of Milton himself."(13)*

It is not necessarily the content of the message itself that triggers Barthes' 'textual revolution'. After all it states the obvious within a theoretical trend that favors system/language as opposed to individual/author in a radical denial of the still existing liberal humanism. What is different in *Death of the Author* from any other language-centered comment related to authorship is the tone of voice, the self assumed significance with which

the announcement is made.

The term of the 'scriptor' is introduced by Barthes as an agent of language, a kind of vessel that conveys 'writing', the medium through which language is manifested. He gives several examples that may illustrate this 'function': that of the 'mediator, shaman or relator' in 'ethnographic societies'(1466), the person 'in charge of' narrating stories already known by the community, who can be admired for 'the mastery of the narrative code', the savvy way with which he uses words, but not for his 'genius', not for his creative power. His characteristic is 'impersonality' in which it is the language that performs and not me, the author. So, the scriptor is an individual whose role Barthes links to that of the performative function in linguistics, a function in which the utterance equals that of an action. As such, the scriptor represents the constant present of the text. There is nobody who 'nourishes' the book who conveys his/her own experiences in it, thus performing an operation of 'recording, notation, representation, 'depiction''. 'The modern scriptor is born simultaneously with the text' and exists in it. It is the creation of language and not vice versa.

The text resulting is 'a field without origin' 'a tissue of signs', framed and created by nothing else than language, since the most a scriptor can do is turn to a 'ready-made dictionary' (like the shaman telling ancient tales), that has 'no halt'. Such a text is to be '*disentangled*', 'the structure can be 'followed, 'run' (like the thread of a stocking, Barthes says)' in its multiplicity of meanings, liberated by the removal of the Author (the ultimate keeper of the 'secret' of meaning). It is a web of meanings intertwined, just *writing*, not literature, an intertext with no origins and no boundaries.

Yet, Barthes cannot avoid stating the necessity of a cohesive element in the text which he finds 'not in its origin but in its destination'. The reader represents a one-time, transitory center to a text. He is '*without history, biography, psychology; he is simply that someone who holds together in a single field all the traces by which the written text is constituted'* (1469). Such a shift is the prerequisite of the multiplicity of meanings in a text that Barthes is arguing for.

3. MICHAEL FOUCAULT: WHAT IS AN AUTHOR?

Foucault's essay followed Barthes' and it was undoubtedly influenced by it. In the words of Andrew Bennett: "*Barthes's essay may be said to be Foucault's unstated premise, his silent*

progenitor and antagonist, his 'intertext'" (20). Indeed, at the beginning of *What is an Author?* Foucault admits the omission of taking for granted the names of some authors in his comments on discoursive units like 'natural history' or 'political economy' in *The Order of Things* and states the 'wish to propose a necessary criticism and reevaluation'(1622). Yet, while *The Death of the Author* has a rather sweeping effect with its radical affirmations, Foucault's essay is '*more carefully argued and more historically decisive'* (Bennett. 20).

In his approach to the question of authorship Foucault employs the same method as for other issues discussed by him (prison, madness, sexuality). His basic concept is *discourse,* "*something which produces something else, (an utterance, a concept, an effect), rather than something which exists in and of itself and which can be analyzed in isolation*."(Mills, 17*).* Under such circumstances, 'the material with which one is dealing is, in its raw, neutral state, a population of events in the space of discourse in general' and the one carrying out such an analysis deals with '*pure description of discursive events'.* Nothing exists beyond discourse and the question to be asked is: '*how is it that one particular statement appeared rather than another?*' *(Foucault: 2004,92).*

The focus of such an investigation should be a diachronic one, very much related to the method of 'digging deeper' into the layers of the history of thought just like in archeology, in the course of which the artificial quality, the constructedness of a particular concept is revealed. In such a system the subject itself, the alleged source of knowledge is, in fact, an effect of discourse. According to this principle, Foucault identifies the appearance of the author as a '*privileged moment of individualization'* and calls it the '*author - function'*. His concern in this essay is '*the singular relationship that holds between an author and a text, the manner in which a text apparently points to this figure who is outside and precedes it'* (1623). As opposed to Barthes, who draws the conclusion that nobody is speaking in a text, Foucault's question is directed towards the importance attributed to 'ownership' of a particular text.

The alleged disappearance of the author in modern writing has had two reasons, Foucault argues. One of them stands in the peculiar nature of writing itself of constantly revealing and, at the same time, concealing its way of being an artifact, of pointing towards signifieds that seem to exist outside the text, yet, establishing an immanence that cancels this possible connection: "*The writing of our day has freed itself from the necessity of "expression"; it only refers to itself, yet it is not restricted to the confines of interiority. On the contrary, we recognize it in its exterior deployment*"(1623).

Such a text – typical of modernist writing - is not 'concerned' with 'the exalted emotions related to the composition or the insertion of a subject into language'. Rather, it constantly creates 'an *opening where the writing subject endlessly disappears'*. Related to this is the connection between writing and death. Whereas earlier narratives were meant to assure the immortality of a hero, existence beyond regular lifespan, in modern texts 'the link between writing and death is manifested in the total effacement of the individual characteristics of the writer'. The existence of a writer in a modern text occurs through the 'singularity of his absence' from it (1624). Andrew Bennett illustrates this paradox of the modern writer's relation to the text by the famous example of Joyce's Stephen Daedalus, the modern artist, who, "'remains within or behind or beyond or above his handiwork, invisible, refined out of existence, indifferent, paring his fingernails' (Joyce 2000:180–1)"(21).

Foucault realizes that it is hardly enough to state:" *The author has disappeared. God and man died a common death. […] we should reexamine the empty space left by the author's disappearance; we should attentively observe, along its gaps and its fault lines, its new demarcations, and the reapportionment of this void; we should await the fluid functions released by this disappearance"(1626).*

The name of the author is a means of classification (we can separate the work of one author from that of another), but, more that this, it is some sort of a trade mark, some sort of indicator that allows us to classify it into a certain kind of discourse category and gives us a clue to its reception. We don't read a 'poet' the same way we read a 'philosophical author' and the perception of an 18th century author is different from that of a contemporary one. Furthermore, the presence of an author rendered to that text or work provides it a certain 'unity' that explains the possible contradictions within the text(s). It represents a cohesive principle that makes it possible for us to understand, to attribute meaning to it (1629). Some of Foucault's understanding of the author's presence in the text is very much similar to Wayne Booth's concept of 'implied author' (also formulated in the 60s): "*It is well known that, in a*

novel narrated in the first person, neither the first person pronoun, the present indicative tense, nor [...] its sign of localization refer directly to the writer [...] rather, they stand for a "second self" whose similarity to the author is never fixed and undergoes considerable alteration within the course of a single book. It would be as false to seek the author in relation to the actual writer as to the fictional narrator; the 'author function' arises out of their scission – in the division and distance of the two."(1631).

As opposed to Barthes, Foucault doesn't approach the question of authorship with the intention of proving the author's absence from it, rather, his analysis aims at locating the position of the – constructed – subject within a text, the positions and function that discourse allows to it. In fact, neither Barthes nor Foucault deny the necessity of some sort of cohesive principle within a text; rather than that, their undertaking is aimed at transferring the nucleus of text/literature analysis from the authorial figure to either the periphery of the concerns of analysis (the reader) or to a more complex set of relations (discourse), undertaking which reflects the theoretical tendency of their age.

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THE CAREER PROFILE OF THE MILITARY STUDENTS

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***Abstract**: The career profile of the military students was determined by a set of values, packed in the Super's Work Value Inventory (WVI). The sample of this study includes 1.020 military students in the branch academies: Air Force, Navy and Land Forces Academy. The study proves that it is possible to build a professional profile based on a set of values, which contains:"way of life", "surroundings", and "supervisory relationships". Values such as "management", "associates", and "variety" are not appreciated as they should. The study confirms Moskos' hypothesis of postmodern armed forces and offers the perspective of understanding the army as a job (cost-benefit relation), to the detriment of the institutional dimension. Moreover, our investigation underlines some aspects of a similar study realized in 1994 by Septimiu Chelcea on a sample of 602 students.*

***Key words**: Work Value Inventory, military students, career profile.*

1. INTRODUCTION. WVI INSTRUMENT

The career profile of the military student may be outlined by investigating values, interests and attitudes. In order to emphasize these aspects we used the Work Value Inventory (WVI) (Donald E. Super), adapted to Romania's population by Septimiu Chelcea. By using this instrument, we attempted not only to underline the axiological essence, the *potential values* of the military students, but mainly the *expressed values*, taking those verbal and action behaviors explicitly stated, as a differentiating element from the axiological structure highlighted by previous studies [1]. The enumerated values may have a more or less conspicuous character, that is, some of them are in agreement with the military environment, whereas, others are not and remain in their intentional stage, with a reduced probability of ever becoming manifest.

The WVI is useful for establishing the nearness of subjects to certain aspects of the particular activity. It highlights 15 career values [2], as follows:

- altruism, A (items 2, 30 and 31), representing the possibility of contributing to the others' welfare and indicating inclination towards social services, respectively, towards social aspects aimed at by the military career;
- aesthetic values, Av (items 7, 20, 45), regarding the aesthetic dimension, dissonant with the rigid military environment, which does not constitute a favorable setting for art products;
- intellectual stimulation, Is (items 1, 23 and 38), associated with those professions/ professional aspects that favor the autonomous reflections and permanent learning, dissonant with the military environment, to a great extent (excepting the narrow sector of education and scientific research);
- professional achievement, Pa (items 13, 17, 44), which offers the satisfaction of the work well done, involving the orientation towards activities that have with tangible results in the end, consonant with the military environment, where visible results are a permanent indicator of the level of training (in military activities, firings etc.);
- independence, I (items 5, 21, 40), a dissonant value with the military environment, and which presupposes individual planning

and a self-pace for the development of activities. Value I is, in general, positively illustrated only with liberal professions, the tendency at the level of desirability being to reduce the level of this indicator of the WVI;

- prestige, P (items 6, 28, 33), value associated with professions or professional activities implying respect, consonant with the military environment and desirable, to a great extent;

- management, M (items 14, 24, 37), including professional aspects that aim at the planning, organizing, training, controlling and assessing the others' work. The value is highly consonant with the military environment, although not in its whole, but, especially with officers. Not all branches seek to promote this value at high level (a counter-example: the air force), yet, its positive illustration may constitute an indicator of the orientation of military students towards future careers in command and staff structures;

- economic return, Er (items 3, 22, 39), which implies the orientation towards a satisfying payment and which, although it may not be directly associated with a specific social organization or professional aspects, can be a reference element in reducing certain economic instabilities (under the market economy conditions). Naturally, the result for this indicator is expected to be high, yet, it is not necessarily relevant for the outline of the profile, it rather holds an important role in checking and validating the correct administration of the research instrument;

- professional security, S (items 9, 19, 42), with reference to the certainty related to the preservation of the workplace and which represents one of the key indicators in selecting the career/military career. The dimension is influenced, just like the previous one, by the economic- financial crisis to which the Romanian society is exposed, but there is the possibility of a not very favorable featuring mainly due to the characteristics of the military environment, which, implicitly ensures a high level of security/professional stability;

- physical surroundings, Ps (items 12, 25, 36), in connection with the satisfactory work conditions, without implying consonance with the military environment that is imagologically associated with hard working conditions;

- supervisory relationships, Sr (items 11, 18, 43), in consonance with the military environment and implying professional activities directed by impartial chiefs, with whom fair relationships, of mutual respect, are possible to achieve;

- associates, As (items 8, 27, 34), illustrating the positive social relationships within collectivities/ work groups, consonant with the military environment that is imagologically characterized by esprit de corps and comradery;

- way of life, Wol (items 10, 26, 35), related to labor valorization that allows one to organize his/her life as he/she likes it. The value is consonant, although not very strongly, with the military environment that is restrictive from certain perspectives (accomplishment of permanent active-duty, operational shift, missions etc.). It can be associated with those activities involving an eight-hour schedule/ five days per week, which is, largely the case of the military system;

- variety, V (items 4, 29, 32), related to professions/ professional aspects allowing the accomplishment of diversified operations and consonant with the military environment, presupposing a limitation of the area of diversification of connected activities and action modes;

- creativity, C (items 15, 16, 45), associated with those professional aspects allowing for the production of new ideas/products and which is situated on a dissonant position in relation with the military environment.

2. SAMPLE

The questionnaire, administered to 1,020 military students, valid for 998 individuals, is representative at the level of the investigated category and holds a significant value related to the level of future officers. The sample has the following structure:

Gender:

male (M):	795 subjects - 79,66%
female (F):	189 subjects - 18,94%

non-answer (NA): 14 subjects - 1,40%

Branches:

air force (AF): 163 subjects - 16,33%%
navy (N): 152 subjects - 15,23%
land forces (LF): 668 subjects - 66,93%
non-answer (NA): 15 subjects - 1,50%

Year of study:

4th year (IV): 18 subjects - 1,80%
3rd year (III): 328 subjects - 32,87%
2nd year (II): 273 subjects - 27,35%
1st year (I): 341 subjects - 34,17%
non-answer (NA): 38 subjects - 3,81%

We can observe a relatively high percentage of non-answers (especially with regard to the year of study) generated by a fear of repercussions as a result of a sincere filling out of the questionnaire. The percentages of non-answers allow, though, for an account of values related to the structural categories of the sample, especially due to the fact that the study is exhaustive. The standardization of the questionnaire is not necessary because Chelcea has already established the WVI standard [3]. The precise positioning of results by means of medians, for each of the professional values, in turn, is sufficient:

Table no.1 Medians of the results for each professional category

category	A	Av	Is	Pa	I	P	M	Er	S	Ps	Sr	As	Wol	V	C
general	12	10	12	12	12	12	11	12	12	13	13	11	14	11	12
F	12	10	12	13	11	12	10	12	12	13	13	11	14	11	12
M	12	10	11	12	12	12	11	12	12	13	13	11	14	11	12
AF	12	10	12	12	11	12	10	12	12	13	13	11	14	11	12
N	12	11	12	13	12	13	12	13	13	14	14	11	14	11	12
LF	12	10	11	12	12	12	11	12	12	13	13	10	14	10	12
IV	12	10	12	13	13	13	12	13	13	14	14	11	14	11	12
III	12	10	12	13	12	12	11	12	12	13	13	11	14	11	12
II	12	9	11	12	12	12	11	13	12	13	13	11	14	10	12
I	12	10	12	12	12	12	11	12	12	13	13	11	14	10	12

3. RESULTS

The "way of life" occupies the first place in the hierarchy of professional values from the total of military students of the branch academies, with an average of 13.41, followed by the "physical surrounding", with an average of 12.92, and "supervisory relationships", with an average of 12.87. The opposite end is occupied by the "aesthetic values", averaging 9.81, "variety", averaging 10.25 and "associates", averaging 10.26. Holistically, the results are as follows:

Table no.2 Ranking of professional categories

rank	professional values	scores
I	Way of life (Wol)	13.40
II	Surroundings (Ps)	12.92
III	Supervisory relationships (Sr)	12.87
IV	Achievement (Pa)	12.21
V	Economic return (Er)	12.14
VI	Prestige (P)	12.09
VII	Altruism (A)	11.92
VIII	Security (S)	11.72
IX	Creativity (C)	11.71
X	Independence (I)	11.55
XI	Intellectual stimulation (Is)	11.31
XII	Management (M)	11.15
XIII	Associates (As)	10.26
XIV	Variety (V)	10.25
XV	Aesthetic (Av)	9.81

Generally, there are not many insignificant differences, from a statistical point of view ($p>0.05$), the averages ranging between 13.40 and 9.81, on a scale of 3.59p. From a statistical point of view, the insignificant differences are:

"economic return" – "prestige"
"security " – "creativity"
"associates" – "variety".

The descriptive statistical values for the whole sample are, as follows:

Table no. 3 The descriptive statistical values

professional values	average	median	mode	dispersion	deviation
Altruism (A)	11.92	12.00	12.00	5.30	2.30
Aesthetic (Av)	9.81	10.00	9.00	5.75	2.40
Intellectual stimulation (Is)	11.31	12.00	11.00	3.58	1.89
Achievement (Pa)	12.21	12.00	12.00	3.57	1.89
Independence (I)	11.55	12.00	12.00	4.14	2.03
Prestige (P)	12.09	12.00	13.00	4.92	2.22
Management (M)	11.15	11.00	12.00	4.81	2.19
Economic return (Er)	12.14	12.00	12.00	4.35	2.09
Security (S)	11.72	12.00	13.00	5.08	2.25
Surroundings (Ps)	12.92	13.00	15.00	4.39	2.10
Supervisory relationships (Sr)	12.87	13.00	15.00	4.50	2.12
Associates (As)	10.26	11.00	11.00	2.33	1.53
Way of life (Wol)	13.40	14.00	15.00	4.26	2.06
Variety (V)	10.25	11.00	11.00	4.97	2.23
Creativity (C)	11.71	12.00	12.00	5.53	2.35

The cumulated percentages are the following:

Table no.4 Cumulated percentages

score	A	Av	Is	Pa	I	P	M	Er	S	Ps	Sr	As	Wol	V	C
15	15.36	2.22	3.75	9.73	7.85	12.46	4.95	15.02	10.41	28.16	25.09	1.19	41.13	3.24	14.16
14	25.09	5.12	9.56	24.40	18.09	28.16	12.12	30.55	26.11	46.25	47.27	2.22	57.85	6.66	21.50
13	39.25	14.16	27.30	47.78	34.30	46.42	24.23	47.44	46.08	66.21	66.89	6.14	73.89	15.02	34.47
12	65.53	26.62	50.68	71.16	55.80	63.99	44.20	68.26	62.29	81.40	81.91	15.19	89.59	32.76	62.63
11	78.16	41.64	74.74	86.01	72.70	79.18	61.26	83.11	76.96	91.98	90.10	52.90	94.37	51.88	74.23
10	87.20	57.68	85.84	92.66	86.35	88.57	76.62	91.47	86.52	95.39	94.71	75.43	96.42	65.19	84.47
9	93.52	75.94	93.00	95.90	93.17	93.52	87.37	95.56	91.64	97.27	96.76	91.47	96.76	80.20	92.83
8	95.90	85.67	96.42	97.95	97.27	95.73	93.69	97.10	95.56	97.27	97.27	96.59	97.27	91.30	94.71
7	96.76	90.44	98.12	98.63	97.61	97.61	96.93	97.61	97.61	97.61	97.61	98.12	97.61	95.39	96.42
6	98.29	95.22	98.98	98.98	99.49	98.46	98.29	98.98	98.63	98.12	97.95	99.32	97.78	97.95	98.29
5	98.63	97.78	99.49	99.66	100.00	99.49	99.49	99.66	99.32	98.63	98.81	99.49	98.98	98.81	98.81
4	99.15	99.49	99.83	99.66		99.66	100.00	100.00	99.66	99.49	99.32	100.00	99.49	99.32	99.32
3	100.00	100.00	100.00	100.00		100.00			100.00	100.00	100.00		100.00	100.00	100.00

Related to the categories of subjects, the results differ as shown below:

I. **according to gender:** the more significant differences occur in relation with the "management" value: 10.26F < 11.18 M. The male students also indicated higher values than the female students for the indicators: "prestige": 11.56 F < 12.16 M, "independence": 11.37F < 11.70 M, "economic return": 11.92F < 12.33M, "professional security": 11.73F < 11.96 M, whereas the female students valued "altruism": 12.09F > 11.88M, "aesthetic values": 10.17F > 9.87M, and "variety": 10.55F > 10.21M. In a table representation, the average results and the standard deviation for the professional values differentiated according to gender are:

Table no.5 Statistical values compared according to gender

professional values	students (M)		students (F)		observations			
	average	deviation	average	deviation	difference M-F	rank M	rank F	general rank
Altruism (A)	11.88	2.29	12.09	2.27	-0.21	VIII	V	VII
Aesthetic (Av)	9.87	2.45	10.17	2.18	-0.30	XV	XV	XV

Intellectual stimulation (Is)	11.35	1.94	11.51	1.88	-0.16	XI	X	XI
Achievement (Pa)	12.21	1.91	12.32	1.99	-0.11	V	IV	IV
Independence (I)	11.70	2.03	11.37	2.07	0.33	X	XI	X
Prestige (P)	12.16	2.22	11.56	2.31	0.60	VI	IX	VI
Management (M)	11.18	2.20	10.26	2.06	0.92	XII	XIV	XII
Economic return (Er)	12.33	2.06	11.92	2.19	0.41	IV	VI	V
Security (S)	11.96	2.26	11.73	2.42	0.23	VII	VIII	VIII
Surroundings (Ps)	12.99	2.07	12.98	2.38	0.01	III	II	II
Supervisory relationships (Sr)	13.03	2.17	12.95	2.40	0.08	II	III	III
Associates (A)	10.39	1.49	10.38	1.66	0.01	XIII	XIII	XIII
Way of life (Wol)	13.39	1.95	13.48	2.46	-0.09	I	I	I
Variety (V)	10.21	2.22	10.55	2.05	-0.34	XIV	XII	XIV
Creativity (C)	11.71	2.40	11.81	2.14	-0.10	IX	VII	IX

As for ranks, the major differences are in connection with the following indicators: "supervisory relationships", more appreciated by the male students (r.II) rather than by the female students (r.III), "prestige", weakly appreciated by the female students (r.IX), as compared to the general rank (r.VI), "altruism", valued by the female students (r.V) as compared to the average (r.VII) or to the students average (r.VIII), existing a certain appetence of the female military students for the sectors/ professional activities approaching the social services. The "security" is better valued by the male students (r.VII) than by the female students (r.VIII), "creativity" is appreciated mainly by the female students (r.VII), as compared to the male students and the average (r.IX), "independence" ranks higher for the male students (r.X), different from the female students (r.XI), "intellectual stimulation" means more to the female students (r. X) than to the male students (r. XI) and the average, and the "management", placed before the last position by the female students (r.XIV), different from the general rank and the male students' (r. XII). This last aspect (management) may be explained by the female military students' inclination towards some specific bureaucratic activities and not towards areas concerning the management and staff. Because of the same availability of employing a larger range of positions, the female students (r.XII) appreciated "variety" more highly than the male students or the general rank (r.XIV), the difference, measured in absolute values, being of 0.34 p in favor of the female students. The maximum difference in rank is three levels, both for the gender categories, and between the latter and the average.

II. **according to the military branch:** totally, there is a higher average in case of the students trained at the Naval Academy (N): 12.02, different from the students trained at the Air Force Academy: 11.61 and those trained for the Land Forces (LF): 11.60, these two categories being closer to the average: 11.69. Judging the professional values, there are some peaks: "management": the average for the Navy is 11.62, as compared to the average of 11.15, "security": the average for the Navy is 12.41, while the average adds to 11.72, "variety": the average for the Air Force is 10.63 and the average is 10.25. The minimal values are: "management": the average for the Air Force is 10.00 and the average is 11.15, whereas, for "security", the average for the Land Forces is 11.55 and the average is 11.72. the extremely low value of the indicator "management", within the Air Force, may be explained by the fact that, excepting the students trained for artillery and surface-to-air missiles (representing 27.60% of the total students trained by the Air Force), generally, this is the only branch for which a high positioning of value in the WVI is necessary.

Table no. 6 Comparative statistical values regarding affiliation to a branch

professional values	air force (AF)		navy (N)		land forces (LF)		observations						
	average	deviation	average	deviation	average	evia tion	difference AF-N	difference AF-LF	difference N-LF	rank AF	rank N	rank LF	gen. rank
Altruism (A)	11.72	2.28	12.09	2.18	11.93	2.31	-0.37	-0.21	0.16	VII	VIII	VII	VII
Aesthetic (Av)	9.85	2.50	10.32	2.39	9.72	2.32	-0.47	0.13	0.60	XV	XV	XV	XV
Intellectual stim. (Is)	11.46	1.84	11.60	1.83	11.16	1.92	-0.14	0.30	0.44	X	XII	XII	XI
Achievement (Pa)	12.13	2.15	12.43	1.79	12.12	1.78	-0.30	0.01	0.31	V	VI	IV	IV
Independence (I)	11.36	1.98	11.85	2.13	11.48	2.06	-0.49	-0.12	0.37	XI	X	X	X
Prestige (P)	11.56	2.19	12.45	1.93	12.09	2.32	-0.89	-0.53	0.36	VIII	V	V	VI
Management (M)	10.00	2.23	11.62	2.00	11.27	2.06	-1.62	-1.27	0.35	XIV	XI	XI	XII
Economic return (Er)	12.24	2.09	12.65	1.96	12.04	2.30	-0.41	0.20	0.61	IV	IV	VI	V
Security (S)	11.98	2.16	12.41	2.16	11.55	0.00	-0.43	0.43	0.86	VI	VII	VIII	VIII
Surroundings (Ps)	12.97	2.11	13.20	1.89	12.81	0.00	-0.23	0.16	0.39	II	II	II	II
Supervisory rel.(Sr)	12.90	2.22	13.15	1.97	12.78	0.00	-0.25	0.12	0.37	III	III	III	III
Associates (A)	10.42	1.44	10.60	1.46	10.16	0.00	-0.18	0.26	0.44	XIII	XIII	XIII	XIII
Way of life (Wol)	13.33	2.25	13.52	1.67	13.36	0.00	-0.19	-0.03	0.16	I	I	I	I
Variety (V)	10.63	2.20	10.52	2.18	10.08	0.00	0.11	0.55	0.44	XII	XIV	XIV	XIV
Creativity (C)	11.54	2.39	11.96	2.30	11.50	0.00	-0.42	0.04	0.46	IX	IX	IX	IX

In a table representation, the results average and the standard deviation for the professional values, differentiated according to the branches for which the military students are trained, are shown above.

Pointing out the differences from the average on ranks is important, given the fact that, generally, the Land Forces average is higher than the other two averages: the Air Force average and the Navy average. The following aspects are worth mentioning: the positioning of "economic return" on rank VI in case of the Land Forces, as compared to rank IV, in case of the Air Force and Navy, explicable due to the "passion" for the military career within this military branch; the two-rank dropping of the "achievement" in case of the Land Forces; the positioning on position VIII of the "prestige" within the Air Force (comparable with the general rank VI, respectively rank V, in the Navy and Land Forces hierarchies); rank VIII for "altruism" with the Navy while the general rank is VII; the increased demand for "security" within the Air Force (r. VI) – the general rank being VIII; the low rank (IX) of the value "independence" in the Air Force, as compared to the general rank X and compared to a better positioning (r. X) of the "intellectual stimulation" against a general rank XI.

It is also worth highlighting especially positions XIV, for the value "management" in the Air Force – the general rank XII (previously explained), respectively XIII, for the value "variety" within the Air Force – the general rank XIV. The maximum observed difference is of three levels between the average values of the students belonging to the branch academies, and two levels between their average and the general average. A differentiated profile from the other branches is that of the Air Force students, who meet specific career demands (pilots, air traffic controllers, radio operators etc.).

III. **according to the year of study**: totally, there is a higher value of the average for the students in their 4th year (12.23), as compared to the general average (11.69).

Table no.7 Comparative statistical values, according to the year of study

professional values	3rd year		2nd year		1st year		observations						
	average	deviation	average	deviation	average	deviation	difference III-II	difference III-I	difference II-I	rank III	rank II	rank I	gen. rank
Altruism (A)	11.77	2.40	11.95	2.13	12.26	2.37	-0.18	-0.49	-0.31	VIII	VI	V	VII
Aesthetic (Av)	10.02	2.37	9.59	2.38	10.03	2.50	0.43	-0.01	-0.44	XV	XV	XV	XV
Intellectual stim. (Is)	11.53	1.79	11.81	2.51	11.37	1.94	-0.28	0.16	0.44	XI	IX	X	XI
Achievement (Pa)	12.33	1.91	11.99	1.74	12.23	1.94	0.34	0.10	-0.24	IV	V	VI	IV
Independence (I)	11.64	1.95	11.88	2.11	11.34	2.04	-0.24	0.30	0.54	X	VII	XI	X
Prestige (P)	11.95	2.18	11.83	2.36	12.29	2.42	0.12	-0.34	-0.46	VI	VIII	IV	VI
Management (M)	10.97	2.27	11.04	2.25	10.92	2.14	-0.07	0.05	0.12	XII	XII	XII	XII
Economic return (Er)	12.17	2.07	12.50	2.21	12.09	2.08	-0.33	0.08	0.41	V	IV	VII	V
Security (S)	11.73	2.21	11.78	2.29	12.08	2.29	-0.05	-0.35	-0.30	IX	X	VIII	VIII
Surroundings (Ps)	12.95	2.04	12.99	2.07	12.93	2.19	-0.04	0.02	0.06	III	II	II	II
Supervisory rel.(Sr)	13.03	1.98	12.91	2.28	12.84	2.12	0.12	0.19	0.07	II	III	III	III
Associates (A)	10.36	1.55	10.27	1.67	10.40	1.42	0.09	-0.04	-0.13	XIV	XIV	XIII	XIII
Way of life (Wol)	13.38	2.01	13.39	2.15	13.40	2.11	-0.01	-0.02	-0.01	I	I	I	I
Variety (V)	10.50	2.25	10.30	2.12	10.29	2.31	0.20	0.21	0.01	XIII	XIII	XIV	XIV
Creativity (C)	11.78	2.25	11.64	2.24	11.63	2.46	0.14	0.15	0.01	VIII	XI	IX	IX

Eighteen students in the 4th year of study (and who identified themselves), all of them belonging to "Mircea cel Bătrân" Naval Academy, filled out the questionnaire. The following peaks are distinct regarding the averages on administered indicators: "altruism": the average (a) on the administered indicator is 12.26 as compared to the general average (g.a.) of 11.92; "aesthetic": aIV=10.17, compared to g.a=9.81; "intellectual stimulation": aIV=11.81, compared to g.a.=11.31, but especially the "economic return", with aIV=13.22, compared to g.a.=12.14; "security": aIV=12.83, and g.a.=11.72, and, finally, the "surroundings", with aIV=13.78, comparable with g.a.=12.92. Between the years of study I, II and III (represented in all the three academies), the differences were significant, the variation limits oscillating between 0.001 ("way of life": aIII=13.38, aII=13.39 and aI=13.40) and 0.49 ("altruism": aIII=11.77, aI=12.26). Under these circumstances and because the 4th year is weakly represented, 1.80% of the total respondents, we chose to present the score average and the standard deviation only for the years III, II and I.

With regard to the values ranking the "way of life" is rank II only for the 4th year, "supervisory relationships" is rank II for the 3rd year (compared to the general rank III), the "economic return" is more positively perceived by the 3rd year (r.V) as compared to the 1st year (r.VII), the "achievement" ranks differently to all the four years of study: the 3rd year: r.IV, the 2nd year: r.V, the 1st year: r.VI, the 4th year: r.VII. Except for the 4th year, which is not quite relevant to our study, there is an higher inclination towards duty, explicable by the experience gained throughout the years of study – an aspect highlighted by the indicator "altruism"- which proves a decreasing tendency once the experience is being gained: year I: r.V, year II: r.VI, year III: r. VIII, year IV: r.IX. Similarly, significant differences are recorded for the indicators "prestige": I – r.IV, Iv – r.V, III – r.VI, II – r. VIII; "security": IV – r.VI, I – r.VIII, III – r. IX, II – r.X, "creativity": III – r.VIII, IV – r.VIII, I – r.IX, II – r.XI, " independence": II – r.VII, IV – r.IX, III – r.X, I – r.XI. For the last ranks in the general perceptions, the rank differences are less significant: "intellectual stimulation": II – r.IX, I,IV – r.X, III – r.XI, "associates": I,IV – r.XIII, II, III – r.XIV, "variety": II, III – r.XIII, I,IV – r.XIV,, whereas for the "management" and "aesthetic" ranks, the values are identical.

The 4th year strikes as dissonant, from the numerical (averages) values perspective,

but its contribution to the final configuration is irrelevant. A higher degree of relevance is given to the qualitative assessment concerning the values obtained by the years I, II, and III. Besides the general tendency of passing from the inclination towards relations to the inclination towards duties, there is also a higher predisposition towards those values able to meet extrinsic motivations, especially with the terminal years of study, and, respectively, a better perception of the fundamental intrinsic values with the years before the terminal one. Distribution on ranks offers an image that is closer to reality than the analysis of the numerical distribution, where differences are not higher than 0.5 points between the years I, II and III of study. It is noticeable a continuous decrease of the values with an intrinsic motivation, anda moving away, in Charles Moskos's terms [4], from the army's values – perceived as vocation and job - and a coming closer to the army as a career. The structuring of answers on years of study is relevant and it offers clues with regard to the future nature of the military people – army relationships. The correlation value of ranks (Spearman value), positioned between 0.95 and 0.99 for the gender and year of study comparison reaches the minimal point only with the last correlations, where there is a maximal difference of six ranks between categories and a maximal difference of four ranks as compared to the general average rank.

Mention should be made that the first and last positions in the professional values hierarchy vary the least, which confirms the obtained profile.

4. QUALITATIVE ANALYSIS

The economic and social context of the last few years is reflected in the social investigation results and, implicitly, in the current investigation results, which indicates several manifest tendencies, starting with the first years following the Romanian Revolution of '89: the abandonment of collectivism in favor of individualism, abandonment of the inclination towards relationships, in favor of an inclination towards duty, the predominance of success-oriented actions, compared to understanding-oriented actions (Habermas) [5]. Students appear to value more the professional aspect regarding a favorable way of life and satisfying surroundings and they tend to appreciate aesthetic, variety or associates less. These aspects are clear indicators of their orientation towards a market economy, based on competition, to the detriment of cooperation. Individualism is not only a characteristic of incertitude of the Romanian economy, but also an indicator of alienation, of estrangement from culture, of an activation of contact elements with the reference points of the value systems within the western civilization (a preponderant abandonment present with the urban environment), an estrangement from the culture-related German model, in favor of the western model [6, 7]. Furthermore, students (born in the '90s) brought up in a competitive environment, value more the extrinsic motivational factors with regard to the professional dimension (the desired way of life, satisfying surroundings, financial independence, professional security, and achievement), and not necessarily the intrinsic motivational factors (professional self-achievement, excellence, vocation, intellectual stimulation, creativity, aesthetic, variety etc.). The values in the former category are represented as follows: "aesthetic":r.XV; "variety": r.XIV; "associates": r.XIII; "intellectual stimulation": r.XI; "management": r.XII, whereas the latter, of the intrinsic factors, is top-positioned: "way of life": r.I; "surroundings": r.II; "achievement": r.IV; "economic return": r.V; "security": r. VIII. The army loses its image of attractive institution to those people favoring the military life. Instead, it becomes a reference element relating to a suitable way of life (a nine-to-five/5- like schedule), proper conditions for performing professional tasks, stable payment (above the value of the market year average salary), visible outcomes: regular promotions, based not on value criteria but on minimal stage completion for a military rank, with the necessary "migration" to a position favoring the promotion. Furthermore, the security of employment (not necessarily regarding the position, but regarding the contract, which is

able to ensure stability and a secure employment), the substantial economic advantages at retirement and the possibility of early retirement (starting with the age of 38) etc. are other attractions of the military profession. The army does no longer stand for a long-term-career-oriented perspective, as an alternative, it turns into a fertile land for extrinsic characteristics, within an unstable society, from the economic and social perception. In addition, the results of our study confirm the results obtained by the investigations of the Military Psychology Department of the General Staff, based on which, the military personnel volunteering for international peace-keeping missions, irrelative of the operation-theatre have only financial motivations. The study also confirms, theoretically, Moskos's hypothesis and offers the perspective of understanding the army as a job (cost-benefit relation), to the detriment of the institutional dimension.

A set of similarities resulted from the analysis of our investigation, compared with the study performed by Septimiu Chelcea, in 1994, on a sample of 602 students, irrelevant, at the national scale, but holding an indicative value in the research area. The findings were:

- a tendency of positively valuing the extrinsic components, compared to the intrinsic ones, in motivating the inclination towards specific professional activities;
- the scores level and range of averages level;
- the ranks for certain professional values, especially the first two: "way of life" and "surroundings".

In a comparative table representation, we have the following differences:

Table no.8 Differences between ranks, compared to the model study

professional values	rank Lesenciuc study	rank Chelcea study
Altruism (A)	VII	IX
Aesthetic (Av)	XV	XIV
Intellectual stimulation (Is)	XI	VII
Achievement (Pa)	IV	V
Independence (I)	X	IV
Prestige (P)	VI	XII
Management (M)	XII	XV
Economic return (Er)	V	III
Security (S)	VIII	X
Surroundings (Ps)	II	II
Supervisory relationships (Sr)	III	VI
Associates (A)	XIII	XI
Way of life (Wol)	I	I
Variety (V)	XIV	XIII
Creativity (C)	IX	VIII

It is worth mentioning that between 1980 and 1981, a variant of the WVI was administered to a sample of 330 pupils in their final year of study, from Bucharest. The first positions, within this study, were hold, again, by the values "way of life" and "surroundings" [8], but an approach towards intrinsic professional values was noticeable, these values ("creativity" and "intellectual stimulation") occupying positions III and IV.

5. CONCLUSIONS

The differences highlight the following findings:

- the results of the WVI administered to the military students show that position III is hold by "supervisory relationships", a value consistent with the structure of the military environment, with a three-rank higher positioning as compared to the position occupied within the model WVI;
- the positioning of "economic return" on position V is insignificant, comparable with rank III occupied within the diagram of the model averages. Nevertheless, the value "independence", placed on position X, six levels lower than in the model diagram (an undesirable value within the military environment), constitutes a reference point for the partial validation of our expectations;
- another clue for different interpretation is the three-level leap of the value "prestige", specific to some professional categories, among which the military personnel are included;

- the three-level leap, from position XV to position XII of the value "management" constitutes another indicator for the checking of our expectations, but this leap is unexpectedly small, since the "management" represents a key value, desirable within the military environment and consistent with the career profile of the officer. Moreover, the investigation of the professional profile was performed on military students with insignificant managerial expertise (mainly for the last year of study), which justifies the relatively low rank for this value;
- the loss of five positions in case of the value "intellectual stimulation" (a value generally dissonant with the military environment, excepting the research sector and the educational one - which are insignificant from a numerical perspective). Similarly, the loss of two levels for the value "associates" is relevant, partially denying the expectations connected to the dimensions esprit de corps and comradery/corporateness, but confirming the individualization and competition trend, which has become prominent on the Romanian labor market, after December 1989.

The differences of one or two ranks between the values "economic return", "altruism", "security", "variety" or "aesthetic" are not significant.

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COMMUNICATION ENGLISH IN THE CONTEXT OF GLOBALIZATION

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Abstract :*The context of globalisation opposes different cultural spaces, image transfer and specific concept adaptations, and these are realised through communication. Thus, the communication field has become the science of the 21st century. And, in its turn, communication is characterised by specialised language, in which case the language of the global communication can be turned into the concept of communication English.*

This is a specific linguistic nucleus that does not imply the simple translation into the reference language – in the actual case, the Romanian language; teaching communication English supposes the acquisition of a specific set of teaching and learning methods and techniques. Not only would they offer a formal translation, but also a complex transfer of all the concepts. The goal is to offer the communicator belonging to the Romanian cultural space, the access to the original linguistic matrix of communication English, so that he/she is able to transfer the whole semantic charge of the concepts.

Chapter 1. Vocabulary Teaching Approaches

For a long time, a multiple series of teaching approaches has been developed so as to enable teachers to effectively teach vocabulary to students of different ages and knowledge levels. Some of these are focused on the teaching of grammatical structures, some of them on vocabulary. They are also centred on the language skills. Here is a short overview of the most common ones.

The Grammar Translation Method focuses only on written skills of the learners thus teaching through translation method under specified techniques of deductive style.

The Reading Approach is very similar to The Grammar Translation Method, as it is also stressed on written skills. Taking the teaching in consideration, this method is more flexible than the Grammar Teaching Approach.

The Cognitive Approach is more modern and it is based on the concept of language as a natural process. It also focuses on all the four skills.

The Comprehension Based Approach is the next step based on the Cognitive Approach. The process of teaching is more natural, it is based on a great deal of listening and it does not force the student to speak.

The Audio-Lingual Approach enhances the Direct Method and depreciates the Reading Approach. It is more based on mimicry than on fresh learning.

The Direct Method Approach focuses on spoken skills and teaching inductively. However, it has its own flaws, e.g., trained teacher and other necessary equipment like realia, pictures, is hard to acquire in every situation.

And finally, *the Communicative Approach*, which views language learning more as a system, which means teaching is considered as a system. It is the approach that first sets the stage for a major re-think of vocabulary and its importance in the process of language learning.

"The recognition of the meaning-making potential of the words meant that vocabulary became a learning objective in its own right. In 1984, for example, in the introduction to their ***Cambridge English***

***Course**, Swan and Walter wrote that <vocabulary acquisition is the largest and most important task facing the language learner>".* [Thornbury, 2007].

As one can easily deduce, the last three methods mentioned in the short presentation above are the ones focusing on vocabulary teaching, thus enabling the reader to have a quick historical overview of the didactical development of vocabulary teaching methods and approaches.

1.1. The Direct Method Approach

The Direct Method Approach was developed initially as a reaction to the grammar-translation approach in an attempt to integrate more use of the target language in instruction.

The set point of this method is based on the idea that second language learning processes should be more like the ones used in the first language learning.

This is why the activities included by this method are based a lot on oral interaction and the spontaneous use of language. The teacher discourages translation between first and second languages, and puts little emphasis on the rules of grammar.

According to the direct method, the students are organized into small, intensive classes. The major points of interest are speech and listening comprehension. During the whole process, the teacher gives instruction exclusively in the target language, teaching everyday vocabulary and sentences. The teacher also develops oral communication skills following an increasing progression, which is structured around questions-and-answer exchanges. The new teaching method points through modelling and practice.

The teacher also focuses on emphasizing correct pronunciation and grammar, but these are taught inductively. Concrete vocabulary is presented through demonstration, realia and pictures, for example, while abstract vocabulary is introduced through association of ideas.

Verbs are used first and systematically conjugated only much later after some oral mastery of the target language.

Advanced students read literature for comprehension and pleasure. Literary texts are not analysed grammatically. The culture associated with the target language is also taught inductively. Culture is considered an important aspect of learning the language.

Historically speaking, the Direct Method Approach was the first to catch the attention of language teachers, as it was the first one to offer a new methodology which seemed to move language teaching into a new era.

1.2. The Audio-Lingual Approach

Following the Direct **Approach**, the Audio-lingual Approach constitutes an important step forward in language teaching methodology aiming at communicative competence. The teacher's need to be "productive" is in favour of this approach. The elaborate activities have as purpose the facilitation of forming good learning habits within students and they add to the former techniques new parts of communicative methods.

It is true that many of the Direct Approach features are incorporated here but the "habit-forming" concept has been added to them. This is the first approach which has its roots *"firmly grounded in linguistic and psychological theory"* (Brown 1994:57), and this aspect increased its credibility. Probably this was the reason for which this method enjoyed a real popularity for quite a long time, and its influences can be seen in the approaches to come.

An important aspect that contributes to the success of this approach is given by the immediate results, despite the extended memorization, mimicry and language patterns over-learning. Yet, this was one of the approach's weaknesses, as the critics emphasised the fact that the communicative ability acquired through this method did not work in the long run.

However, the approach maintained its popularity and proved to be fit in different educational contexts. And this happens because there are countries where the English language is almost compulsory and people have to learn it out of extrinsic motives. We

mustn't forget that the expression *"practice makes perfect"* was invented in a period when there was the sign of equality between practice and repetition and when learning English as a foreign language meant repeating its forms and patterns without thinking much of the content.

We can sum up the most important features of the Audiolingual Approach taken from Brown (1994:57) and adapted from Prator and Celce-Murcia (1979). Thus the new material to be taught is presented in dialog form and it depends on memorization of set phrases, imitation and overlearning. The structural patterns are taught using repetition and are sequenced using contrastive analysis, which means that only one structure at a time can be learned. Grammar is little explained and it is taught by inductive analogy. Vocabulary is used in context and thus limited. The use of realia, tapes and language labs is extended and pronunciation is considered to be of great importance. The use of the mother tongue is not allowed, which means that it is quite difficult for students to utter structures without making mistakes. And the general tendency is to dismiss the content and manipulate the language.

1.3. The Communicative Approach

Both the Direct and the Audiolingual Approaches symbolize the progress recorded by the foreign language teaching methods in the last century. Several methods appeared, some of them already disappeared, but the competition among the existing ones gave birth to new approaches, as new motivations for learning English came up, along with different needs of students and teachers. In this respect, the one approach that proved highly successful is the Communicative Language Teaching Approach, also known as CLT.

Based on the idea that learners have to be able to make themselves effectively understood as quick as possible, the teacher has to create the situation in which communication is promoted and the genuine background for learning is provided.

Thus, grammar structures are no longer taught specifically, but they are embodied within the lesson. Once the context has been set, grammar structures are highlighted and focused upon.

David Nunan (1991:279) lists five basic characteristics of Communicative Language Teaching:

1. An emphasis on learning to communicate through interaction in the target language. 2. The introduction of authentic texts into the learning situation. 3. The provision of opportunities for learners to focus, not only on the language but also on the learning process itself. 4. An enhancement of the learner's own personal experiences as important contributing elements to classroom learning. 5. An attempt to link classroom language learning with language activation outside the classroom.

Finnochiaro and Brumfit (1983:91-93) compiled this list of CLT features way back in 1983. According to their theory, dialogues, when used, centre on communicative functions and are not normally memorized. The basic premise is contextualization and the actual language learning is, in fact, learning to communicate. This is what we seek through this method: effective communication, comprehensible pronunciation, and learners are encouraged to communicate from the very beginning.

Of course, the learners' age, interests, motivations have to be taken into account, and in order for them to acquire the necessary knowledge of English, any device that helps them is accepted, as well as the use of native language or translation. The goal of this approach is to obtain communicative competence, by reading, writing, listening and speaking, and, as far as speaking is concerned, accuracy isn't judged in abstract but in context, while learners are encouraged to interact to other people.

The teacher's main roles are to facilitate learning and monitor learners, to build round situations/functions practical in the real world, like for instance complaining, apologizing, asking for information, giving advice, telephoning, job interviews. Teachers have to set activities that have relevance and purpose to real life situations, and students are taught to socialize. The lessons focus on communication and meaning, accuracy being one of the last aspects to be considered. And a very important aspect concerns the feedback and correction:

teachers mustn't interrupt the flow, which means that they are to be given at the completion of the tasks.

As the lessons are topic or theme based, learners are more motivated, and group work activities, pair work activities are a better way to practice the target language, thus maximizing the percentage of talking time.

Chapter 2. Internal and External Factors

Learning new vocabulary might prove to be a challenge for the students. The process depends on efforts coming from two sides: on one side, it is the effort coming from the students themselves, and on the other hand, it is the effort coming from the teacher. Both of them have to link their knowledge in order to make the learning process work.

2.1. Student-oriented elements

The factors which can influence the learning process can be both student~ and teacher-oriented. They are of same importance and can lead to an increase or decrease of learning capacities of the student.

2.1.1. Memory

"At the most basic level, knowing a word involves knowing its form and its meaning." [Thornbury, 2007]. Many of the new words are thus memorized by the student either because their form resembles to the form of the word in their primary language. When there is no connection or resemblance between the two forms, the student uses his/her categorising skills and network building skills to remember them.

But in the end, it all comes down to memory. Researchers divide memory into three systems: short-term store, working memory and long-term memory.

Short-term store is "the brain's capacity to hold a limited item of information for periods of time up to a few seconds" [Thornbury, 2007]. It is clearly not the appropriate system for vocabulary learning.

The working memory is a longer process than the short-term store, and it involves focussing on words for a longer period of time, enough to perform operations on words. It is the case when the students make comparisons between words and understand them.

Long-term memory "can be thought as a kind of filing system. Unlike working memory, which has a limited capacity and no permanent content, long-term memory has an enormous capacity, and its contents are durable over time." [Thornbury, 2007].

The way words can pass from the working memory to the long-term memory involves some activities performed by the student.

- Motivation: the students should personally want to learn new words;
- Attention: the student really needs to focus on learning the new words, and not let his attention to be attracted anywhere else.
- Personal organising: the student should personalize the judgements they make about the new word;
- Repetition: the student should repeat the word, while it is still in the working memory;
- Imaging: the student should associate the word to a mental image;
- Retrieval: the student retrieves a word from his memory;
- Cognitive depth: a new word is better remembered if the student makes many decisions about it;
- Spacing: the student distributes memory work over a period of time, instead of comprising it into one single block;
- Pacing: the student should be able to establish their worn learning rhythm, individually;
- Use: the student should make use of the new words in different exercises.

2.1.2. Integrating new knowledge into old

In every student's mind, there is a mental unit called "the mental lexicon". The mental lexicon is defined as *"the learners' existing network of word associations."* [Thornbury, 2007].

New words cannot be effectively learned unless they are integrated into the student's

mental lexicon. The simple repetition of the new words is most of the times not enough to make the new word move from the short-term memory into the long-term memory.

In order to successfully complete the transfer from the short-term memory into the long-term memory, the student has to "work on the word" in the stage of working memory. The student will then start operating with the new words and will combine, compare, match, sort and visualise them.

All these operations are divided into two major types of activities or tasks, called "decision making" and "productive" activities. Both categories will be briefly overviewed in the third chapter of this paper.

2.2. Teacher-oriented elements

The teacher-oriented elements are also of major importance in the process of vocabulary learning. Not only that the teacher guides the whole learning process, but also the way the teacher manages the class activities and presents the new words is of crucial importance for the extent in which students succeed in learning new vocabulary.

2.2.1. Presenting new vocabulary

This is the first step that the teacher makes in introducing new vocabulary to the students.

One first aspect to be considered is the fact that the new vocabulary has to be introduced so as not to leave gaps between the introduction of form and meaning. The closest the two elements are presented to the students, the more likely these are to remember the new words. The introduction of the new words depends on some factors, like:

- The level of learners
- The familiarity of the students with the words
- The difficulty of the items
- The "teachability" of the words, meaning how easy they can be explained or demonstrated

Also, the number of new items to be introduced should be according to the capability of the students to work effectively with the new items. The items will then be presented in their written and/or spoken form. It is also up to the teacher to decide whether the new words are presented starting with the meaning and then with the form, or the other way round. The new item can also be presented through translation, definitions or situations of usage.

2.2.2. Explaining meanings

One basic means for explaining meanings is the direct translation. Translation is time-economic, but this can only apply in case there is a close match between the word and its equivalent in the mother tongue of the student. Direct translation also has its drawbacks. The most important one is the fact that the students fail to develop a lexicon in the language they are learning.

Another way to explain new meaning to students and also help them develop a lexicon in the target language is based on the fact that the teacher presents the new words by explaining them in the target language. It is the principle behind the dictionary definitions.

In order to explain the meaning of an unknown word, the teacher has the possibility of:

- providing an example situation;
- giving synonyms, antonyms and superordinate terms;
- giving several example sentences using the word;
- giving a full definition of the word.

Of course, it is the teacher's choice, which of the methods mentioned above are to be used or in which combination. This procedure is more time-consuming than the direct translation method. It is also important that the words used by the teacher in the explanation are totally comprehensible for the students and are part of the student's known vocabulary.

The situational presentation of the meaning is another way pf presenting new vocabulary. This involves providing a scenario which contextualizes the target word in a clear way. This approach can also be sustained by the teacher asking the students to finding and expressing or building own scenarios to highlight the usage of the new word. Thus, the students will have the opportunity to listen and

speak, activities which justifies the time spent in class with this type of approach.

When giving example sentences, the teacher actually forces the student to hypothesise the meaning of the target word. The students have the opportunity to hear the same word several times and also in a multitude of different contexts. They will also get a complete set of information on the new word's form and grammar.

The last approach, that of the teacher providing definitions like the ones found in the dictionary. This method is not really the most appropriate, as it takes a lot of time and requires effort both from the teacher and from the student.

2.2.3. Highlighting word forms

"There are a number of ways of highlighting the spoken form of the word. Essentially, these are:

- listening drills
- oral drills
- board work [Thornbury, 2007].

The listening drills involve the teacher repeating the same word for several times, in order to accustom the learner to the phonological features of the word.

The oral drills include, for instance the mumble drill, a way of encouraging subvocalization. It allows the student to repeat the new word to themselves in their own rhythm. The repetition of the new word can be both choral and individual.

The board work activity implies the fact that the teacher writes the new word on the board and also gives their phonemic script for the students to read and understand the pronunciation. This enables the students to avoid the negative effects of the sound-spelling errors.

Chapter 3. Exercising vocabulary

Exercising vocabulary is the most common means to make the new word shift from the working memory to the long-term memory. There are different types of exercises available to the teacher to make the students exercise vocabulary. The ones we see fit for the university students are the following (at present, they are already integrated in the practical part of the English courses):

- Filling-in – text completion
- Matching and sorting words and meanings
- Rephrasing exercises
- Reading texts and answering questions
- Creating texts

Generally speaking, a productive task is the one in which the student is required to incorporate the newly studied words into a speaking or writing activity. One of the written activities is the sentence and text completion, which is actually better known as gap-fills. This type of activity can be generally divided into two categories: open gap-fills and closed gap-fills. To complete an open gap-fill, the student has to draw on his/her own mental lexicon. This type of exercises will be thus used in the Revision chapters of a course. In case of the closed gap-fills, the students work with given words (generally new words) which have to be filled-in in the text given to them.

Matching the words is a type of exercise that involves recognition of their meaning and invites the student to pair them to a definition, a synonym or an antonym. It usually helps students to fix the coordination between word and meaning. Sorting words, on the other hand does not focus on both word and actual definition. The student is already familiar to he meaning of the words and is able to operate with them. The sorting can be done according to different criteria: either according to meaning (in exercises where the students are asked to choose the odd word from a group) or according to word classes.

The rephrasing exercises are more complex, as the students are asked not only to recognise the word and its meaning, but also to re-integrate it into a different grammatical and notional structure, which he/she has to reformulate starting from a given one. This type of exercise involves a higher level of grammatical and vocabulary knowledge and the ability of the students to operate with all the categories of grammatical and vocabulary structures.

The next level of difficulty is presented by the reading text and answering questions type of exercises. "For the vocabulary building

purposes, texts – whether spoken or written – have enormous advantages over learning words from lists.“ [Thornbury, 2007]. Learning the new words from texts increases the learner's chances to comprehend, because the words are in context, the totality of information connected to that word: grammar, collocations, different meanings in contexts. They can also come into contact with the word's lexical field. Of course, in this context, the short texts containing specific vocabulary are the best choice for the Communication English course. These can be subjected to intensive grammatical and lexical study, without burdening the student's memory or attention, as it happens with longer texts. The question-answering activity enables the students not only to repeat the new words, but also to use them in new structures built by themselves.

Finally, students can also be asked to create texts (usually not very large, the content being somewhere between 200 and 450 words) and use a certain number of words. This type of exercise asks students to create contexts for every new word used in the exercise. They also help the student move the new words from the working memory into the long-term memory. The text creation type of exercises can have a written or an oral form for instance, the teacher can ask the students to work in groups or pairs and orally present a certain dialogue or situation. For example, the students can be asked to present a whole press conference on a given topic during an English class. Such type of activity involves many of the processes in pairs or small groups. These activities involve many of the processes that serve to promote retention in long-term memory, such as rehearsal, repetition and explanation.

Chapter 4. Conclusions

> “ A word is a microcosm of human consciousness”. [Vygotsky]

Today's globalizational society confronts communities belonging to different cultural spaces. Taking in consideration this continuous cultural dislocation and the natural contacts between the representatives of different cultural environments, the role played by communication is decisive.

Communication English is a true linking element of human consciousness. It is communication which makes the world we live in function at amazing speeds. Communication is the basis of interconnection and interculturality. Communication is the building means of image. And the process of creating image is the global seller of today's world. We sell everything by creating images, starting with our own image and ending with the most basic products. We are buying images, we are voting images, and we trust, appreciate or hate images. Our whole world is formed by a multitude of images.

And images are created through language, because images are based on messages, communication and public relations. This is what creates images and messages. And it is a field which requires a specialized language, a language that enables the person projecting a certain image to make it break through a crowded and noisy environment. It is the communication language that allows PR specialists to make their message be heard.

The world turned global and gave birth to a global language of communication: Communication English.

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DESIGN TECHNIQUES FOR KNOWLEDGE COMMUNICATION PROGRAMS

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Abstract. *The accelerated rhythm of the daily existence, the amount of knowledge, the extent of the educational act, adversely affects the time reserved for training, regardless of its conservation measures. For that reason we must find effective ways to stem and optimize the methods and the classical processes of teaching, to encourage and to favor self teaching and to keep the balance between "individualism" and "socialization".*
Our approach is in this direction; the support and the dynamic teacher's effort, amplifying the effect of educational activities using media teaching aids, designed to strengthen the role of the manual, to detach it from the psychological dependency to the professor and, at the same time, to get the student closer.
The purpose of our approach is to develop design criteria of learning programs, to strengthen the formative role of the manual, to accompany and supplement it and, at the same time, to support and complement the teaching approach of the teacher.

Keywords: *educational software design, computer-assisted instruction.*

1. INTRODUCTION

Educational ideal of the contemporary society, detects distortedly the personal development process, the process of individual growth, the joint between what the individual is and what he's supposed to become through the educational process. The educational ideal's requirements are no longer in total correspondence with the social aspirations and with the educational possibilities; the equilibrium between reality and possibility is no longer acquired.

The distortions target both the social dimension, which regards the general tendency of social development, the pedagogical dimension that refers to the possibilities that the education has in order to transpose into practice this ideal and the psychological one, which refers to the type of personality that the society requires, as an educational result.

The actual educational model became static, losing its cadence due to the society's evolution, with its requirements and the education's possibilities.

The educational system needs to be deeply reformed; it has to adapt its methods and classical practice and to find new didactical methods and practices, which should allow the students to form new skills: efficient communication abilities, autonomy of action, flexibility, cooperation ability and team work, digital skills, moving skills, physic and psychic endurance.

The individual must be prepared for a new lifestyle and training: lifelong learning. "Human survival depends on its ability to learn, to retrain, to forget what he once learned and to learn differently in the future"[1].

2. ARGUMENTATIONS

Level oriented education, limited in time and as number of students is shyly guided towards lifelong learning, able to prepare the individuals whenever and wherever they are.

Our contemporary society's requirements are under a continuous dynamics in terms of intellectual and professional knowledge and skills, and place an overwhelming responsibility to the educational institutions.

The great challenge of the educational system consists in reforming itself, without consequences on the individual's training, on medium and short term[1].

The informational society's technology – the information and communications technology come to support the education. Traditional teaching methods cannot cope with the knowledge avalanche and the increased dispersion of qualifications, professions and areas of activity, which are becoming more specialized, but paradoxically more interconnected[2].

The advantages of using computers in the training process requires to establish a way as accurate as possible, their qualities as interactivity, precision operations performed, the ability to provide multiple representations and dynamic phenomena and, especially, that can interact consistently and differentiated with each student, may be as well capitalized.

The total of teaching methods and processes is naturally supported by ancillary staff to the teaching program based on the latest research results in areas like artificial intelligence, operational research, information and communication technology, electronics, cybernetics, etc[4].

Using computers has created educational premises, created in designing and implementing educational activities software educational sites, viewed as learning programs, which systematically links to browse the lesson, in conditions similar to those of class, without the influence of disturbances[3].

Educational software for knowledge communication, made in accordance with the characteristics of the target population, enable the communication of scientific content, fully and correctly, in a methodical manner, using differently and adapted to the context of science, the most appropriate teaching methods and procedures, an alternative which increases their effectiveness.

The communication of scientific content is sustained by achieving sequential feed-back, to ensure retention and operational objectives through formative assessment.

The project incorporates educational software and exploits the full activity of planning and designing educational activities, eliminating the training process the elements of improvisation due to disruptive factors, omissions or inconsistencies with the lesson's project. This can be done at unit level or during the lesson.

Using software educational lesson allows the student to learn on his own paced, repeatedly and independent from the training schedule required by a classical teaching, in favorable environmental conditions, familiar to the students and to which they are best adapted.

Designing educational software involves, primarily, to create the premises which render it the qualities of the manual and to extend them, and secondly, to establish a teaching scenario that values the scientific content as a methodical aspect.

Fig. 1. Presentation of the scientific content

To achieve the first goal can be used the classic manual, supported by the specialty literature. Scientific content should be presented in a balanced way, depending on the characteristics of the target population, in three forms:

- image - as the least coded representation of information;

- audio recording - a form of coded by language;

- text - the most complex double-coded by language and set of characters[5].

Presentation of the scientific content (Fig. 1.) requires the design of one or more screens containing text and images. Achieving these

screens requires a compliance with specific rules:

- structure and the readability of the text (character set, font size feature, color, size, location of the column, rows length);
- images (clarity and representativeness of their scientific content, aesthetics of presentation, according colors the scientific content of the lesson;
- elements of interactivity (custom words, buttons, triggers, etc.).

It is recommended to consult the textbooks for shaping the scientific content and to determine the degree of difficulty and detail to which the lessons are addressed to.

Găurirea este operația tehnologica de prelucrare prin *așchiere*, cu ajutorul unor scule așchietoare numite *burghie*, pe *mașini de găurit*.

Prin găurire se generează suprafețe cilindrice interioare numite *alezaje*.

Burghiele se confecționează din *oțel rapid* și mai rar din *oțel carbon*, de scule. Se durifică prin *călire*.

Fig. 2. Links

In the teaching scenario, the main element of the student - software interactivity is the custom word written in *italics*, called link, which creates a learning situation at the mouse hover, triggered by the student, usually by double-clicking the word (Fig. 2.).

The selection of the custom words is usually done according to the objectives of the lesson, its scientific content, the peculiarities of the student's age, the motivation, the assimilation capacity, the feed-back frequency etc.

The learning situations' range is extremely diverse. Simple mouse hover over the word will display a short explanation in a rectangular box, near the link, and also a presentation of synonyms, or elements from the explanatory or scientific dictionary. The displayed text disappears when the mouse is removed from the Link and reappears at a new approach.

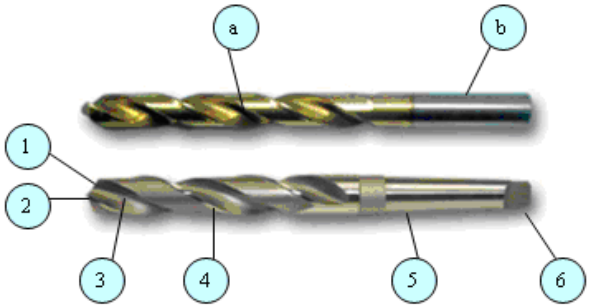

Fig. 3. Extensive explanations

The links are commonly used for the production of complex learning situations as:

- extension of scientific content (optional content elements);
- submission of extensive explanations, supported by images, audio and video files(Fig. 3.);
- resumption of content items in order to achieve synthesis, to underline the essential, strengthening the retention etc;
- output feed-back(Fig. 4.);
- achieving formative evaluation, initiation of learning situations based on exercises, demonstrations, etc.

3. Alegeți răspunsul corect! Acidul clorhidric lichefiat nu ataca majoritatea:	
☐	nemetalelor
◉	metalelor
☐	oxizilor

Fig. 3. Feed-back

Obviously, depending on content, static images can be used as links (Fig. 4.), which can trigger animations, scrolling images at different speeds, audio files, subtitles or karaoke type scrolling text[6].

Making the teaching scenario is strongly conditioned by the representation ways of the

objectives and content, teaching methods and processes.

Fig. 4. Feed-back

3. CONCLUSIONS

These ways of representation should ensure an easy interactivity, permanent and flexible, adapted to the particular target population, the perceptions and the aspirations of the target population.

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Flexible Intelligence and Higher Education

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Abstract

The main purpose of this article is to briefly examine the need of establishing a community-wide intelligence education framework that meets the needs of intelligence professionals at all levels (military or civilian) and to analyze what the differences are between professional development, education, and training.

Lately, there has been a new concern for the multiple connections in the intelligence environment. The world wide intelligence liaison needs at least similar approaches at the level of intelligence education. An integrated workforce focused on enabling collaboration thought leadership will be the key to national security as the world is becoming more complex, and the threats, more distributed and uncertain. No longer will an agency specific approach to intelligence education and training be adequate for the 21st century challenges.

Keywords: *intelligence, higher education, intelligence education framework, intelligence discipline*

The rapid and quick changes of the world we were used to had the inevitable effect of institutional transformations and reconstructions.

The analysis of these changes and their causal connections highlights the global concerns of the last decade: cultural and economic discrepancies, asymmetric conflicts, unpredictable threats, increasingly dangerous non-military threats and a necessity to rethink security in non-military terms, global and regional interests, and new spaces of geopolitical interest.

We are not only witnesses of these changes. We are part of the global chain of these changes, together with the institutions where we develop our activity, be they private or state-owned, multinational, transnational or national.

In the past years, debates on intelligence have focused on the necessity of restructuring intelligence services; this necessity comes as an effect of the change in the security paradigm. For the first time in the last five, six decades, the activities of the secret services (which from now on we will call intelligence activity) is considered an integral part of governing, a fundamental activity of any decisional process. For the first time in the past years it has become widely recognized that meeting the targets of national interest largely depends on the functional capacity of intelligence services. Even though studies and research have almost completely covered the issue of institutional reconfiguration of intelligence activities, there is still a topic of major interest that is still under debate: intelligence education.

1. WHY INTELLIGENCE EDUCATION?

If you ask a high school graduate (and not only) what is the first thing that crosses their mind when they think of an intelligence officer they will answer "James Bond" or "The Recruit". Most of the times,

the adrenaline and the spectacular define the intelligence activity in the eyes of the youth. Which is not bad; on the contrary, attracted by the spectacular, many young people will dream of a career in intelligence. But there will come up problems that may or may not find a solution during their educational and professional training. One of them is the intellectual quality of these young people. At 18-19 it is almost impossible to conceive the perfect balance between talent, loyalty, hard work, calling, that are so necessary for a good professional in intelligence activity. Once involved in the specific educational mechanisms, there comes another problem: finding the proper methods to reduce frustration and intellectual dead-end. More often than not, these phenomena appear when the young generations realize that their "James Bond" expectations match neither the realities of intelligence activity, nor the requirements and offers of the academic intelligence education. And at this point we can mention those responsible with academic activity, those responsible with turning these young people into professionals in intelligence.

The public perception of intelligence as part of intelligence as an integral and indispensable role of good governing raised an increased academic interest in this profession. Civil society is more and more interested in aspects related to intelligence. The need for specialists in intelligence is felt not only in the state sector, but also in the private one. From the requirements of initial training in the field we have reached the requirements of a continuous training by organizing master's and doctoral studies in intelligence. Through these educational offers we opened new opportunities for collaboration and communication between civil society and intelligence services.

Each nation-state has chosen its own avenue in training, educating and specializing its own personnel involved in intelligence activity. In general, most of the states that chose to offer initial and professional training through post-university courses in centers belonging to intelligence services follow specific short-term training courses, function of the specific field of activity. On the one hand, this educational program ensures the transfer of knowledge from former officers to "young apprentices in intelligence", but on the other hand it has a great disadvantage. Too strict a specialization may become a hindrance when speaking about flexibility, and intelligence education aiming strictly at specialized issues is only a piece (though a very important one) of a much more complex puzzle. Specialized education within agencies is focused on developing aptitudes, specific competencies, increasing students' "natural talent" through intensive training. This kind of approach cannot meet regular standards, because each service has its own responsibilities in security and intelligence, its own needs for personnel, and most of the times there are significant differences both in the means and methods used and personnel and in activity strategies.

Despite all these shortcomings, training within own educational systems fully serves the needs of the respective services. There are voices in the USA [1] saying that this kind of training and the lack of common strategies and capabilities of professional development in intelligence field resulted in gaps in the field of inter-agency cooperation. Sidney Fuchs (international Association for Intelligence Education, 2008) considers that training within own educational systems has weakened the efficiency of the American intelligence community in training young officers and low rank managers for activities that are specific to joint operations and inter-agency cooperation.

In general, intelligence services focus on the basic and further professional training in two major fields: intelligence gathering and intelligence analysis, leaving aside the aspects that may contribute to a better officer qualification. These aspects are generally related to the evolution of national and international political systems, international policies and concerns in the field of security, understanding the mechanisms of internal and international political decisions, in other words it is about

education with a view to gathering extensive knowledge in political sciences and international relations. Intelligence education must not be strictly centered on intelligence services. Cooperation, collaboration, partnership – they all imply the existence of a common national and international language. Intelligence education needs to become part of security and intelligence culture, and this security and intelligence culture should represent the common language for all levels of society – the ordinary citizen, the political elite, or the professional in intelligence.

2. HOW DO WE CARRY OUT INTELLIGENCE EDUCATION/STUDY?

The most appropriate answer would be: starting from the intelligence cycle (in Romanian it is often referred to as intelligence flux). This answer though does not offer an ideal solution, given the fact that the classical intelligence cycle is largely disputed nowadays [2]. Another hypothesis is the one starting from the concept of intelligence and how we may define it. Defining intelligence is far more controversial than the intelligence cycle. For this reason, the approaches in intelligence studies or education vary according to the understanding of the concept of intelligence.

For us it is difficult to deal with this concept, since in Romanian there is no linguistic equivalent. In the literature regarding political theory, in strategy and state politics, *intelligence* is used with the meaning of ”knowledge referring to events, tendencies, and personalities that may affect the observer or the country, institution, governmental service for which the observer works, in an imminent situation or one that is perceived as imminent. This information identifies, describes and defines situations that require or seem to require taking certain decisions.”[3]. Essentially, it means activities of gathering and analyzing intelligence in order to support the political process – that is to fundament or to adjust national security strategies.

Wesley Wark, an esteemed academic in intelligence established difficulties in making intelligence an academic discipline. Intelligence education is tackled from various points of view by Anglo-Saxons themselves (Americans and Brits), or even within the same intelligence communit [4]. The literature [5] in the field is extremely useful in pointing the right avenues to follow for a competitive intelligence education offering solutions, approaches, weak points and lessons learnt. The educational needs in intelligence are obvious in all analyses dedicated to the processes of restructuring and increasing the performance of intelligence services. Two studies on the necessity of qualitative intellectual modifications of the human capital come to attention: Loch K. Johnson, *The CIA’s Weakest Link: Forget James Bond. What Our Intelligence Agencies Need Are More Professors*[6] and Richard J. Aldrich, *The Name Is Bond. Professor Bond* [7]

3. LESSONS LEARNT-THE CURRENT APPROACH OF INTELLIGENCE

The Anglo-Saxon concerns in intelligence training and education bears the generic name **Intelligence Education and Training – IET.** These concerns can be met in the studies and research published in peer-reviewed magazines such as: *International Journal of Intelligence and Counter Intelligence, Studies in Intelligence, Intelligence and National Security*. Their councils are made up of renowned professors specialized in intelligence, such as: Peter Jackson – Aberystwyth University, William M. Nolte – Maryland University, Richard R. Valcourt –American Military University, Mark M. Lowenthal – The Intelligence and Security Academy, Arthur S. Hulnick – Boston University.

Debates referring to finding a balance between professional training and development and education led to the creation of an international association called International Association for Intelligence Education, **IAFIE**. The creation of this international association is another proof of

the necessity for a common denominator both in professional education and training, and in the didactic programs and curricula that ensure further learning. The subjects debated in this association's workshops included topics of interest for Romania:

- Is there a profession such as "intelligence specialist"? At first sight it may seem a certainty, but it is in the classified list? How can we connect intelligence training and education to the realities of the work market?
- Are there in the national classified lists disciplines related to Studies in Intelligence? Can we speak of a distinct branch of study, education and research? Can we speak of this discipline, "Intelligence"? When we speak of Intelligence education do we mean also interdisciplinary, multidisciplinary?
- Do we need a different approach for each educational cycle? Do we refer to the requirements specific to basic training programs, BA, MA and doctoral studies?
- What obligatory disciplines should the studies previous to intelligence specialization cover? For example, in the case of MA or BA programs, what are the obligatory disciplines that a candidate should have studied in the educational cycles preceding university courses?
- Narrowing the gap between the academic community and intelligence should really take place, or is the gap beneficial to maintaining a secret character of intelligence activities?
- What should be the optimal balance between theoreticians and practitioners in creating the professorate?

An answer to this final question can be found on the very official site of CIA in the document *Officer in Residence Program*. This program is both interesting and surprising for the academic community in Romania.

CIA's program, coordinated by the Center for Intelligence Studies (a renowned center for intelligence and security research belonging to CIA), supports and sponsors the academic involvement of its officers for two or three years. This academic involvement means an active participation of officers in the teaching process and/or in research. This activity focuses on the issue of national security and CIA's role in protecting it. The program is not new; it started in the '80s, with eight-twelve officers included in the annual educational and research program of some of the most prestigious American universities: Harvard, Princeton, Georgetown, Marquette, Oregon and the military academies.

The objectives of the program are: promoting a better understanding of the missions and role of intelligence services, strengthening collaboration between the academic and intelligence community, extending the offer of professional expertise in research and in preparing teaching materials in the field of intelligence. The development of this program during the past years has been a proof of the quality and competence of the Agency's employees, which contributed to the complex process of socially recognizing the utility, quality and efficacy of intelligence.

In 2005, the Directorate of National Intelligence put into practice the Intelligence Community Program, *Intelligence Community Centers of Academic Excellence* (IC CAE). Through this program, the Director of National Intelligence offered competitive grants to sponsor research and innovation in leveling the university curricula (technical, linguistic and cultural studies, international relations and socio-humanistic studies). The program was created respecting the national intelligence strategy and the Human Capital Development Strategy [8]. The objectives of the program include rendering financial and technical aid to those university centers that are willing to modify their curricula in order to support the needs of the USA Intelligence Community, as well as starting and developing relations with students in order to ensure a „diverse, highly qualified and deeply motivated" recruiting basis.

It is not a surprise that the famous 9/11 Report of the American Congress asks

in Title III, the Director of National Intelligence – DNI to take responsibility for ensuring collaboration, good practice and common educational network in the field of education and intelligence training. The congress also asked DNI to draw up a report on the necessity, utility and fezability of creating the *National Intelligence University* (NIU), the legal basis being the *National Intelligence Education and Training Act* of March 2004.

In 2006 it became obvious for everyone involved in the project that the *Intelligence University* cannot exist and should not physically exist on its own. It became a kind of consortium made up of American civil and military universities that have in common intelligence education for all forms of university programs. The DNI appoints the Rector of the University from among personalities in the academic and intelligence field. The position of rector equals the position of DNI's deputy director for education and traning. This position was held by personalities recognized in the field of higher education and intelligence and security: Carson K. Eoyang – professor in the Monterey Naval High School, Bill Nolte – professor in the University of Maryland.

The fundamental mission of the Intelligence University is based on educating and training local and national leaders [9] of the National Intelligence Community, both civilian and military, personnel of governmental agencies with attributions in intelligence and security, national and local leaders [10] in fields such as the Strategic Information Management; Joint, Multinational, and Interagency Operations; Aquisitions; Multi-Source Data Analysis; Regional Defense; and Security and Intelligence Studies.

4. CONCLUSIONS

The changes that have taken place in the past years in the international system, as well as the diversification of national security concerns have a less predictible effect on the range of concerns of the intelligence community. 50 years ago, J.F.Kennedy said „don't ask what your country can do for you but ask yourself what you can do for your country." It seems it is not enough to do *anything* and *anyhow* for the country, and moreover it is not enough that *anyone* should do something for the country. Those who want or are called to serve the interests of a country should be thouroughly prepared for the missions they have to carry out. If some of the most powerful intelligence services in the world, such as the American, feel the urge of a qualitative development of university education in the field, creating long-term educational strategies, projecting the future of the American intelligence community for the next two generations, maybe time has come for Romania as well to creates strategies in intelligence education through its specialized structures, to draw up programs that would help the national intelligence community and the academic community, as well as programs that would lead to achieving the targets of national interest of Romania, be they desirable or vital.

NOTE

[1] Sidney E. Fuchs, The Intelligence Education Framework for the 21st Century, available at www.dni.gov.press.../20060505_3_release.htm
[2] See Arthur S. Hulnick, What's Wrong with the Intelligence Cycle, in Intelligence and National Security, vol.21, nr.6, 2006, pp.959-979 and Amos Kovacs, Using Intelligence, in Intelligence and National Security, vol.12, nr.4, 1977, pp.145-164
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[6] Loch K. Johnson, Washington Monthly, July-August 2001, p.6
[7] Richard J. Aldrich in S.Tang, *Serviciile de informații și Drepturile Omului în era terorismului global*, Ed. Univers Enciclopedic, 2008, p.328
[8] Documents accessible at www.dni.gov
[9] It is about the local and federal organization specific to the Unites States of America.
[10] From mayors and governors to the managerial staff of corporations of national importance in the field of security, homeland security, defense, etc.

THE MANAGEMENT OF COMMUNICATION AND EDUCATIONAL EVALUATION IN MODERN EDUCATION SYSTEM

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Abstract: *This subject propose to treat some theoretical aspects about the part of intercommunity and educational estimation in the aim of development the modern education system.*

Key words: *communication, education, system*

1. INTRODUCTION

The communication can be defined as being the process of comprehension between people, through transfer of information; its management is essential in affiliation of the interpersonal relations, regardless of social scale.

The matter analyzed in this document has the purpose to highlight the decisive factors of the transfer of the information's management, particular of the modern system of education, with the objective to develop its efficiency by obtaining proper new data necessary for the educational evaluation.

2. THE FUNCTIONS OF THE COMMUNICATION RELATED TO THE EDUCATION SYSTEM

The communication is defined by a number of particular functions, decisive, among which the most important are described above:

1 – Mediates the members education system's leavening

The manner on how a certain level of knowledge for scholars or students is provided, to assimilate these knowledge, decides how teenagers organize, and vice-versa.

When knowledge is conceived as being specialized and hierarchic, it can be regarded that the institutions of education are identical.

Once put in this pattern, these institutions will seek to block the establishment of knowledge, obstructing it by lack of flexibility, both the basic concepts that could start radical modifications in the system, and especially a free thinking of problems among scholars and students.

Through a number of inflexible concepts, the education institutions will assert its own rules, by adopting a "dogmatic" system, the lack of communication bringing to the limit of both teachers, but also scholars and students.

2 – Allows to express the feelings and emotions

Usually, it has been established that the motivations of the human actions can be material, emotional or ideological. The decision of a person, in this case a teacher, will influence that person, when the decision is being adopted, of the information from that moment and of the mental or health condition, which can influence the mental condition.

3 – Provides, receives or exchanges information

The particularly learning system of an education structure succeeds only when its component parts coexist. Inside this system, every specialty can be compared with a room where the information is sent upon directions established through official channels of communication.

An information is given from superior level to the inferior one, and also to all of the members of the inferior level. It can be said that the system of knowledge, sending the information is horizontally disjoined and vertically reassembled. The structure of power based on the control of information is that: the room is controlled by a specialist, and the channel is controlled by a manager.

The process of communication inside a modern education system has the role to consolidate the organization's unofficial structure.

In a modern education system, the information must be reach to teenagers in a clear, original method, updated in aftermarth, being permanently in correlation to real events.

3. OBJECTIVE AND SUBJECTIVE BARRIERS PARTICULAR TO COMMUNICATION

Concerning the efficiency of communication, the can be distinguished objective or subjective barriers. Thus, the following situations are encountered:

• The number of the hierarchic levels leads to the possibility to misrepresent the message (parting, elimination).

• The high specialty language aggravates to understand the message, extending or stopping its comprehension. Maybe that is the reason why the western European bookshops and more recently, the Romanian ones, have volumes to make science likable, written in an easy, affordable language.

• The focus for realizing own objectives, by own methods, without considering the objectives and the needs of others.

The skills of a communication, born or obtained by education, should characterize the majority of teachers, improves the quality of communication.

The patience in listening the message, the capacity to understand and know the message and to analyze the emotions of the speaker, turn a listener into a good receiver of information.

4. COMMUNICATION CLIMATE IN THE PUBLIC STRUCTURES

The communication climate in an organization is extremely important. This climate is: defensive climate and open climate.

• In a defensive communication climate there is an estimative pattern of communication, a communication based on valuable considerations. In this case, the manager or the high-ranking person tries mainly to influence the adjunct persons; the manager will provide neutrality, superiority, and the whole communication will be based on strategic arguments. Distinctive to this type of climate is certainty and communication in categorical terms.

• Also, the outspoken communication climate can be found in public structures. This type of climate is a descriptive one, the communication is turned towards the content. In this case, the high-ranking person talks in an equal manner, and can be spontaneous and empathic.

5. ASPECTS CONCERNING THE EDUCATIONAL EVALUATION

The educational evaluation can be divided in two main classes:

• The *traditional evaluation*, is the one where, mainly:

- the most frequent expressions used to name the evaluation activity are: examination, verification, listening, control, even if this evaluation activity is in a daily framework, not to be found at the end of a training program;

- the school estimation or the verification formed as a separate element from the teaching-learning activity;
- acts for choice periodically, usually making a summary evaluation;
- finishes with the classify (scholar's top) (comparative evaluation)
- selects and removes certain learning branches, more difficult to evaluate; skills, behaviors, types of personality;
- is centered on knowledge;
- the marking system is a goal, a method to rank or to certify;
- is similar with the control of knowledge notion;
- the assessor observes, compares and evaluates; so the evaluation is centered towards scholar and appreciated the conformity of taught knowledge (the lesson learned) with a scale of values which is left to the estimate of the teacher and remains mostly implicative, it is not available to scholars;
- incriminates just the scholar, not the evaluation criteria, although the criteria are often insufficient defined or unclear.

• The *modern evaluation*, characterized by the following aspects:

- is associated to the concern to the measurement and evaluation of the results;
- it is not a distinctive purpose, it is just a simple examination, and is done for adopting some decisions and better measures;
- emphasizes on the essential problems and to emit judgment of value;
- shows predominance over the educative function of evaluation;
- tries to become a global interrogation, responsible for the promotion of the human factor, usually;
- covers both cognitive matters, and also the affective and psychomotor areas of the scholar learning;
- is an integrated part of the learning process, and it is not considered outside this process any more;
- develops permanently a feed-back function for the pupil;
- takes an active role, of constant transformation of the teaching and learning methods, and of development intervention;
- becomes a continous process and is organic integrated into the process of training;
- the evaluation becomes an instrument of communication of information on the learning phase, for its improvement or its reorganization;
- evaluates the pupils related to a norm, with criteria set before;
- those criteria are known by the assessor, and also by the one who is being assessed;
- requires for a diversity of the evaluation of the techniques, of the methods and at the increasing of the level of adequacy of those elements, to concrete didactic situations;
- aims to open the evaluation towards several perspectives of the learning system (relational competences, communication between teacher and pupil, possibilities of social integration);
- focuses the evaluation on positive results, without sanctioning all the time the negative results;
- the pupil becomes a partner with equal rights, in an educational relation which is based on "a pedagogic contract".
- offers transparency and methodological precision;
- attempts to appreciate the efficiency of the processes' ensemble that must lead to the act of learning.

6. CONCLUSIONS

The conclusion from the material previously presented, is that the didactic activity, only by a rigorous analyze of the information, linked very well with modern methods of evaluation, the education system can be significantly improved.

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A BRITISH MEMORANDUM FROM 1791 REGARDING NAVIGATION AND COMMERCE IN THE BLACK SEA – NEW ASPECTS AND COMMENT

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Abstract: *The papers in my hands contain a memorandum written by William Linsday, Secretary of Legation at St.Petersburg, 1788-1791 first published by Jeremy Black in Archives, London, XXII (1996), no.95 (Oct.) and by Paul Cernovodeanu in Revista de Istorie, t.7, no.**7-8**, July-Aug., Bucharest, 1996. The memorandum describes for the first time the coasts of the Black Sea, trade and commercial opportunities in the Black Sea after the treaty of Küçük Kaynarca in 1774.In this paper I underline the new details and aspects regarding the Southern coast of the Black Sea and emphasize the Turkish names of ports and settlements on the Southern coast of the Black Sea.*

Key words*: Black Sea, memorandum, southern costs, Turkish names*

England was not interested by the economic and political situation of the Ottoman Empire until the end of the 18th Century. During the 18th Century trade between England and Ottoman world was a restricted and limited one. At the beginning of the 18th Century English diplomacy show a great interest for this aspect only to keep apart by the Ottoman trade its rival France.

The English government tried to negotiate for many times the political conflicts between Ottomans and Austrians during the 18th Century. England was no more interested by the evolution of the Oriental Question when at the Middle of 18th Century the alliance between the Great Powers of Europe was broken. The English political interest for the Oriental Question was reactivated after 1790, when English diplomacy that was fighting for the European political balance showed signs of worry regarding Russian expansion towards the Black Sea coasts.

The Oceakov Question was for the English politician decision makers the turning point of Oriental politics regarding the Foreign Office relations with the Ottoman Empire. Lord Grenville, the Foreign Secretary, started a series of researches in order to get the best information on the Balkans and the Black Sea region. Lord Grenville was also interested by Russian military methods on how Russia could try to attempt over the Ottoman domain and Constantinople.

England interest for trade in the Black Sea region until the Oceakov Question (1791) was lower as it was interested only for products coming from the Black Sea. [1] The events of 1791 brought the Black Sea as one of the main subjects of Foreign Office addendum and also for Lordul Grenville the Foreign Secretary.

The Black Sea region proved to be a good supplier of goods like hemp and iron. Great quantities of masts and timber could be carried by Danube on lower prices than the same goods by the trade developed through the Baltic Sea as it is showed in the reports sent by the Secretary of Legation at St.Petersburg [2].

The minute shows the opportunities for the trade of Levant Company with the Black Sea when the English merchandisers enter the Black Sea, showing the opportunities for goods coming from the Black Sea region on lower prices than the same goods coming by the Baltic Sea. England could penetrate trade

in this region with its manufactures (Manchester and Birmingham goods) and sell in different Ottoman and Russian ports but also in Moldavia and Wallachia. Even if the Ottoman capitulations offered trade opportunities all over the Ottoman domains for English merchandisers, English merchandisers were not interested on the Black Sea trade.

The English Levant merchants were not ready to undertake the risk for trade with the Black Sea region, even if trade in the Eastern Mediterranean Sea was on decline at the end of the 18th Century [3].

England started its trade with the Black Sea region when Russia started its conquest for the Ottoman domains on the Northen Black Sea. The Küçük- Kaynarca treaty was the start on trade opportunities for Russian merchants at the Black Sea and it brought the change of the Russian-English commercial treaty with the Russian-French commercial treaty in 1786. Those events had a hard impact over the Foreign Office and its policy relative to the Eastern Europe territories.

The commercial activities of England in the Black Sea get a positive impulse after the political crisis of 1791 when the Foreign Office started its researches to get the necessary information relative to the trade in the Balkan countries. The documents of James Bland Burges, Under-Secretary at Foreign Office between 1789-1795, contain an important memorandum drawn-up by William Linsday, Secretary of Legation at St. Petersburg. The memorandum was written to the Foreign Secretary, Lord Grenville.

In this memorandum for the first time we get the necessary information regarding the Black Sea shores and trade opportunities in the Russian harbours. The document (see Jeremy Black, "Notes and Documents. The Russian Black Sea Littoral in 1791: A Memorandum on Commercial Opportunities", in *Archives,* vol. xxii, **no.95**, oct.1996, University of Exeter, p.121) can be found at *The Bodleian Library din Oxford, volume 58, Bland Burges.* The document contains strategic data relative to the Black Sea shores and necessary information for commercial opportunities in the region.

The same document was published by Paul Cernovodeanu, in his article „*Un raport britanic din 1791 privitor la navigaţia şi comerţul în Marea Neagr*ă (*A British Memorandum From 1791 Regarding Black Sea Navigation and Trade*)", published in *Revista de Istorie*, t.VII, nr.**7-8**, July-Aug.,1996, Bucharest.

The papers in my hands contain both the memorandum written by William Linsday, Secretary of Legation at St. Petersburg, 1788-1791 first published by Jeremy Black in *Archives,* London, XXII(1996), no.95(Oct.) and the article written by Paul Cernovodeanu and published in *Revista de Istorie*, t.7, no.**7-8**, July-Aug., Bucharest, 1996.

There are a lot of mistakes between data of the two documents and misspellings of Turkish names of ports and settlements on the Southern coast of the Black Sea.

The original document contains detailed description of the Black Sea coasts and the characteristics of its navigation. The document mentions about the dangerous storms of the Black Sea but it observes that the storms are less violent than the Mediterranean events"... *Black-Sea is particularly dangerous, but it may very fairly be questioned whether it deserves this Reproach. It has been observed that even the Mediterranean is subject to frequent and violent squalls*…" [4]. The Black Sea shore are described as being rocky and dangerous for Ottoman sailors as they are not good on sailing and they could not be safe even navigating Thames"... *with bold Shores, and which where extend beyond the 47th Degree of Latitude. It may, perhaps be true that the Black-Sea has been fatal to near one Tenth of the vessels employed by the Porte in this Navigation, but it is certain that even the Thames could be safely explored by Turkish Navigators"*[5]

The author of the memorandum starts with the shores of Black Sea at Bosphorus and then extends his description with the promontory near Varna with a sandy coast perfect and safe for vessels" *..the mountainous Promontory near Warna; the result was that the shore was shelving with a firm, sandy Bottom, so that Vessels might every where take the Ground with perfect Safety*…"[6].

The Secretary of Legation presents the harbour Yennisada situated at 75 miles from Constantinople, which was re-enforced by Ottomans. Near the harbour there are Sisopoli and Varna (Burgas and Varna), well-known harbours for their commercial activities and their hard competition with the commercial activities of Silistra and Adrianopole" *About 75 Miles N.W. of the Channel of Constantinople is a good Port called Yennisada, which the Turks have fortified lately, and a little further are the Gulphs and Ports of Sisopoli and Warna. This last is a considerable Port; the Town has little Trade, because the neighbouring Cities of Silistra and Adrianople are themselves provided with good Water Communication*."[7].

William Linsday describes the mouth of Danube, with its deepest entrance at Sulina „*The deepest Entrance into the Danube is called Sulina-Boga, where is only from Ten to Twelve Feet of water, and at some Seasons even less; the Land near the Danube for about 100 Miles is so low that Vessels at anchor in the River, or close in with the land are seen long before the Shore becomes visible*" [8].

The author of the memorandum presents the possibilities of a safety navigation on Dniester and he gives information about the north-west wind and says that vessels may anchor 15 or 20 miles of the mouth of the river in all weathers"*Northward of the Dniester, towards the Dnieper, ships may generally ride in safety at some Distance from the Shore with northerly or western Winds, and s Fleet may anchor within 15 or 20 Miles of the Mouth of the Liman in all Weathers"*[9].

William Linsday describes the Crimean harbors Sevastopol and Caffa with a safety shore to anchor and vessels may navigate up from the shore with northern and western wind" *Sevastopol is good anchoring Ground, where Ships may lay safety 'till the Wind blows from the Sea, when they may, whenever they please, sail into Sevastopol"* [10].

The Secretary of Legation presents the road from Sevastopol to Caffa as a navigable one for some 20 de yards from the shore*" From Sevastopol to Caffa a ship may sail within 20 yards of shore, which is mountainous and seen at a great Distance; near Sevastopol is a sand-bank which may easily be avoided"* [11].

William Linsday, the Secretary of Legation describes the harbor of Caffa, as a place where in the past a very advantageous commerce was carried on before the trade route was changed between southern Europe and Asia, Alexandria and the Cape of Good-Hope, and all the trade routes had been changed through Smyrna. He mentions also about the past when the port was ruled by the Genoese and they were carried on a good trade with Ottomans and Armenians*" Caffa, though formerly much frequented, is at present a port only for small vessels. Before the Trade of Europe from the Southern Parts of Asia, had taken the route of Alexandria and the Cape of Good-Hope; and the Staple for the commerce of the North-western Countries of the same Continent had been established at Smyrna, this Port, which was the at that Time, possessed by the Genoese, was one of the most flourishing Places of Trade in the known World, being the seat of the principal Exchange between Europe and Asia; and, till the period of the Russia usurpation was the chief place of resort for the Turkish and American Merchands"*[12].

The Crimean coasts from Caffa to Kerch are described as being lower and surrounded by high hills. Linsday recommends the large frigates that can anchor Kerch and months July and August as being unsafe because water is low but anyway vessels can navigate all seasons*" Large Frigates may go to Kertch, but up the Sea of Asoph ships only that draw 16 Feet Water, and for these it is not safe in July and August, when the water is low;-ships that draw 12 or 14 Feet may always navigate it-all over this Sea a Vessel may in all Seasons"* [13].

William Linsday presents the Caucasian shore and stops at Anapa harbor and he mentions that the domains belongs to the Porte, situated at the foot of western side of Caucasian Mountains and there is one of the well-know market for slaves. Selçuk Kale [misspelt Soshuck-Kale] is the main borough of Georgia. Iskowrin [misspelt Isgarver] is situated on east-south-east at 130 mils of Selçuk-Kale and at Mingrelia harbor vessels can anchor and there is a good market for

different raw materials*" Anapa (the territory round which belongs to the Porte) is situated at the Foot of the Western Extremity of Mount Caucasus, is a good Port, and is the Mart of the Constantinople Slave Trade […]. Sotschuck-Kale is the principal Town of Abchasia[…]. Isgarver (Iskowrin) about 130 miles E.S.E. from Sotchuk-Kale near the Frontiers between Abchasia and Mingrelia, affords good anchoring Ground and an advatageous Mart, for the Sale as well as Purchase of several raw Commodities'*[14].

From the Caucasian shore Linsday mentions Poti harbor good to anchor and a market for merchants coming from Georgia to trade their products as wine, honey, wax, fur, raw silk, fruit and timber. Batumi [misspelt Batomi], is a harbor situated on south-east at 35 miles to Poti and Borçka [misspelt Comi or Gomch] a harbor situated 64 miles south of Batumi with favorable bottom to anchor for which reason the Ottoman Customs was established there.

These shores are inhabited by Georgians and Turkish. The boroughs as Arpaçay and Kars are situated on the east shore and the inhabitants trade their goods on the market of Poti*" Poti[....] there is good landing and anchoring Ground[...] the inhabitants of Imeretia and Georgia assemble here for the Purpose of Trade;the articles to be purchased are wine, honey, wax, raw-silk, wool, ottersns, several sorts of fruit and wood for joiner's work. Batomi, about 35 miles S.W. from Poti[...], Comi (Gomch) lies about 64 miles S. And affords better Landing-Ground than Batomi-for which Reason the Turks Custom-house is established here, and it is much frequented by the ships of that Nation. This is the last place on the Black Sea inhabited by Georgians and the Turkish Towns of Achabrik and Kars lie due East from hence and are likewise inhabited by Georgians; they carry on here their principal Trade"*[15] .

The author of the memorandum reaches the southern shore of the Black Sea at Rize [misspelt Rizeh] that lies at la 70 miles on south-west of Borçka [misspelt Comi or Gomch] and Trabzon [misspelt Trebizonde] lies at 60 miles west of Rize [misspelt Rizeh]. Both harbors are situated on the southern shore of the Black Sea with good bottom to anchor for small vessels. The inhabitants of these settlements are Turkish, Greeks and Armenians. These harbors are situated at 80 miles of Erzurum [misspelt Eryerum (Arckaum)] a well-known market.

Giresun harbour [misspelt Keragam] is situated south-west of Trapezunt, at 75 miles distance. Here small vessels can anchor and the harbour is situated at 117 miles distance of Tokat [misspelt Tocal], on the Route of Silk. From this point caravans can take two routes one towards Constantinople and the other for Smyrna. The route affords Samsun harbor at 125 miles west and merchants can trade here their commodities as fruit, wine, saffron, silk, cotton and rice" *Rizeh, or Risso about 70 miles S.W. from Gom, and Terabesam or Trebizonde 60 miles West from Rizeh both of these Towns lie close upon the sea-coast possess Harbours, which, however, are capable of admitting only ships of a very small. Their inhabitants are Turks mingled with Greeks and Armenians [....]. These Harbours are the more noted, because the large Turkish city of Eryerum (Arckaum) distant about 80 miles from each carried on by means of them a very considerable foreign Trade. Keragam is a Turkish Town, lying about 75 miles S.W. from Trebizonde; its' harbour is only fit for small vessels, but the place is so far remarkable that lying only about 117 miles N.E. from the Turkish town of Tocal, where the caravans from Persia separate into two divisions, one destinated for Constantinople and the other for Smyrna; it affords, as well as the town of Smyrna about 125 miles further W., a convenient place of embarkation for such marchants as wish to avoid the fatigues as a land journey from Tocal to Smyrna or Constantinople. The envirous of the town of Tocal furnish excellent fruits, good wine and abundance of saffron, together with silk, cotton and rice, partly of its' own growth, partly brought from Persia"* [16].

William Linsday describes the southern coast of the Black Sea and Sinope harbor as less commercial importance*" The Coast to the Eastward, round to Sinope[....] with respect to this Part of the Black Sea which, for many*

Reasons, is not likely soon to become of much commercial Importance"[17].

Sinope lies at 210 miles west of Kerci [misspelt Kercum], and it has two harbors, situated southward only on130 miles distance to the Anatolian town Angora [the ancient name of Ankara]. Angora [Ankara] is well known for its manufactured products of goats-hair. These commodities together with other goods like cotton, silk and fruit coming from Asia are delivered by Kerci and Sinope towards Smyrna*" Sinope lies about 210 miles W. of Kercum; it has two harbours and is remarkable for its' vicinity to the Anatolian city of Angora, or Angouri, which is only about 130 miles distant to the southward. This city of Angora furnishes, exclusively, that fine species of goats-hair which is commonly known under the name of camels'hair, and being purchased here in the shape of spun yarn, furnishes the materials of the fine camlets manufactured in Europe. It would be easy to furnish from Kercum and Sinope, this together with many other products of Asia Minor, which now go by the road of Smyrna, such as cotton, fruits and silk and woolen carpets"*[18].

Next settlement described by the author of the memorandum is Amasra [misspelt Amasnch or Amastro] as a small harbour that lies at 100 miles west of Sinope and Hilis [misspelt Tios or Tilios] a small harbour with yard at 25 miles of Amasra and at 180 miles of Constantinopole "*Amasnch or Amantro a small harbour about 100 miles W.from Sinope and Tios or Tilios a small harbour with a Turkish dock-yard, it lies about 25 miles from Amasch and is within 180 miles of the Chanal of Constantinople"*[19].

Paul Cernovodeau in his article published in *Revista de Istorie*, t.VII,nr.**7-8**, July-Aug.,1996, Bucharest describes the southern shore of the Balck Sea as the Anatolian coast and there are no references about the above mentioned harbors and settlements. The author of the essay mantions only harbors of Rize, Giresun, Trabzon, Samsung and markets ofTokat and Angora (the ancient name of Ankara) *"*...the Anatolian coast, with important harbors as *Rizak [Rize] and Trabzon, with inhabitants Turks, Greeks and Armenians, and then Giresun[Kirazam] and Samsung, heading city of Tokat situated on the caravans road from Persia on their route to Constantinople and Smyrna. Sinope was an important settlements with two harbors, situated at 130 milse distance of Angora, a commercial town, well-known for its manufactured products..."*[20].

Westward at a 60 miles distance there is Ereğli [misspelt Erekli] a deep bay where a fleet can safely anchor" *Beyond this to the Westward 60 miles is Bender Heraclea (Erekli) a deep Bay in which a Fleet of men of war may safely anchor in all winds"* [21].

Linsday the Secretary of Legation describes he possibilities of navigation in the Black Sea and he starts from Constantinople towards Crimean shore. He mentions that sailing in the Black Sea is not dangerous in any seasons but the Russian rivers linked to the Black Sea are frozen from December to April*" Ships sailing from Constantinople up the Black-sea have nothing to fear in any season, they may always work their passage up to the North if destined for Crimea they cannot well mistake. All the Russian Rivers connected with the Black-sea are generally frozen from the end of December to the middle of April. The Straits of Kertch are also frozen, but not so far out to sea but that a vessel may anchor near the entrance in case of necessity. Kaffa, Baluclava, Giosleve and Sevastopol are always open, as are all the Salt-water ports. The navigation down the Black-sea from the North is somewhat dangerous in winter, as the landmarks near the Channel of Constantinople are then so disfigured with snow as not easily to be know"*[22].

The Secretary of Legation describes the city of Constantinople with its huge trade and luxurious Court and many consumers. Its export means first wool for France and other commodities as wheat, fruit, silk, cotton but the whole trade is controled by the Ottoman Sovereign " *Its' import trade indeed is immense, because it is the residence of a rich and luxurious Court, but there are only consumers. Its' exports are confined to a little coarse. Wool collected in the neighbouring districts and bought up by the French; the other articles carried from hence are*

originally supplied by foreigners, and the trade of these is monopolised by the Sovereign; these articles are wheat, snuff, and kusma a preparation of quick lime and orpiment, used [....] to take off the hair of the body, and such general consumption that it is said to yield an annual profit of 30,000 ducats"[23]

William Linsday describes the city of Constantinople and its strategic and military position and importance. Regarding the commerce at the Black Sea, Secretary of Legation William Linsday mentions that many Russian commodities as hem and iron could be imported from Russian ports at the Black Sea at a lower price that at St. Petersburg. He gives the price for iron and mentions that the price is 10% lower at Taganroc(situated at the Black Sea) that at St. Petersburg " *Iron is brought down to the South from the very Forges in Siberia at Catherinburg all the way to Czaritgen on the Wolga, whence it is carried by Land (about 60 Wersts) to the Don [...]. Iron has been constantly delivered 10 per cent cheaper at Taganroc than at Petersburg, and before the War very considerable Quantities began to be exported for Turkey, Italy, Egypt, Barbary etc.[...]. Iron could be delivered still cheaper at Taganroc"* [24]

Wheat another commodity than has a lower price at Taganroc and then could be sold on the markets of Italy, France and Spain "*The Wheat which grows round Taganroc is of an excellent Quality, and bears a high price in Italy, France and Spain; - the Re-production is 40 Times the Seed."*[25].

The Secretary of Legation William Linsday mentions that England could export its manufactures produced in Manchester and Birmingham on Astrahan for the markets of Buhara and Persia and England could import from Persia good quality silk" *English Manufactures might be sold in this Part of Russia [...] English manufactures (Manchester and Birmingham Goods) would sell in the different Turkish and Russian Ports and in Moldavia and Wallachia. English Cloth sell at Astracan for Bochera and the Persian Markets. In those Parts they prefer strong English Cloth to the thin light French-cloth, worn by the Turks. From Persia and Astracan Ghilan-silk might be brought to Taganroc*". [26]. William Linsday then presents the trade that England might have with Persia by sea as on the Mediterranean Sea English ships are preferred of all other foreign vessels." *England might have an advantageous Establishment in Persia, if Russia would grant Her the Privileges she formerly had. The English east-India company carry Ghilian –silk from The Borders of the Caspian sea to India. English vessels will come in for a great Share of the Euxine carrying Trade. They are preferred in the Mediterranean to ships of all other Nations – foreign vessels sail at a greater Expense than the English."*[27]

The Secretary of Legation William Linsday gives details regarding trade in the Black Sea and mentions that the ports were opened to commerce only in the last 12 years, after the treaty of Kücük Kaynarca. At the end of his presentation William Linsday underlines the natural value of the Black Sea and encourages the trade and the English merchants" *The only Russian Exports likely to be taking a different Chanel are Iron, Corn and Fish. On the other Hand the Importation into Russia of foreign commodities are likely to be mostly objects of Luxury [..] and Russia can never hope for as advantageous a Trade in the South, as she at present carries on with England, by means of Baltic. To conclude, I really believe that the natural advantages of a Situation on the Black-Sea are highly valuable, and though I think at the same time, that the Dread of Competition, entertained by our Merchants, is premature at least, if not groundless."* [28]

It is well-known that at the end of the 18th Century and the beginning of the 19th Century England became interested by the commerce with the Ottoman domains and the Ottoman Empire was backed by England. In order to keep Russia away from the Mediterranean shores England offered military and political support to Ottoman Empire. At the beginning of the 19th Century Ottoman domains were the most important strategic points for England for its political and commercial relationships with India.

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Psychological connotations of the concept word door

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Abstract: *Enunciation of the word door may have / has certain connotations that trigger in a given situation attitude-behavior states, designed to decode a psychological perception of the phenomenon in question.*

In this context, states triggered by the word door, fall within the: emotional, conflicting, and behavioral, which results in a certain aknowledging interpretation, placing them in time and psychological space.

All these psychological connotations, may be trigger when the door remains opened or not, yes or no creating duality and the acceptance or refusal, remark the identity. Do the connotations of the word door create attitudinal-behavioral dispositions? Certainly yes!

Keywords*: door-connotations-attitude-state conflict-triggered-affective-behavioral.*

There are some states that show a person, and appropriating them and developing them over time when it has to do with, is pronounced the word door? We try to answer that provocative question, even if for some of us, the door does not mean anything, or almost nothing.

In this regard, states triggered by the word door, there is a fund that accumulates: feelings, experiences, events, attitudes and behaviors that may develop in some cases, the form of skills and / or moral perception. These occur when requests daily emotional load, stress and add new, with equal importance, style and quality of life of every person within reach to accumulate in a number of attitudinal-behavioral dispositions special and unmistakable.

In this context, we outline some of the **states triggered** by the word **door** namely:

1) - emotional
2) - conflict
3) - behavioral

1) - emotional states are encountered especially when emotions and experiences, reveal a good humor, optimism and positive thinking, deliberately triggering memories of connections made at such times and decoded, while increasing self esteem and image, in a time and adequate space.

We can practically talk, for example, of the aparitoinof a state security assigned to the door:

a) -from the child- to the door house and then to his room, what ensure privacy, discretion and trust, gaining acceptance and actual feeling within the family, without creating special problems;

b) –froms the adults-to the door of the house and the children's room, respect and responsibility, and sometimes even unconditiuonal acceptance, of their manifestations, the common memory is one that allocates the feelingsof trust and love for family and home, which are "epicenter" of their identity at a time.

Also, the security that there is beyond that door a person for whom one harbors some feelings that lead to great emotional experiences, in most cases, the door may :

- not exist from the psychological point of view;
- not be an obstacle;
- be a possible obstacle to be passed / passed;
- provide a doubt;
- exist as a point of reflection,

all combined in an attitude, which / who triggers the anticipated reaction.

In such cases, the impact of the word door, would not trigger conditions that can not respond to commands from higher level neuropsychological data, but on the contrary, it generally creates a sense of well, normal and healthy response to the item created or existing, it is and always remains open.

2) - conflict states are found especially in moments where / what tense relationship between the transmitter (T) and receiver (R), the door being that either:

- is not open;
- remains permanently closed;
- maintains a sense of anxiety and uncertainty;
- can be addressed;
- is not affordable;
- does not represint trust;
- remains stiff,

but mostly **closed**, representing its position in relation to communication and networking, needed to exist at a time.

We exemplify by:

a) - classroom door may fall into the category of conflicts, especially when the relationship between teacher and student vs. student teacher, is not one of: understanding, acceptance and mutual respect;

b) - the teenagers' room, attenuate or conflict, especially when "the great misunderstood" remains incomprehensible to understand that there is, often not knowing how to act and react;

c) - office door when the relationship between employee and employer is stressful "hermetism" they can and in many cases happened, trigger conflicts that generate disobedience actions, actions that "count" state conflict arising as a result of: failure, disapproval, uncertainty, practically, lack of confidence and lower self-esteem and image.

The person does no longer found himself, loses his last hope of success, and tameness and permanent stress, leading for sure to conflicting states in different levels, which consequently triggers the action considered by law, deviant, sometimes irregular, leaving the door often closed.

3) - the states of behavior occur as a consequence of failure in mitigating conflicts arised between parties, the door releasing them or "witnessing" them. Thus, starting from the risk behavior itself, we come to the manifestation of deviant behaviors, especially, being mentioned as a result of such attitudes, shown as:

a) - anger:
- slamming the door by the wall;
- striking with the foot;
- hitting with fists;
- throwing objects in it;

b) - aggression:
- scratching slogans and insults;
- denigrating bill posting at the address of a person;
- drawing obscene images;

c) - violence:
- breaking the door;
- unhingeing it;
- destructing it by special means, pyrotechnics,

all represinting events which, existing and being brought to the level and upon the **door**, make from this a true enemy, danger, disopssessing it practically of its entire identity depersonalizeing it.

Thus, the **door** replaces the person in question because it is interposed at a time, is an obstacle to be overcome to reach the victim, assuming the risk of being in front of the aggressor which the situation of not finding the place clean, free and open, overcomes him and acts accordingly.

We note that in the **behavioral state, the door disappears** as a result of unacepting the situation of being the defeated one, playing in most cases, the role of "battle horse" in the sense of "receive blows from the others", which makes it special twords its „sisters".

Are being noted in this case, the **doors** of:

- public places;
- state institutions;
- lavatories (toilets);

having both behavioral states triggered by a problem situation created and the namely person does not find its solving only by this atypical form of attitude that can occur in most cases, on the background of failures, and the

failures' rebound being very strong.

Stemming from those found previously, capacity and availability of **the door** which thus receives the behavioral condition of the person who:

- sees it / does not see it;
- open it / do not open it,

by the emergence of an attitude.

In this context, the chain reaction triggered behavior, leading ultimately to an adequate behavior, manifested in various aspects, which determine the need to know, the idea of explaining the attitude taken by that person at a time towards **the door**.

Rhetoric, we might ask: "For ourselves we hide or not behind the door? Why?

And in the same spirit of structural decoding of the states triggered by psychological connotations of the word door, we can only start from the "serenity prayer" to understand what is understandable to say:

"God, grant me the serenity to accept things that I can not change, courage to change things I can change and the wisdom to see the difference", any comment being superfluous.

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THE AFRICAN AMERICAN VERNACULAR ENGLISH IN ALL ITS CULTURAL UNIQUENESS

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Abstract: *The present paper analyzes the language spoken by the African Americans in the context of the American culture, highlighting the way in which the African American Vernacular English came into being. AAVE or Ebonics is not bad English as most people think. It is a language having its own grammatical and phonological features. Compared to Standard English, AAVE could easily be considered corrupt English as it is thought to be spoken mainly by uneducated people. This language appeared many centuries ago, when the Africans have been brought to the United States as slaves in order to perform hard labor for the White people who mixed up Africans from different parts of Africa in order to keep them away from causing riots. As slaves, they had no rights, no freedom of speech, no identity. Nowadays they have a completely different way of living, but some of them could not overcome prejudice.*

Key words*: AAVE, African American, Ebonics, Black English.*

1. INTRODUCTION

African American Vernacular English or AAVE is a form of American English spoken primarily by African Americans.

Outside the academic society, AAVE is referred to as *Ebonics*. In the 1960s and 1970s, Ebonics was called Black Vernacular English (BVE). In the 1980s and 1990s, the name has turned into African American Vernacular English (AAVE).

Ebonics has been considered a dialect of English by linguists such as Fromkin & Rodman [3]. Throughout decades, it has been discussed whether Ebonics is a form of Standard English (SE) or it is just a dialect derived from English.

Ebonics derives its form from *ebony* (black) and *phonics* (study of sounds) and it refers to the study of the language of black people in all its cultural uniqueness. It is a combination of African languages and Standard English. It combines the formal rules of the African languages of Ibo, Yoruba, Ewe, Tula as well as Wolof with American English.

2. ORIGIN OF AAVE

The origin of AAVE is somewhat uncertain. There are two hypotheses about its origins. The first hypothesis deals with the dialect and the second with the Creole.

On the one hand, the dialect hypothesis is the belief according to which the African slaves, when coming to the United States, learned English slow and incorrectly and all the mistakes have passed on from generation to generation.

On the other hand, according to the Creole hypothesis, the modern AAVE is the result of a Creole derived from English and various West African languages.

Besides these two hypotheses, there is one more according to Labov and it is called *the unified view*: *'… research found that in many of its important features, African American Vernacular English was becoming not less, but more different from other dialects. Research on the language of ex-slaves showed that some of the most prominent features of the modern dialect were not present in the 19th century. It appears that the present day form of African*

American English is not the inheritance of the slavery period, but the creation off the second half of the 20th century [4].

According to Rickford, such slaves were probably not very numerous. However, the case for significant Creole importation from the Caribbean in the founding period has been supported by recent evidence that *'slaves brought in from Caribbean colonies where Creole English is spoken were the predominant segments of the early Black population in so many American colonies, including Massachusetts, New York, South Carolina, Georgia, Virginia and Maryland in particular'* [5].

To be able to communicate, they developed a pidgin language by applying English and some West African vocabulary to the familiar grammar rules of their native tongue. This pidgin was passed on to future generations and as soon as it became the primary language of its speakers, it was classified as a Creole.

Crystal points out that the history of Black English in the United States is *'complex, controversial and only partly understood'* [1].

After the migration of the African Americans to the northern part of the country, they came into contact with different kinds of dialects that were spoken in the North. After this contact, the separation of White and Black speech became more obvious. Step by step, the black residential zones separated from those of the Whites and the contacts with other ethnic groups were limited. White American English has not influenced the black speech: *'the result was that the speech forms of the Blacks became considerably different from the Southern variations'* [2].

The biggest problem that AAVE speakers face is prejudice. Most people think that AAVE is sub-standard to Standard English for some reason. Because of this prejudice, there is a big push in the African American community to be dialectal-fluent in both Standard English and AAVE.

African American Vernacular English does not have a separate vocabulary from other varieties of English. Still AAVE speakers do use certain words, which are not found in other varieties and they use some English words in ways that differ from the standard dialects.

A number of words used in Standard English may also have their origin in AAVE or at least in the West African languages that contributed to African Americans' Vernacular English development. Examples of such words are the following ones: *'banjo', 'jazz'* [7].

Nowadays AAVE has become widely accepted as a rule-governed linguistic system. In many cases, AAVE is similar to SE, but from a grammatical point of view, there are some differences between these two variants of English.

The idea that Ebonics is bad or broken English is obviously wrong to linguists who have studied it minutely. Outside the linguists' circles, the idea that Ebonics is corrupt English is held to be true. Ebonics is a regularized language with its own quite consistent rules and grammatical constructions. It can be both taught and understood by practically anyone who wants to take the time to learn it.

Until recent decades, AAVE did not receive much linguistic interest. According to Crystal, *'AAVE is the variety spoken by some 80 percent of present-day black Americans'* [1].

AAVE is quite a distinct form of communication. It has its own history of development, which begins on the continent of Africa. The slave trade from 300 years ago also contributed to its beginnings. AAVE has contributed a lot to the Standard American English of today.

3. A SOCIAL HISTORY OF BLACK ENGLISH

Even today in the United States, African Americans deal with the fact that they differ from other ethnic groups. Almost all of them were brought in the United States as slaves and they remained so until the Emancipation Proclamation of 1863. Their condition raised a lot of questions among White Americans.

The African Americans were thought to be inferior to the Whites and their language was considered to be bad English, their human rights were limited until the 1960s and because of these treatments that were applied to them, they developed some sort of handicap very hard to be overcome.

The pidgin language developed from a combination between the African slaves' languages and the English spoken by the sailors. The Creole language developed from generation to generation and now it is called Black English. By 1715, the African Pidgin English had been known worldwide.

The black servants were exposed to their masters' language and culture. Although they were living among white Americans, they continued to live in their isolated communities developing their own community's *lingua franca*.

By the end of the 18th century, slaves from different parts of America were speaking three types of English: African Pidgin English, spoken mainly by slaves imported from Africa; Plantation Creole, spoken by the greatest majority of field workers; Standard English, spoken by the slaves who had learned English from their masters.

The pidgin language and the Creole language started to decreolize as time passed and thus, different dialects came into being because of the geographical and social variations.

AAVE was known almost all over America before the Civil War. The slaves that still lived on plantations had not given up their native language. But AAVE spread mostly after the American Civil War when slaves received their civil rights for the first time. The Black migrated to different parts of the country and their culture became known mainly through their music and dance style.

The informal vocabulary of the Black community was picked up mainly from jazz, gospel and blues. Later on, the White Americans started to use their vocabulary, too. Thus, they made a new cultural contact with mainstream Americans resulting in a change in their speech forms. The situation did not change much in the south where they kept on using the Creole language even after the Emancipation.

After WWII, the Black Power Movement brought Black English to the Whites' attention. A huge attention was given to AAVE and eventually the Whites understood that AAVE was not broken English, but a language with its distinctive rules and grammar that was worth to be studied. Since a language is kept alive by its speakers, it cannot be eradicated. AAVE was turned into a symbol of black unity by the 1960s artists and intellectuals.

4. MAIN FEATURES OF AAVE

AAVE is an urban phenomenon as much as it is a rural one. Its features vary depending on age, social class, gender and style.

Rickford points out that not many speakers of AAVE use all the features all the time and not all African Americans speak AAVE. It is mainly in the speech of *'younger lower- and working-class speakers in urban area and informal styles'* [5] that these features can be identified. Further on, he reminds us that for its speakers, AAVE has several functions: *'for the preachers, novelists, storytellers, poets, playwrights, actors and actresses, street corner hustlers, church-going grandparents, working mothers and fathers and schoolyard children, rappers, singers, barber-shop and beauty-shop salon clients who draw on it daily, AAVE is not simply a compendium of features, but the integral whole which Brown evocatively called "Spoken Soul"'* [5].

There are two main categories of features that must be analyzed when dealing with AAVE: namely, the grammatical features and the phonological features, respectively.

4.1. GRAMMATICAL FEATURES OF AAVE

The grammatical features of AAVE deal with the following issues: the deletion of the auxiliary/ copula *'be'*, the multiple or double negation, the absence of the third person singular *'s'*, the use of *'ain't'*, the generalization of *'is'* and *'was'*, the dropping of the inflectional plural suffix and the habitual *'be'*. Each of these grammatical rules is very important to the structure of AAVE as well as to the understanding of the language.

Concerning the deletion of the auxiliary/ copula *'be'*, it is worth to mention the fact that Standard English uses a conjugated *'be'* verb called copula in different types of sentences whereas in AAVE, this verb is often not

included: *'this feature is specific for AAVE that is, it cannot be found in any other American dialect. More so, it is a frequently used feature in Caribbean Creoles'* [5].

There are also people criticizing this theory by saying that the deletion of *'is'* and *'are'* is the result of a mixture of different AAVE features: *'since the deletion only takes place where "is" and "are" can be contracted, it could be done because the speakers of AAVE sometimes leave out the word final consonant'* [3].

The deletion of the auxiliary *'be'* can occur in the following cases: in future sentences with *gonna* or *gon* (e.g. *'I don't care what she say, you _ gonna laugh.'*), before verbs with *–ing* or *–in* ending (e.g. *'I don't care what she_saying to my friend now.'*), before adjectives and expressions of location (e.g. *'She_at her place.'*), before nouns (e.g. *'She_the one woman I know.'*)

The multiple negations are unique grammatical structures among AAVE speakers. The double negation is not used in Standard English, but this kind of negation can be found in other languages, such as: Romanian, Spanish and so on. This kind of negation is not a distinctive feature for the AAVE speakers. Rickford claims that this feature together with others, which can be identified in dialects other than AAVE as well, are more common in AAVE being used in a great range of linguistic situations [5].

Here are a couple of examples of double negations: e.g. *'I ain't done nothing.'; 'I ain't going nowhere.'* Such examples of double negations are not specific to AAVE speakers and can also be heard being uttered by members belonging to other ethnic groups from the United States.

Here are a couple of examples of multiple negations: e.g. *'Ain't nobody gonna see me nowhere.'; 'I ain't done nothing to no one'*. The previously mentioned examples of multiple negations are specific to the AAVE. Such examples can be uttered only by AAVE speakers and they can be confusing to non-AAVE speakers.

Regarding the absence of the third person singular *'s'*, it is worth to mention that the dropping of *'s'* explains the African Americans' use of *'has'* instead of the Standard English *'have'*, *'don't'* in the third person singular instead of *'doesn't'*. According to Rickford, *'since both these words have a third person singular 's' in them in the SAE version, they are replaced by their plural equivalents'* [5].

In a sentence such as: *'She don't see him'*, *'don't'* is used to get away from the third person singular *'s'*.

Certain scholars and ordinary people do not agree with the fact that AAVE has its own distinctive rules and logic. In order to understand this kind of language, one must understand the syntax and background of Black English Vernacular.

Many AAVE grammatical features can be identified in the language spoken by the Whites in the South. The use of *'ain't'* is one of these features. *'Ain't'* is used as a general negator in AAVE. Nowadays, it has various usages: *'am not', 'are not', 'is not', 'has not'*, or *'have not'*. For instance: *'I ain't got no idea about it.'; 'Ain't it nice to meet him again?'*

Concerning the generalization of *'is'* and *'was'*, this is an exception to the rule about the absence of the third person singular *'s'* which has been previously mentioned. The focus has already been laid on the omission of *'s'*, namely, *'doesn't'* becoming *'don't'* and *'has'* turning into *'have'*. Now it is the other way round. According to Rickford, *'when it comes to "is" and "was", these forms have been generalized, and are used not only with singular person subjects, but with plural and second person subjects as well'* [5]. Here is an example: *'You was doing a lot of work.'*

The dropping of the inflectional plural suffix is another grammatical feature of AAVE. The number itself carries the plural. The numeral preceding the noun marks plurality. Here are a few examples: *'She is five foot tall.'; 'She owns three brand new car.'*

The habitual *'be'* is almost only found in AAVE referring to repeated actions throughout a considerable extent of time.

According to Fromkin & Rodman, *'this feature is not identifiable in any other American vernacular, but it occurs in many other languages. It has been suggested that the use of habitual "be" is the result of a mixture*

of features similar to this one, which can be found in African, Creole and Irish English' [3].

4.2. PHONOLOGICAL FEATURES OF AAVE

The phonological features of AAVE deal with the following issues: the final *'ng'* pronounced as [n], the pronunciation of *'th'*, [aj] and [oj] as monophthongs, consonant cluster simplification, metathesis, deletion of *'l'*, deletion of *'r'*, deletion of *'d'* and *'g'*.

The final *'ng'* pronounced as [n] is also called *'g-dropping'* taking place in gerunds where final *'ng'* is pronounced [n]. This feature is very common in the speech of several Americans irrespective of their ethnical background. According to Rickford, there is no dropping involved for *'an alveolar nasal is used as a substitute for a velar nasal'* [5]. This is debatable: if we refer to the phonological structure, then he is right; but if we refer to the actual dropping, it does not happen.

The pronunciation of *'th'* plays an important part in AAVE as [d] and [t] are fricatives, which in AAVE are lost. The voiced [d] sound in *'brother'* is pronounced [v] and the voiceless [t] sound in *'south'* is pronounced [f], which is also a feature of the Cockney Rhyming Slang. As Fromkin & Rodman state, *'when the [d] sound has initial position, it is often pronounced [d], and [t] in the same surrounding is pronounced [t]. This is something, which can be found in many other English Vernaculars, but (…) the feature is much more common in AAVE'* [3]. AAVE also uses a [d] sound for the voiced Standard English *'th'* at the beginning of words, such as: *'that', 'those', 'there', 'they'* which are replaced by *'[d]at', '[d]ose', '[d]ere'* and *'[d]ey'*.

Monophthongs [aj] and [oj] occur in African American English Vernacular usually before *'l'*. Thus, the word *'boil'* is pronounced as *'boy'*.

The consonant cluster simplification is another phonological feature of AAVE and it refers to the deletion of one or two consonants at the end of a certain word.

Standard English words, such as: *'round'* and *'just'* turn into the AAVE *'roun[_]'* and *'jus[_]'* being pronounced without the final consonant. The consonant cluster simplification is applied in those cases in which one of the consonants is an alveolar one [t], [d], [s] or [z]. Fromkin & Rodman gave as an example the words *'men', 'mend'* and *'meant'*, which are all pronounced [men] in AAVE [3]. Generally speaking, this type of simplification occurs in words where grammar is not affected: e.g. where the final [d] or [t] does not mark past tense.

Standard English words ending in the sounds [s], [p], [t] or [k] change their form in AAVE so that the final consonant is dropped and an *'-es'* is added in the plural form. A good example is the Standard English word *'desk'*, which turns into *'des[_]'* in AAVE having as plural AAVE form the word *'desses'*.

Metathesis is another phonological feature of AAVE and in this case two consonants standing next to each other switch places as the word is pronounced. Thus, [ask] turns into [aks].

Concerning the deletion of *'l',* it is worth to mention that *'l'* may be deleted or vocalized after vowels and it can sometimes lead to the deletion of the contracted form of *'will' ('ll').* In AAVE, *'l'* may also be deleted in front of a vowel and this is specific to AAVE.

The deletion of *'r'* occurs in the same surroundings as the deletion of *'l'*. For instance, the SE word *'story'* turns into 'sto[_]y' in AAVE. As Rickford asserts, the deletion of *'r'* can affect grammar in certain cases because the plural possessive *'their'* can be understood as *'they'* [5].

The deletion of *'g'* applies to certain auxiliary verbs, such as *'going'*, which after deletion turns into *'gonna'*. Concerning the deletion of *'d'*, the form *'ain't'* seems to derive from the deletion of the initial *'d'*.

5. BLACK ENGLISH AS A SOCIAL DIALECT

AAVE is a social dialect characteristic to African Americans. When a group within the framework of society suffers some kind of

social isolation, then the social dialect differences become more obvious. Such a social dialect can cause a problem from the social point of view that the variety of speech may be qualified as bad.

Standard English speakers can categorize Black English as broken because it does not fulfill the grammatical rules of SE, for instance, the absence of the verb *'be'* in pattern like *'You crazy'*.

The history of Black English has played an important part in the development of AAVE. At the beginning, it was about the pidgin language and the Creole language among slaves and the current Black English still has some influences of West African languages.

The English spoken by African Americans has always been marked by the patterns of communication between the African Americans and other Americans, which have reflected the social distance between them.

Using AAVE is a type of identification with one's *blackness* as part of *Black America.* African Americans have a unique way of talking within their communities. The way the Black preach, their rituals, the vivid style of street talk among adults have been part of the Black community.

6. CONCLUSIONS

The role of AAVE is very important to the African Americans because it is like a stain of color in their history. Their ancestors have come up with and developed this kind of language, this being one of the reasons why the African Americans from the contemporary society have not given up their language.

AAVE is more like a tradition; it is part of the African Americans' history. One's language is, in fact, the legacy of their great parents for the generations to come. African Americans have endured both suffering and humiliation.

African Americans were considered illiterate and uneducated because of the way they used to speak. But, in fact, the White people were not educated enough to tell that AAVE was not broken English.

Nowadays AAVE is more like a trend. The young and even the adults in the United States use this kind of language. Even White people have borrowed this language in order to speak like them, to try and integrate among the African Americans.

Equality among people irrespective of ethnicity, skin color, beliefs, religion, politics, sex or any other aspects of life should exist between us.

The problem is that equality does not exist. Probably, it will never exist. But the first step for these things to happen is to understand the person that stands next to us from any angle we look at him/ her.

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MARK TWAIN'S LANGUAGES OF POWER AND WEAKNESS

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***Abstract**: This paper highlights the power given by speech to Mark Twain's characters in 'Pudd'nhead Wilson' and 'The Prince and the Pauper', which best illustrate the tension created by language between master and slave. In 'Pudd'nhead Wilson', a clear-cut distinction between the white and the black is being drawn. The slaves are doomed to follow orders blindly. Their speech has no social power. Mark Twain manages to turn the powerful into the weak and the slave into master. Furthermore, the supreme power is held by the collective voice of society. Roles are also shifted in 'The Prince and the Pauper', where the king becomes a beggar and the beggar ends up being the king of a great nation. Mark Twain points out the fact that roles can be inverted any time. Power and weakness are placed on a wheel that can easily roll and crush the one that least expects it.*

***Key words**: language, power, weakness, master, slave.*

1. INTRODUCTION

Mark Twain wrote two novels that illustrate the tensions between masters and slaves: *Pudd'nhead Wilson* and *The Prince and the Pauper*. An in-depth analysis is needed when highlighting the important role played by language in defining the relationship between power and weakness.

In *Pudd'nhead Wilson*, the role of the powerful is played by white people while the role of the humble is given to black people. The latter ones are destined to be obedient to the others and to follow their commands blindly. However, Mark Twain brought an extraordinary twist to the plot of the novel by shifting the role of the master with that of the slave. The powerful becomes submissive and the humble learns to give orders.

Furthermore, in Dawson's Landing, both whites and blacks are controlled by society. The inhabitants of this town have the power to ban whoever they want without any effort. For example, even though David Wilson is one of the smartest persons that has ever laid foot in their town, the citizens manage to destroy his social status only because they could not understand an ironic observation.

In *The Prince and the Pauper*, roles are also shifted and the king ends up being a beggar, and the beggar is treated as a king. The resemblance between their language and their manners is so striking that only with hard evidence can they return to normality. In this novel as well, the crowd is the one that plays the role of a judge. Edward and Tom must prove to the people who they really are and only after convincing them they can return to their rightful positions.

It is also worth to lay emphasis upon the behavior of slaves among themselves. They are submissive and humble when addressing to a white, but they change radically when they talk to each other. In the second situation, they are more confident and the reader can even trace irony in their speech.

2. FROM POWERFUL TO WEAK AND THE OTHER WAY ROUND

The Adventures of Huckleberry Finn was written in 1884 and *Pudd'nhead Wilson* in 1894. In between these two important novels, Mark Twain suffered from great changes. The most obvious one is that his optimism, that was characteristic to Huckleberry Finn, turned

into pessimism. His pure humor, which could be found in any paragraph of the first novel, has turned into tragedy into the latter one.

Henry Nash Smith, in his book *The Development of a Writer* [5], said that he observed a gradual loss of faith in the possibilities of vernacular values and the language that expresses them. After *The Adventures of Huckleberry Finn*, Mark Twain never regains Huck's voice because he has lost Huck's vision. However, he is not entirely true because what Mark Twain lost in the years following the book about Huck is the belief that a character can stand up to a multitude of voices without losing his own integrity.

In *Pudd'nhead Wilson* there is no central narrative consciousness, no Huck to integrate the voices, because integration is impossible in Dawson's Landing. Dialogue has become a weapon used to destroy one party or the other. The reader can no longer enjoy the language that comes natural and has no destructive purpose. Even though in *The Adventures of Huckleberry Finn* Mark Twain used language as a means of manipulation, he never intended to destroy some other character with it.

Another important difference between the two novels is that in *Pudd'nhead Wilson* there is no conflict between Standard English and vernacular. In this book, language is spoken by two major categories of the human race: the powerful and the weak. These two have been battling for supreme power since this planet has appeared and the conflict is also characteristic to animals which are in a constant search to dominate one another. It is an unwritten rule that the weak must obey the powerful. Unlike animals, which use claws and teeth to fight each other, humans have a stronger weapon, their language. By uttering only a simple word like '*stay*' they can make the other obey.

In this work, the powerful are represented by the white race, which has control over the black one. For the whites, language is a tool for preserving authority, mastery or domination. They clearly hold the supreme social power over the black race. Their speech is powerful by virtue of social sanction while submission is the prescribed norm for black speech. George Steiner asserted about the conflict between these two races that '*where there is no true kinship of interests, where power relations determine the conditions of meeting, linguistic exchange becomes a duel*' [6]. Traces of authentic Standard English can be found in both Wilson and Roxanna's speech, but having no common interests, by the end of the novel, they become adversaries.

In *The Adventures of Huckleberry Finn*, the authority of Standard English was accepted as given by all who aspired to use it. On the other hand, in *Pudd'nhead Wilson*, the linguistic authority was variable and open to negotiation. In Dawson's Landing, the power is held by the mass of citizens and the entire action of the novel is affected by two elections: one, at the beginning of the novel, that removes authority from David Wilson's speech and another that, in the end, restores it. Eberhard Alsen stated that the restoration of Wilson's authority symbolizes a '*change from a society in which the power depended on property to one in which the power is based on popularity*' [1]. David Wilson gets his power back only because he has solved a crime case, which was very popular among the citizens of Dawson's Landing.

Although it is mighty powerful, white speech can become impotent only when an individual member of their community is dominated by another's authority. This process goes the other way round for the black speech too. The exchange of social roles between Tom and Chambers is the best example to illustrate the loss of power suffered by the whites and the celebration of power among the blacks. Furthermore, the white speech suffers another defeat when Roxanna, the black slave, has control over Tom, a former Yale student.

This exchange of roles between the powerful and the weak is also specific for Mark Twain's *The Prince and the Pauper* and *A Connecticut Yankee at King Arthur's Court.* In the first novel, the king becomes a beggar and the beggar a king. Tom must learn how to speak and give orders like a king and Edward must learn how to speak and behave among the lowest of the social classes. The first one can easily pass for a prince right from the beginning because of his familiarity with tales about the noble life. He had a lot of practice in

Offal Court where, with his friends, he used to put in practice scenes from those tales and he imagined his '*own self a prince, giving law and command to all, saying "do this, do that", whilst none durst offer let or hindrance to [his] will*' [7].

However, at the court, he finds himself in the impossibility of giving orders; he is used to obey his father and grandmother, which were two drunkards that ruled his life. Only after he learns to command can he really be considered to be a true king. He managed to play his role so well that in the end, when he wants to restore the power to the true king, only with difficulty does he succeed in convincing the others who is the real king.

On the other hand, Edward cannot adapt to live by the rules of the low society. He does not manage to integrate in the world of thieves and misery. One of the major factors that prevent him from becoming a member of the gang of thieves is his lofty style and elevated language. Although he encountered a lot of problems and had to suffer he could not change his way of speaking or his sense of righteousness. His kingly way of behaving produced nothing but '*derisive laugh*' [7] among the simple people of the low class. In the end, even though his speech and manners are those of an authentic king, he cannot convince his people that he is the true King Edward. His language has no power and only when hard evidence is provided do the people restore him to his right position. The same thing goes for David Wilson; his genius is recognized only after he brought outstanding evidence to his case. In both novels, *The Prince and the Pauper* and *Pudd'nhead Wilson*, the supreme power is that of the people. Only they can give or take away somebody's authority.

Furthermore, Mark Twain uses again this motif in chapter 28 of *A Connecticut Yankee at King Arthur's Court*, where Hank Morgan tries to teach the king the manners and speech that will allow him to appear as a poor, humble person. In spite of all the efforts, King Arthur cannot change his lofty style of speaking and thus, when he has to ask the master of a thatched hut for something to eat he cannot help commanding him: '*Valet, bring a seat; and serve to me what cheer ye have*' [7]. He even calls the owner of the hut '*valet*', as he is used to do with his servants at the castle. One's habitual speech results from the education he received, but the ability to alter it depends on temperament. Among Mark Twain's characters, the kings are the ones that are in the impossibility to change their speech and behavior and this is mainly because of their strong characters and pride.

In Mark Twain's work, the language of command is characteristic to the power figures that can be as courtly as King Arthur who believes that language is an extension of the self that compels others to act. The language of command transforms the others into manipulative objects and, as Mark Twain shows in his novel *Pudd'head Wilson*, once an entire group is associated with mastery or servility, its manners and language tend to become markers of a social class. Take, for example, the black vernacular, which is associated with slavery because of the low social status of its speakers. Thus, Valet de Chambre, Judge Driscoll's true heir, is absolutely terrified with the white man's parlor because he speaks the Negro dialect which stands no chance in comparison with Standard English. Furthermore, an individual cannot proclaim himself as a power figure; he must be elected by the society or the social group to which he or she belongs.

3. SOCIETY AGAINST THE INDIVIDUAL

In *Pudd'nhead Wilson*, the only character that speaks mainly in Standard English is the college-bred lawyer who emigrated from New York to a small town. In spite of his impressive education, the citizens of Dawson's Landing deny him the authority that could be provided by his discourse. All this happens because of a remark he made about a yelping dog:' *"I wish I owned half of that dog."/"Why?" somebody asked./ "Because, I would kill my half."/ The group searched his face with curiosity, with anxiety even, but found no light there, no expression that they could read…One said – /"Pears to be a fool."/*

"Pears?" said another. "Is, I reckon you better say" ' [7].

The villagers hurry to destroy his reputation right from the first day he got in town. What he said puzzled them and they wonder whether the other half of the dog would die too. They want to know if he would be responsible for the entire dog. The answer to their question is the fact that Wilson is a '*lummox*', a '*labrick*', a '*damn fool*' and definitely a '*perfect jackass*' [7]. The crowd clearly has the supreme power over everybody in town. It had the power to turn any character into a hero or into a big fool:*' "And it ain't going too far to say he is a pudd'nhead. If he ain't a pudd'nhead, I ain't no judge, that's all."/ Mr. Wilson stood elected…Within a week he had lost his first name; Pudd'nhead took its place…That first day's verdict made him a fool'* [7].

Wilson stands no chance against the decision of the villagers. Their authority is so strong that they can even rename him. If he were to face them and fight for his rights, he would have been like a blade of grass fighting against a strong wind.

The literal mindedness of the crowd is almost similar to that of Huck's with the big difference that the latter one was only an observer while the citizens are judges. When they meet a form of language that is not familiar with them, they decide to ban the speaker from their social existence. By rejecting Wilson's ironic speech act, they assert that the normative and authoritative speech act in Dawson's Landing is the literal utterance.

Still, James M. Cox [3] stated that the irony that initially sets David Wilson at odds with the crowd stands above and apart from the dialectic of power and submission. Hence, the iconic function of the maxims from '*Pudd'nhead Wilson's Calendar*' that preface each chapter of the novel. From outside the narrative, they mock its tragedy with sarcasm. The villagers of Dawson's Landing misinterpret Wilson's '*playful trifles*' by reading them '*in the solidest earnst*' [7].

Unappreciated as an ironist, Wilson turns to the opposite extreme of absolute literalism when he adopts fingerprinting as a hobby. Unlike linguistic signs, fingerprints are indices: they signify an individual by virtue of a natural, biological connection.

Fingerprints cannot lie or be ironic, they only refer to the person who produced them. They are immune to the vicissitudes of human language, as Wilson implies in his courtroom speech: *'Every human being carries with him from his cradle to his grave certain physical marks which do not change their character, and by which he can always be identified – and that without shade of doubt or question. These marks are his signature, his physiological autograph, so to speak, and this autograph cannot be counterfeited, nor can he disguise it or hide it away, nor can it become illegible by the wear and the mutations of time'* [7].

Fingerprints seem to be the novel's one innocent language. '*These print's are Tom's*' is an objectively verifiable statement, not an evaluative judgment like '*this man is a fool*'. David Wilson is transformed from ironist to victim of irony precisely when he fails to see that in moving from '*These prints are Tom's*' to '*Tom is guilty*' he deprives the prints of their innocence and makes them one more judgmental tool by which Dawson's Landing maintains control over its citizens.

4. THE LANGUAGE OF COMMAND

In *Pudd'nhead Wilson*, the speech act most closely linked to power is the command. This is the first speech act performed by Tom Driscoll: *'When he got to be old enough to begin to toddle about, and say broken words…He would call for anything and everything he saw, simply saying, "Awnt it!" (want it), which was a command. When it was brought, he said, in a frenzy…"Don't awnt it! Don't awnt it!" and the moment it was gone he set up frantic yells of "Awnt it! Awnt it! Awnt it!"'* [7].

Even as a baby boy, Tom used to give orders and to have everything his way. The reader can clearly see that his position as an authority over the slave Roxanna gives him pleasure. He enjoys giving her orders. Normally, when somebody gives a command, it does this with a specific purpose. However,

in Tom's case, there is no purpose, he does it for fun. He enjoys having the control over somebody. Furthermore, Tom's first recorded speech as a boy is a command given to his servant Chambers: '*Knock their heads off!*' [7]. As he lacks physical power, Tom uses his speech authority to compensate for the other. Chambers is the one that makes his power complete; by having total control over him, Tom uses his physical strength as if it were his own.

The language of command, in a milder way, is also representative for the gentleman class. For example, when Tom responded to an insult by taking the opponent to court in violation of the code of honor, Judge Driscoll said:*' "You have challenged him?"/ "N-no," hesitated Tom, turning pale./ "You will challenge him to-night. Howard will carry it" '* [7].

'*You will*' – the modal verb of this imperative demonstrates the theory that commands function by overlaying one person's will with another's. Moreover, the judge's actual power over Tom is his literal will, which he revises to disinherit his nephew every time he is disobedient. He can control Tom's life only because of his testament and Tom adopts the posture of obedience only because he wants his uncle's money. He accepts his uncle as being the authoritative figure for he needs his money not because he raised him or because he is a judge.

In this novel, the only requirement for speaking the language of power is that the listener acknowledges the authority of its imperatives; it does not care whether the speaker is vernacular or genteel. In Judge Driscoll's case, command seems a pompous discourse of a melodramatic hero: '*Once more you have forced me to disinherit you, you base son of a most noble father! Leave my sight!*' [7]. His command reveals disappointment rather that authority over his nephew. The imperative '*Leave my sight!*', used after a reproach, loses its power to impress Tom and the readers too.

On the other hand, when he is feeling self-assured, Tom tends to mix college slang with Missouri colloquial speech: '*Dave's just an all-around genius, a genius of the first water, gentlemen, a great scientist running to seed here in this village… for here they don't give shucks for his scientifics, and they call his skull a notion-factory – hey, Dave, ain't it so?*' [7]. Here, the question *'ain't it so?'*, coming after a long series of ironies, states the fact that Tom has a clear authority over Dave. Moreover, this rhetorical question at the end of his line is a form of humiliating the other character and of reminding him who has the power.

For Tom Driscoll, an elegant formal register comes more easily when he is in an inferior position, begging favors or justifying himself with his uncle or his mother Roxy. She herself shows no desire to modify her own vernacular once she has gained power over Tom. She makes a former Yale student obey orders constructed in the slave's dialect as part of her revenge.

In Dawson's Landing, hearing white people fighting over power among them is not as fascinating as it is the relation between the language of power spoken by the whites and the language of submission used by the blacks. In this case, interlocutors cannot share power, the only thing that would give authority to a black is a complete reversal of roles. The slave's dream becomes the master's nightmare, just as it happened with Tom Driscoll and his slave Roxy. Tom is forced to learn the language of submission and Roxy learns to command. He finds out his true identity and thus he loses power over his mother Roxy, he can no longer control her.

He is humiliated by his real social status while Roxy, who knows that her native dialect is destined to be servile towards white people, says: '*Fine nice young white gen'lman kneelin' down to a nigger wench! I's wanted to see dat jes' once befo' I's called*' [7]. With these words, Roxy tries to humiliate him by showing him the truth that was always there but he did not see it. Before she confessed the truth about his identity, she acted differently: *'[she] approached her son with all the wheedling and supplicating servilities that fear and interest can impart to the words and attitudes of the born slave*' [7]. She acted as a slave and she spoke the language of submission. At the beginning, she was the

humiliated one and Tom was the one that used to humiliate.

In *Pudd'nhead Wilson*, the reversal of roles also involves a linguistic shift. Initially, the slave's discourse characterizes its speaker as an object whose only possible act of will is supplication. On the other hand, the master's speech is powerful and it represents a clear refusal of the slave's requests. Reversal of power becomes effective only when the slave first uses the imperative mood and when the former master is given a lesson in the discourse of servitude.

Roxy first approaches Tom in chapter 8 and she uses what might be called a 'yas-massa' speech: *'Look at me good; does you 'member ole Roxy? – does you know yo' ole nigger mammy, honey?'./ ' "Oh, Marse Tom, de po'ole mammy is in sich hard luck, dese days; en she's kinder crippled in de arms en can't work" '* [7].

Self-reference in the third person is typical for the slave's speech. The ego of independent adult speech is replaced by a form that suggests the slave's status as property and the familial relationships that Southern slavery fostered. Slaves were '*mammies*' or '*uncles*' to their owners and third-person self-reference was common in a dialogue between children and parents.

On the other hand, Tom's attitude towards Roxy was that of a ruler. He used to give orders to her and to Valet de Chambre as well: '*Face the door – March!*', '*Send her in!*', '*Cut it short, damn it, cut it short!*', '*Clear out, and be quick about it!*' [7]. The fact that he uses short imperatives is a clear sign that he has the power over the two slaves.

The moment Roxy shifts places with Tom and gets in control is when her resentment makes her to open defiance and abandon her use of the third person for good. From that point on she used only the first person, the imperative mood and a series of periphrastic commands. Instead of directly ordering Tom to get on his knees and beg, she reminds him what will happen if he does not: *'Dis is what is gwine to happen. I's gwine as straight to yo' uncles as I kin walk, en tell him every las' thing I knows 'bout you.*' [7]. The act of kneeling symbolizes the shift of roles between the master and the slave. Only after Tom performed the action of kneeling, does Roxy use the imperative: '*Git up…Come to de ha'nted house…Gimme de dollah bill!*' [7]. At this point, the slave is in total control of the master. The language of command is now owned by the slave, while the master must use that of humility: '*Oh, Roxy, you wouldn't require your young master to do such a horrible thing*' [7]. After the change of roles is made, Tom is the one that refers to him in the third person.

The reversal between master and slave is complete when Roxy names Tom, altering his identity. She tells him that his real name is Valet de Chambre and that he '*ain't got no fambly name, becaze niggers don't have 'em!*' [7]. Moreover, Tom must not call her Roxy, as if they were equals, because '*chillen don't speak to dey mammies like dat*' [7]. He is now her child and must obey her.

Roxy is the only character in this novel who is aware that both the language of power and the language of slavery are learned forms of speech. Immediately after she switches her baby with Percy Driscoll's, she becomes conscious of the fact that she must call her son Marse Tom and her real master Valet de Chambre. If she were to make a mistake, her entire plan would be ruined. In order to preserve her secret, she spends most of the night 'practicing' and she is *' surprised to see how steadily and surely the awe which had kept her tongue reverent and her manner humble toward her young master was transferring itself to her speech and manner toward the usurper, and how similarly handy she was becoming in transferring her motherly curtness of speech and peremptoriness of manner to the unlucky heir of the ancient house of Driscoll'* [7]. This practice continued throughout the boyhood of both children. The real heir of Judge Driscoll learned the language of slavery while the slave learned the language of power.

5. FREEDOM AMONG SLAVES

Roxy and David Wilson, before being caught up in the events connected with the murder of Judge Driscoll, shared the ability to

use language playfully, particularly in ironic humor. Moreover, Roxy is capable of using a language whose aim is to represent experience free from the rhetorical constraints that govern language in its conative function.

David Wilson is labeled by Mark Twain as the ironist who comes to Dawson's Landing where his genius is not understood. But, there is another ironist in the novel: Roxy. She appears in chapter 2, engaged in a shouted colloquy with the slave Jasper, who is planning to come courting her. Mark Twain describes the conversation as '*idle and aimless jabber'*, a '*friendly duel*' that leaves each speaker '*well satisfied with his own share of the wit exchanged*':*' "You is, you black mud-cat! Yah-yah-yah! I got sump'n better to do den 'sociat'n wid niggers as black as you is. Is ole Miss Cooper's Nancy done give you de mitten?" Roxy followed this sally with another discharge of care-free laughter. "You's gelous, Roxy, dat's what's de matter wid you, you huzzy – yah, yah-yah! Dat's de time I got you!"/ "Oh, yes, you got me, hain't you. 'Clah to goodness if dat conceit o' yo'n strikes in, Jasper, it gwyne to kill you, sho'. If you b'longed to me I'd sell you down de river 'fo' you git too fut gone" '* [7]. This fragment is a perfect example of a conversation among black characters in the absence of tension and, more important, with no whites around. They act in a natural way and, for a moment, it seems that their problems are in the center of attention. By inserting this kind of dialogues in his novel, Mark Twain reveals to the reader a different part of the characters that were considered to be only slaves having nothing to say. In reality, they are alike white people, having the same problems related to everyday life and the same sense of irony.

Mark Twain reinforces this belief by describing Roxy in this manner: '*She had an easy, independent carriage – when she was among her own caste – and a high and "sassy" way, withal; but of course she was week and humble enough where white people were*' [7]. When she was among white people, Roxy was clearly a different person, she did not have the freedom of expression and had to act humble in order to show respect and please her master.

Furthermore, an '*aimless*' and '*friendly*' verbal duel between a slave and a white person was impossible. The slave had to calculate the effect of his or her language on the master. In her conversation with Jasper, Roxy, like David Wilson, can produce an ironic theory about a hypothetical case of owning something undesirable. She is no more serious about selling Jasper than Wilson was about killing his half of a dog.

The only element of Roxy's irony that is not in her control is her slave discourse that can never be free. The black speech is by definition included in the dialects of the master-slave relation. Her language is the only thing she cannot escape from, even when she is among her kind. Moreover, when she mocks Jasper's blackness and his status as a possession, she accidentally falls into complicity with the ones that enslave her.

To go on, the slave can escape the oppression of the master's language only when he or she physically escapes from slavery. Roxy's voice rises to its greatest power and autonomy in the evasion narrative she tells in chapter 18. She tells Tom that: '*I's gwyne to tell you de tale, en cut it jes' as short as I kin, en den I'll tell you what you's got to do*' [7]. The escape narrative allows the slave to exhibit all the qualities of strength, initiative, self-reliance and judgment that must normally be concealed by docile submission. Forms of the verb '*to know*' are used by Roxy five times in the three central paragraphs of her narrative and the number of verbs of action is very high. Similar characteristics can be discovered in Jim's escape narrative in chapter 8 of *The Adventures of Huckleberry Finn*. The competence expressed by his narrative turn him into a character entirely different from the superstitious object of boys' pranks in the first chapters.

Neither Jim, nor Roxy manage to escape permanently from the slaveholding society and they have to return to more calculated forms of speech: Jim to humble submission and Roxy to control. When returning to Dawson's Landing, her first form of speech is a command addressed to Tom: '*Shet de light out en move along*' [7]. Then, at the end of the novel, her last speech, made in the courtroom after all her

plans had collapsed, is a desperate prayer she makes on her knees: '*De Lord have mercy upon me, po' misable sinner that I is!*' [7]. Because her personal rebellion had been defeated, she has no other solution but to be humble again and ask for forgiveness.

6. CONCLUSIONS

The Negro dialect can become a language of power. This happens only when roles are shifted and the slave takes the master's place. Mark Twain made a wonderful job in *Pudd'nhead Wilson* by describing the relation between Roxy, a black mother that ends up being the slave of her own son, Tom. As the plot goes on, this shift is reversed and Tom, who in the meantime was educated at Yale, learns to be humble in front of a slave. The same situation is found in Mark Twain's novel *The Prince and the Pauper* as well, where the shift is performed at a higher scale: the ruler of the country takes the place of a beggar. Only after the king discovers what it means to be humiliated and treated with no justice, can the switch be reversed. In both novels, the supreme power is held by society and its idiotic rules. All characters must be judged by the crowd and they cannot escape it. For example, even if at a certain point Tom Driscoll seems to have avoided this judgment, in the end, he is caught and banned from society.

Another problem dealt with in this paper is the slaves' behavior when not in the presence of white people. Their relationship with each other is clearly different from that with their masters. When they are among themselves, even slaves have dignity and courage.

The only thing that reminds the reader that the slaves are oppressed by somebody is their dialect which is destined to be the language of submission.

To conclude, the language of power can easily be turned into the language of submission. Correct English and dialects cannot determine one's authority over another. It is the social status that holds power both over language and over manners. If Roxy had not made the change between the two babies, Tom would not have been educated at Yale.

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GLOBAL TOTALITARIANISM, AND THE CRISIS OF NEO-LIB MOVEMENT [1]

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Abstract

During the past decades there are growing concerns on the escalation and massive deprivation of the public life's quality, which some researchers attribute these as effects of the so-called 'Globalization'. To cite a few books, Prof. J. Stiglitz's book "Globalization and its Discontent" has sparked debate all over the world. A somewhat less known book which is worth to mention here is N. Hertz's book "The Silent Takeover."

The present article may not offer something new compared to the aforementioned 'standard literature' in the critical analysis of globalization, but we discuss some hints on deep the root causes of the problems related to globalization, not only at phenomenological-social level but also at mathematical foundations of economics theory itself, namely the notion of 'utility'.

Introduction

During the past decades there are growing concerns on the escalation and massive deprivation of the public life's quality, which some researchers attribute these as effects of the so-called 'Globalization'. To cite a few books, Prof. J. Stiglitz's book "Globalization and its Discontent" has sparked debate all over the world. A somewhat less known book which is worth to mention here is N. Hertz's book "The Silent Takeover."

The present article may not offer something new compared to the aforementioned 'standard literature' in the critical analysis of globalization, but we discuss some hints on deep the root causes of the problems related to globalization, not only at phenomenological-social level but also at mathematical foundations of economics theory itself, namely the notion of 'utility'. Furthermore, at an 'empirical' level to supports our arguments, we cite some quotations from Perkins [5], and Prof. M. Chossudovsky, who has studied globalization extensively in the past decades. [6-8].

This so-called "globalization" is called on Internet in the following different ways and names, such as: global totalitarianism, neo-totalitarianism, new world order, global fascist order, neofascism, today's new fascism, semi-colonialism, neocolonialism, global cyber hegemony (global control and manipulation of the Internet), global dictatorship, etc. where a few elites from some power countries try to *take over* the whole globe, which would become a prison planet. These unscrupulous, immoral, corrupted, genocidal, power-hungry elites will exercise an apartheid policy against the whole world, controlling people's soul through their totalitarian regulation coercions.

While the present article may not offer something new from analytical viewpoint, by relying on both phenomenology-sociological and mathematical results, we submit the viewpoint on the validity of the hypothesis presented herein. The purpose of this article is to call attention from national leaders on the extensiveness and criticalities of the issues discussed here, and suggest them to take actions together.

Our only hope for liberty would be… to move to another planet!

This global colonization, which we call in the present article Glob-Colonization, means that a few powerful circles of elites wish to transform the third world countries into politically, ideologically, militarily, economically, financially, spiritually, culturally dominated territories.

While at first glance this proposition sounds like a fantasy, comparable to the dark picture described in Orwell's book 1984, and some others would think that globalization is inevitable in order to reach global prosperity; in the following sections we will cite a number of phenomenology-social facts which supports our argument.

It is generally accepted among academicians (notably S. Huntington) that in a rapid movement towards globalization, societies tend to become unstable and therefore we observe disintegration almost everywhere in the World. His hypothesis is supported with plenty of statistical data in his famous book.

Nonetheless at this point we can also ask, what if instead of 'natural tendency' towards instability as he supposed, the reality is that those small countries are merely 'the puppets' under the strings played by the masters of Global Totalitarianism? In this alternative scenario, then the national leaders of small countries are nothing more than actors who want to maximize the 'utility' function of their role as national leaders, and actually don't care at all if by doing so they serve the 'grandmasters' who want to take advantage of the people in their countries?

This alternative hypothesis, while unknown so far to the majority of academicians who cling to the same belief of 'natural tendency' hypothesis of S. Huntington, are indeed supported by rigorous research by Prof. Chossudovsky [6-8] and also confessions book by Perkins [5].

To support this alternative hypothesis, let us cite a number of observations in the following section.

Phenomenology-Sociology observation

These powerful circles of elites do the followings in order to dominate the underdeveloped countries:

(a) Install puppet or at least semi-puppet governments in underdeveloped countries, easily manipulated and subordinated to them. Many times, they put in power and support

dictators, hated by the local population (see for example Pakistan, then some countries in Latin America, in some Arabic countries, etc.).

(b) Falsify and manipulate underdeveloped countries' local elections in order to bring to power marionettes subordinated to them. The secret services of these powers start by publicizing, before local elections, spurious "Gallup poll" or "opinion statistics" that show as favorable (of course!) their marionette politicians – in order to psychologically prepare the local population for accepting these marionettes. When the falsification of the elections does not succeed, a flood of slandering, defamatory propaganda is lunched by the secret services (sheltered by these power countries' embassies/consulates/missions, etc.) against the democratically elected government. If learning from history can be useful at all, let us cite that in the 17th -19th centuries, Romania and other countries under the Ottoman Empire had eastern leaders, called "Phanariotes" (i.e. Greeks nobles from the Phanar district of Istanbul), now local population jokes that their leaders are… *western-Phanariotes* [or *neo-Phanariotes*].

(c) Destroy the industry of underdeveloped countries, making the populace poorer, jobless, and thus obliged to emigrate to the west as cheap and discriminated labor. In this kind, they eliminate industrial concurrence. A country in general cannot be rich without industrialization.

(d) Dumping third world countries' agriculture system in order to destroy their peasants' small economies, and thus make the citizens of the third world countries dependent of the dominant powers.

(e) Break up underdeveloped countries into small parts, by pedaling on regional differences between various ethnic groups.

(f) Send so-called "peaceful traders" in underdeveloped countries, who in realities are spies who collect information and stir an ethnic group against another in these underdeveloped countries in order to provoke regional turbulence, encourage separatist groups, and try to destabilize these countries. See for example Czechoslovakia, then Yugoslavia and afterwards Serbia [because they are Slavic countries], and who would be dismembered next? Attempts were made against Romania too. Also, attempts to break Brazil, since it is too big and becomes a dangerous competitor, into South Brazil (a rich part) and North Brazil (a poor part), or to remove Amazon's jungle from Brazil because, because as they say: Amazon's jungle belongs to the planet not to Brazil. Maybe, Indonesia will follow next (?) (East Timor was already cut off from it.) There are some scenarios showing that this process may already be apparent. As in paradoxism, the Balkanization of the world is "performed" by non-Balkan powers, the vile actors on the world scene. But the same powerful circles of elites do not want to hear about, for example, dividing Canada into two parts, the French part, Québec – that many times asked for

> independence, and the Anglo part; or splitting Belgium into two parts, French part
> (Wallonie) and Flemish part; or letting Ireland unite with Northern Ireland… .
> So, what kind of globalization is that in which, instead of unifying, it divides? These
> powerful circles of elites do whatever they can for dominance by force and by deceiving.
> To point out the basic scheme here; this can be observed quite easily:

(i) Destabilize local-national governments by supporting the two opposite sides simultaneously [5];

(ii) Replace the national leaders which apparently sound too strong or too 'vocal' against globalization;

(iii) Destruction of national economies and therefore create the necessity to break up into smaller regions;

(iv) Totally dominate the smaller regions by means of contracts with MNCs (see Noreena Hertz, The Silent Takeover);

(v) Deprivation of public quality of life, and therefore create national economics dependence towards international bank resources (the so called 'bail out' game);

(vi) Create more pressures to the public thereafter.

(g) Entangle, by any mean, countries of same language or culture to unite (for example Arabic countries, or Hispanic countries, or all Islamic countries), so they do not become powers.

(h) Create international organizations that pretend serving the whole globe but, in reality, they only serve the interests of a few powers against independent non-obedient states. What kinds of democracy promoted by these international organizations when some countries are allowed to have sophisticated arms and others are not? Clearly, they are biased. In our opinion, all countries should disarm - but this is a utopia today. Also, why some countries have the "right of veto"? That's not fair. These international organizations look for pretexts (saying that they bring "international aid") to intervene in the affairs of underdeveloped countries.

(i) Create an International Court of Justice where these powerful circles of elites punish those who do not obey to them, by biased and set up trials.

(j) Erase the collective memory of other nations by defaming, slandering, detracting nations' history, language, personalities, traditions, culture. This is a cynic strategy of abolishing nations.

(k) Humiliate a whole underdeveloped nation through a propaganda that throws the

particular to the general, i.e. blameworthy facts of a few individuals from an underdeveloped country are generalized to the whole nation they belong to; that's the intentional way of how mass-media of these powerful circles of elites transmit lies to the whole world.

These powerful circles of elites mutually promote at an international level the racial idea of "superior nations" [which is a kind of *neo-Aryanism*] by humiliating other nations (using lies, speculations, slandering, boycotting, ridiculing realizations and people of third world countries). It is indeed a *Global Aryanism*.
This means an attempt to culturally, spiritually, intellectually, etc. exterminating other
nations.
These powerful circles of elites try to intimidate by inspiring international fear and
slavishness.
They publish and promote all kinds of reports, various encyclopedias, handbooks, movies, documentaries, propagandistic news, web sites, etc. in order to indoctrinate the
whole world that they detain the hegemony in every field.

(m) Indoctrination of third world countries with these few powerful circles of elites' ideology, culture, religion, propaganda, while suppressing local values.

(n) Calumniation of underdeveloped nations' traditions, customs. Powerful countries' secret agents pay dishonest local journalists to write and speak against their own countries' culture, history, traditions, but of course praising the dominants.

(o) Ignore, ridicule, detract and boycott underdeveloped countries' realizations, personalities, men and women of arts and letters, scientific research. Falsify the local history. This is part of denationalization and brain washing! From the national poet Eminescu, to high historical leaders as Ştefan cel Mare (Stefan the Great), Mihai Viteazu (Michael the Brave), and to the Romanian folklore characters Făt-Frumos and Ileana Cosânzeana, everything is under a flood of organized denigrations [9], while those who dare to defend them are blacklisted and constantly insulted. It is a way to erase the collective memory of third world country nations.

(p) Weaken the national education system in underdeveloped countries and intoxicate it with these power countries' propaganda, ideology, identity.

(q) International Banks lend money to underdeveloped countries with the pretext of "helping" them, but under cover these banks interfere with underdeveloped countries' political, ideological, economical affairs undermining them, imposing regulations in the interest of a few power countries these banks belong to, and transforming the underdeveloped countries in semi-colonies.

(r) An international swindle done by these few powerful circles of elites is the so-called "convertibility" of only their currencies (or only their currencies to be considered "hard money") in foreign exchange, and not of other countries' currencies. This international financial cunning gave these powerful circles of elites a huge advantage over the world, since it was extremely cheap for them (i.e. only the cost of ink and paper) to print *colored papers* [= their currencies] and pay in the whole world for all kind of goods and services with their 'colored papers': from oil and agriculture products to secret agents acting in third world countries to destabilizing them. Third world countries should not recognize these colored papers, and ask in the international trade to get in exchange: gold, silver, diamond, or other concrete goods and services, but not colored papers.

(s) Those who dare to think otherwise, or countries that do not obey these powers are labeled

"undemocratic", "politically incorrect", and accused of not respecting the "human rights". These powerful circles of elites pretend to promote democracy, but actually they only adhere to a phony democracy, i.e. "democracy of men with money", since

democracy in the classical Greek sense means "power of the people" [in Greek *demokratia* = *demos* (people) + *kratos* (strength), therefore: strength/power of the people], not power of a governmental junta. When, according to pool investigation, majority of people are against a war, and millions demonstrate against the war, but the governmental junta still goes to war, is that a manifestation of the power of the people? Of course not!

There is no much difference between the Stalinist dictatorship and today's so-called "democracy": in the Stalinist dictatorship the citizen were not allowed to say anything; in today's self-called "democracy" you are allowed to speak up, but the effect is the same as in the dictatorship (I mean: there is no effect!... because today's totalitarian governmental junta do whatever it pleases). People can say whatever they want, but it has no consequence! Allowing people to say everything is a psychological tactic from the part of the governmental junta, since people release their anger, and doing that many times without any consequence they would eventually stop… There is a total ignorance from the part of the powerful Klan with respect to the people. Those who dare to criticize these phony democracies are called "unpatriotic" … .

> Today's world meaning of "democracy" is subordination to these powerful circles of elites, so unfortunately "democracy" became a propaganda and a pretext of the powerful circles of elites to interfere in the third world countries' affairs! In addition, countries having a bi-partite political system are less democratic that those having a pluri-partite political system since the last ones offer more alternatives of policies and governance. Another example of lack of democracy and dominance of some elites over the normal citizen is the *lobby* in the American Congress; this lobby is unfortunately on *official corruption* where firms with money bribe senators to vote for firms' interest laws which are in citizens' disadvantage (a such example is the law that obliges each driver to have car insurance, money which in most cases the citizens pay for nothing… they pay like a tax for wind and for illusions!). Further, this "politically incorrect" syntagme is a contemporary form of censorship and denial of freedom of speech (you're not allowed to criticize the dominance... the dominance pretends detaining the global "absolute" truth in any field.). While by respecting the "human rights" they maybe mean: these powers' "human rights" of dominating other nations! The secret services of these powers and their paid influence agents provoke disarray, disorder, and systematic psychological harassment against the governments of disobedient countries.

(t) Countries that oppose the dominancy of those powerful circles of elites are destroyed with bombs, while those countries that yield to the dominants are destroyed with the pen, as Prof. Michel Chossudovsky plastically wrote [6-8], in the sense that local deregulations took place and external regulations from dominant powers were implemented.

In the last category, Eastern Europe countries, such as Romania, Bulgaria for example,

had their industries destroyed, their citizen required to pay high taxes to the government,

> and each whole country required to pay millions of euros for various European Union projects in Western countries, while Eastern European countries receive very little in exchange and their own projects are systematically rejected. As a result, a small percentage of Eastern Europeans became very rich and the majority very poor, while the degree of population's dissatisfaction – most people were plunged into misery - is very high. The majority's disgust and discomfort is reflected today by young generation's movement in poetry and writing called "grievism" [coming from 'grieve'] that it is often seeing on its Internet creations. Alas, the majority of

people in USA feel the same too, that they are merely 'boiled frog' in their own country, because of these practices by powerful circles of elites. European Union (EU), as part of the global totalitarianism (i.e. globalization), exercises - besides an internal neocolonialism of Western European countries against Eastern European countries which transformed eastern countries into the wasted garbage of the west - also an external neocolonialism of European firms against African, parts of Asian, and Latin American countries, forcing these underdeveloped countries to open their markets to EU firms whose products surpass the local products, bringing to ruins the local economies. These few powerful circles of elites use bombs, tortures (defying Geneva convention), invasions, genocides, deceptions, lies against third world countries - pretending they "fight for democracy"… (actually, it is the democracy of the most powerful elites that suck the natural and human resources of the neo-colonies). Eastern European analysts consider that their countries are today under double occupation… .

(u) There are national and international deceptive agencies of so-called "human rights" movement created by these powerful circles of elites, such as Division of Human Rights, Amnesty International, Equal Employment Opportunity Committee (EEOC), etc. that pretend defending the human rights of citizens in the world, but in reality they go after so-called by them "rogue countries" [i.e. countries that do not subordinate to them] and they look for pretexts to interfere in these countries' affairs. These deceptive agencies don't even protect the ordinary citizens in these power countries from the abuse of the elites, not even do much for their discriminated minorities. These so-called agencies of human rights have a propagandistic role. [5]

(v) Encourage local population NOT to learn its country's history, culture, traditions, etc. transforming them in just "speaking servants" (we adjust the Latin "speaking tools" at today's reality), or worse "global working animals" for these powers. This is part of the robotization of the people. This population is thus embezzled from its identity… The more somebody knows, the more he or she demands from the society - which is inconvenient for these powers. That's why the dominance tries to turn the thinking populace into an amorphous ignorant and less educated crowd, and in consequence this populace will simply be pushed into obsequiousness.

(w) Encourage the local creators to imitate and follow these power countries' ideas in arts, letters, science, etc. while discouraging them from having original ideas and creations; these power countries' elites pretend they detain the monopoly of creation;

(x) These power countries try to control and manipulate the information at the global level, as part of globalization, by controlling the national and transnational mass-media, the Internet, and by defaming people who are independent and thus not obeying to them.

(y) Award pompous international awards [with exaggerated epithets such as: "the best in the world", "the genial creator", "the genial theory" (for useless theories that many people contest), etc.] in science, arts, and letters to these powerful circles of elites,' servants, since these powerful circles of elites manipulate the awards as well… Transform the third world countries in cheap leisure places for the vacation of the powerful circles of elites. The middle class is thinning in all countries, and so is the real democracy. Even in U. S. there is no universal medical system as in other developed and even underdeveloped countries, the medical assistance cost is sky rocketing, the medical insurance agencies are simply business companies not medical helpers; the social system is bankrupting, and the retirement system in bad shape menacing contemporary working class to remaining without pensions… .The rich become richer and the middle class poorer.

Despite the initial good features of globalization (amongst them the free circulation of people and ideas across borders), it has drastic negative impacts. The uniformization imposed by global totalitarianists reduces or even annihilates the countries' national specific differences, which are the flavor of foreigners' attraction.

It is obvious to say that those powerful circles of elites who planned and set up the globalization did it in their own advantage/profit.

A global totalitarianism of a few elites is installing today against the whole world.

Equilibrium of powers at the planetary level is needed for a healthy global atmosphere. Today's unipolarity is abusive, aggressive, corrupted, yoking. Therefore, it is hoped that maybe China, India, Brazil and other modest countries will develop in order to counterbalance the arrogance of today's totalitarian power.

History teaches us that no empire lasts forever, consequently sooner or later this glob-colonialism/totalitarianism will fail.

At Mathematical Level

Besides the aforementioned phenomenological-social observation, we can also mention that at theoretical-mathematical level part of the problem comes from basic economics belief started by Adam Smith's 'invisible hand' [4][2]. It can be shown [4] that this belief than subsequently leads to an illusion of 'utility function' as an integrable function. Prices, dynamics, market equilibriums, are supposed to be 'derived' from utility. However, this assertion cannot be proved empirically, from Walras (who assert this function from 'auction' model) to Samuelson (his market-demand equilibrium is only a myth). [4]

In particular, economists assume that price is the gradient of utility in equilibrium, but it can be shown instead that price as the gradient of utility is an integrability condition for the dynamics of an optimization problem in economic control theory [4]. One consequence of this new proposition is that, in a nonintegrable dynamical system, price cannot be expressed as a function of demand and supply variables [4]. This can be observed most vividly in the very-high oil price last year (mid of 2008) which some analysts believed this effect was not supported by the reality of market demand-supply.

Therefore for evidence of stability of prices in free markets simply has not been found.[4] This new finding apparently can affect so much in the design of national economics policies, i.e. instead of pursuing equilibrium at all costs, efforts can be directed toward more 'active' measures to make the best out of the market dynamics of non-equilibrium itself. New types of economics theories can be expected therefore, with the most essential part shall be studying non-equilibrium theories, which are well-known in chemistry studies.

Concluding remarks

We have discussed a number of phenomenology-sociology observations which indicated that the global destabilization processes have taken place.

To point out the basic scheme here; this can be observed quite easily:

(a) Destabilize local-national governments by supporting the two opposite sides simultaneously [5];

(b) Replace the national leaders which apparently sound too strong or too 'vocal' against globalization;

(c) Destruction of national economies and therefore create the necessity to break up

into smaller regions;

(d) Totally dominate the smaller regions by means of contracts with MNCs (see Noreena Hertz, The Silent Takeover);

(e) Deprivation of public quality of life, and therefore create national economics dependence towards international bank resources (the so called 'bail out' game);

(f) Create more pressures to the public thereafter.

In other words, it is obvious to say that a global totalitarianism of a few elites is installing today against the whole world. Those powerful circles of elites who planned and set up the globalization did it in their own advantage/profits, and nothing they have in common with the public interests, both at developed countries and also at underdeveloping countries. Even in developed countries like USA, the majority of people feel that they are only 'boiled frog' whose life quality experiencing deprivation at massive scale.

Equilibrium of powers at the planetary level is needed for a healthy global atmosphere. Today's unipolarity is abusive, aggressive, corrupted, yoking. Therefore, it is hoped that maybe China, India, Brazil and other modest countries will develop in order to counterbalance the arrogance of today's totalitarian power.

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THE IMPORTANCE OF ENGLISH LANGUAGE IN THE CONTEXT OF GLOBALISATION - LINGUISTIC SOURCES OF COALITION MISCOMMUNICATION

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Abstract: *English is the world's lingua franca and a vital asset for international military, corporate, and government leaders. The implications for miscommunication in the military could result in loss of life. Given the fact that all recent military deployments have involved collaborations among multinational teams, breakdown in communication could jeopardise the success of the operation. With the increase in missions beyond traditional warfare, coalition forces have taken on additional tasks in peace keeping and humanitarian relief, thus creating added challenges to the communications among multinational coalition forces. Recent studies have shown that there are serious challenges in coalition communication due to the diverse backgrounds among multinational groups and team members. The purpose of this paper is to present linguistic aspects of the miscommunications, the relationship between cultural differences and variety of language use, and their impact on miscommunication.*

Keywords: *English, miscommunication, language, globalization, international, military, coalition.*

1. INTRODUCTION

Current major military deployments almost always involve collaboration between multinational teams. Joint operations often face operationally and environmentally complex and dynamic scenarios. Effective and efficient communication is a key enabler to success; however, the diverse backgrounds of multinational teams have presented serious challenges in coalition communication. This study investigates miscommunications between military personnel (and civilians working with them). It focuses on understanding miscommunication due to differences in language forms and language use, including the context of use. This study identified a number of categories and patterns of miscommunication. The preliminary results have presented a number of implications for improving communication between international teams, which can serve as insights for improving multinational team communication in general.

The modern military command and control (C2) environment is characterised by its requirement for increased operational tempo and by its use of joint and coalition forces. Moreover, as capabilities evolve it will increasingly rely on diverse human-agent teams. The complexity of interaction between the various human and agent teams may contribute to difficulties experienced in collaboration. Coalition forces carrying out commander's intent during critical command and control tasks are seen as providing creative techniques for problem solving. These creative techniques stem from the expertise existing within the collaborative framework. Whilst the expansion in creativity is extremely advantageous to the success of complex military operations, cultural variation can impact on multi-cultural teamwork. Multi-national teams can experience difficulties with,

for example, coordination and deployment of human-agents to execute command and control functions.

The command hierarchies of military personnel belonging to NATO countries are related and their members have some experience in common. However, as their command hierarchies are not identical, differences can lead to a reduced degree of common knowledge and shared understanding among members. Moreover, the behaviour of military personnel from different NATO countries (UK-US and others) is further influenced by cultural norms specific to their country. These cultural differences may lead to instances of misunderstanding between military personnel, particularly if they are unfamiliar with or new to a coalition environment, such as coalition headquarters. Communications are the basis of a shared understanding and English, as a language shared between the NATO countries, affords inter-cultural communication.

However, instances of misunderstanding due to the cultural differences and diverse backgrounds between multi-national military personnel have been recognized.

A miscommunication event can be defined in several ways. For the present study, miscommunication refers to an event where the speaker's intentions are misunderstood or misinterpreted. The problems associated with miscommunications are further complicated by the fact that some may go unnoticed and any resulting misunderstanding may not be recognized as such. However, many miscommunication events are likely to be identified and resolved immediately with clarification requested almost instantaneously; these will not lead to any persistent misunderstanding.

The examination of miscommunication within coalition environments is in its infancy. In particular, little research has been conducted on the cultural differences in language use between the military personnel and the effect these differences have on the quality and efficiency of communication. The research which has been conducted is of an exploratory nature, but has nevertheless provided interesting anecdotal evidence. These differences represent not only lexical differences but cultural differences in the way language is used. [1]

2. SEMANTICS VERSUS PRAGMATICS

There is one example that is rather singular in that it combines a number of different factors. The US liaison officer reported that there was a vehicle that left the base and their unit mentioned some problems they had with briefing about some procedures. The UK liaison officer sent him an email thanking him for his comments and noted that they would have to improve part of the process. He told the unit that they would have to write up an "Idiot's Guide" for this process to ensure that the problem did not arise again. In the UK, "Idiot's Guide" refers to books on a variety of topics that are introductory in nature. In America, the same type of books are called a "Dummies' Guide". The (US) liaison officer was unaware of this UK usage and thought that the US liaison officer was impugning his intelligence, suggesting he was an idiot. He reported it up the chain and it eventually got to the commanding officer. The commanding officer knew and liked his subordinate and assured his command that it must have been due to a misunderstanding and the UK liaison officer contacted the US liaison officer and resolved the issue.

There are a number of factors that led to this misunderstanding. For instance, although it involves a lexical difference, the UK "Idiot's Guide" versus the US "Dummies' Guide", the misunderstanding is primarily one of connotation rather than denotation [2]; it is not so much that the American officer did not understand that the UK officer meant a set of instructions to help people perform this process without problems, it was rather that "Idiot's Guide" to the American officer had negative connotations, implying only an idiot would need these instructions. Interestingly,

both “dummy” and “idiot” have this connotation in both the US and the UK, but in the context of “Guide” they have each lost this connotation in one of the countries.

There is another cluster of factors that led to the misunderstanding. The UK officer had been trying very hard to adapt to American linguistic conventions, using American spelling and words as much as possible. His communication with the American officer was via email, so the American had no basis for knowing that the UK officer was not American, based on his spelling and word choice. If the interaction had been face-to-face or even through ‘phone or radio, the UK officer’s accent would have cued the supplier that the person he was talking to was not American. So the use of a British phrase was interpreted in the context of coming from another American, so there was not reason to believe that the phrase might have had a different meaning or connotation for the speaker than it did for him.

This also perhaps illustrates the effect of not using a standard or neutral style or register. The UK officer used the more colloquial “Idiot’s Guide” rather than “a set of procedures” probably to express camaraderie and possibly to inject a bit of colour or humour; however, as noted above, colloquialisms also tend to be more parochial than more standard or formal expressions and are more likely to be misunderstood, as this instance was.

Finally, unlike many of the instances of lexical miscommunication, this was not an instance of a failure to understand but rather of a misunderstanding, a communication that was believed to have succeeded on both parts, but had in fact failed to meet the intended effect.

3. ACRONYMS

Acronyms can pose a problem because they are not known by everyone. In this sense, they are similar to slang and jargon [3]. Acronyms, of course, are not confined to the military; they pose a problem in most large businesses and organizations. Many officers have attended briefings in Afghanistan or Iraq and had difficulty following because of the extensive use of acronyms and jargon by the American officers. They also noted that certain specifically military acronyms he knew (“SO1” for Staff Officer 1, “SO2” etc.) are unknown to most American military personnel unless they have spent time with British troops.

4. USE OF SLANG AND COLLOQUIALISMS

Everyone does not just speak a single, monolithic language. Rather, we each have several different registers or styles that we use as appropriate. The language we speak with friends in informal settings can differ in pronunciation, word choice and grammatical complexity from the language we speak in more formal settings. In informal settings, we are more likely to use slang and colloquialisms. These can be very expressive, not only adding colour to our speech but also signalling a sense of camaraderie. Colloquialisms typically originate among a small group and spread slowly from there and may not spread very far. As a result, people outside that group are less likely to understand the colloquialisms than they would for more standard or formal words or expressions. This is true for different national dialects such as British English vs. American English. As a result, colloquialisms are more likely to be misunderstood when used in a coalition setting. For example, an interviewee reported that he was training a UK Forward Air Controller (FAC), who was directing a US pilot. The trainee tried to direct him to a road between two different coloured fields but the pilot reported that he had clear contact with the “dirt ball road” with no reference to the fields. The trainee did not understand the expression and kept pressing him to respond whether he saw the two coloured fields but the pilot kept responding that he had contact with the dirt ball road. Finally the instructor (the

interviewee) had to step in and clarify the situation. Here the use of a colloquialism is compounded with the inflexibility of both the pilot and the trainee to try to describe things in different terms, an aspect of communicative strategy.

5. USE OF JARGON

Another kind of language register that by definition is limited to a smaller group is jargon. Jargon is language that tends to be limited to a specific trade, business or professional group. It not only allows its speakers to communicate succinctly and precisely about their tools and concepts, but can perform a function similar to slang, that is, identifying its users as part of a group or fraternity. Like slang, jargon serves an important function for members of the group that it belongs to, but when used outside that group, it can be potentially confusing.

As an illustration of the value of jargon, an interviewee reported that he had less problem than one might have expected on his job because his role was very technical and the British and American technicians used the same language. So jargon in general technical domains (e.g. information technology) often cuts across national cultures. However, there are contextual differences which do create communication problems; for example, people working night operations use different equipment (e.g. night vision equipment) may say things that are unintelligible to the daytime operators who are not familiar with the equipment.

6. MISINTERPRETED SPEECH ACT

Beyond the lexical or terminological level of language are aspects of linguistic pragmatics or language use, including the speech act performed by an utterance. Language is used to do more than simply make statements or assertions. It can be used to question, to promise, to request, to greet or to congratulate. While there is sometimes a syntactic correlate of the speech act (in English, typical questions have the first auxiliary verb before the subject), this is not always the case and often what looks like one speech act on the surface is really another speech act. For example, the apparent question “Do you have the time?” is actually a request to tell the speaker the time.

One of the most familiar examples of speech act, which is not limited to military personnel or situations, was reported by an officer who is a US exchange staff in UK. A standard UK greeting “Are you all right?” was interpreted by him as a question about his health or situation, and initially responded accordingly. Unlike some simple lexical differences he reported that this misunderstanding took a while to understand.

7. AUDIO-ONLY COMMUNICATION

Audio-only communication provides non-verbal cues and is a popular mode of communication. Audio-only has been found to be characterised by longer dialogues, an observation which is argued to be indicative of less efficient communication. This argument is based on the absence of the visual channel for checking whether a message has been not only received but understood. It is also suggested that turn-taking, an important component of the communication process, is made more difficult in the absence of the visual channel [1]. Evidence pointing to the occurrence of miscommunication events when audio-only communication is used comes from research into pilot and Air Traffic Control (ATC) communication [4]. In order to minimize miscommunication and thus aid more efficient communication, the language, phraseology and structure adopted in pilot and ATC communication is highly constrained and standardised. Pilots are required to read back clearances issued by controllers verbatim. The controller is then expected to verify that the pilot heard and perceived the clearance correctly through hearback. Clearances are verified by the non correction of the readback.

Although this procedure minimises failures, it also increases the working memory load of pilots and controllers [1]. As a result, pilots and controllers often deviate from procedure by using shortcuts to minimize cognitive load. Communication difficulties have been cited as contributing to errors during operations, which have included near collisions between aircraft midair.

8. FACE-TO-FACE COMMUNICATION

Face-to-face communication is media rich considering information is transmitted over the visual and audio channel. The beneficial effect of the visual channel is that it allows speakers to monitor how the listener receives a message and draws inferences from these observations as to whether the listener understood the intent behind a message [5]. More efficient communication has also been observed with face-to-face communication compared to audio-only communication [3]. It may be that face-to-face communication is found to be more efficient than audio-only and video-mediated communication because it is a highly practiced method of communication, featuring well established visual cues such as gestures and expressions [5].

9. VIDEO-MEDIATED COMMUNICATION

Video-mediated communication has been useful in remote communication as it provides a richer medium of communication with cues pertaining to the meaning of information being transmitted over both audio and visual channels [6]. Thus as with face-to face communication, video mediated communication provides an audience with both verbal and non-verbal information. Despite video-mediated communication being a rich medium of communication, Boyle et al. (1994) found video-mediated communication to be no more effective than audio-only communication as measured by accuracy in reproducing a route on a map and time taken to complete this map-reading task. The fact that video-mediated communication does not result in better communication performance in comparison to audio-only communication was also demonstrated by Green and Williges (1995) who used a collaborative writing task as their measure of communication performance. These findings have been explained with reference to the novelty of video mediated communication where the speakers and listeners are unfamiliar with this communication environment. Further, the fact that the visual information in video links may be attenuated, resulting in a reduction in bandwidth, has also been put forward as a possible explanation. Adding support to the above findings, it was observed that video-mediated communications did not provide the same benefits as face to-face communication.

There is an exception in the literature, where video-mediated communication has been shown to be beneficial when communication takes place within a stressful environment. Veinott, Olson, Olson, & Fu (1997) [6] observed that pairs of non-native speakers performed better on a map-reading task when they used video-mediated communication relative to when audio-only communication was adopted. However, native speakers performed equally well whether audio-only or video was the medium of communication adopted during the map-reading task. When communication takes place between non-native speakers, Veinott et al. [6] have argued that video allows speakers to monitor the listener, helping them develop a shared understanding due to the availability of non-verbal cues. This allows misunderstandings to be identified in a short time frame. Veinott et al.’s findings may be applicable to other instances where communication takes place in a stressful environment, such as that experienced in coalition operations [7].

10. CONCLUSION

In this study, we have looked at a small sample of anecdotes of miscommunication between military groups. We have identified various types of linguistic variations and cultural differences manifested by them. American English and British English differ in complex ways not only in terms of lexical differences but also, perhaps more importantly, in terms of language use due to cultural differences. The initial findings suggest that there are indeed cases of misunderstanding between military personnel and that some of these could impact on operations.

The results indicate that much needs to be studied about the current coalition communication patterns, styles and other characteristics of language use. This would then help in identifying appropriate strategies and tools that need to be developed to improve process and cognitive interoperability among multinational forces. Importantly, the current analysis suggests that many relevant issues are largely pragmatic in nature, beyond not only lexical and grammatical differences but also "semantic" similarity of the communication content.

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SUSTAINABLE DEVELOPMENT IN RURAL AREAS IN BRASOV COUNTY

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Abstract: *In the context of the post-accession phase, local development strategies are an essential tool in achieving sustainable development for any local community in Romania. Particularly in rural areas, the development of such a strategic development document faces many difficulties (such as insufficient statistical data, reduced civic participation, etc). To overcome these difficulties an interdisciplinary approach is needed, as was the case of strategies development referred to in this article.*

Key words: *sustainable development, strategy, community.*

1. THE ROLE OF THE DEVELOPMENT STRATEGIES

The approach for developing sustainable development strategies concerning rural communities of Romania has increased in the recent years, rather due to practical considerations than to reconsidering the role of strategic planning in sustainable development. To obtain EU funds for rural development (through the National Program of Rural Development - NPRD), points are obtained if the applicant proves the correspondence between the proposed project and the development strategy of the town / rural area in question. For example, an applicant under Measure 322 of NPRD can obtain five points if he meets this criterion (1), a fact which cannot be overlooked, given that the projects financed under this component have obtained between 75 and 90 points (2).

2. SUSTAINABLE DEVELOPMENT STRATEGIES IN BRAŞOV COUNTY'S RURAL AREA

The authors of this article have participated in the achievement of sustainable development strategies for three communities with distinct characteristics of Brasov county: Bran - best known as "homeland" of rural tourism, but also for its important cultural traditions, the enterprising spirit of its people or for the most visited historical monument in Romania, Bran Castle; Prejmer (a community with a long tradition of ethnic coexistence, a city with a site on the world heritage list of UNESCO (the fortified church and the fortress) and which has determined the largest investment in Brasov county, The Industrial Park - Prejmer) and Vama Buzăului (which until the nineteenth century, had represented a frontier point located at the intersection of the roads linking the three Romanian countries, one of the most "green" rural areas of Romania, with a quasi-non-existent pollution and several Nature 2000 sites, situated in the Ciucaş Mountains).

In preparing the development strategies for a period of seven years (the period chosen to ensure the correspondence with the main European funding programs currently operational) a team expert of five consultants - experts has been engaged (a social development specialist, an education science specialist and a human resources specialist - the two authors of the article – specialists in economic development, environmental protection and civil

society / European citizenship), a team which has worked closely with a working group for development, where every person, institution or organization concerned to accomplish the strategy were invited to attend.
To achieve the three strategies of the aforementioned municipalities the following (joint) set of activities was undertaken:

1. The constituting of the Working Group for Development (WGD), composed of representatives of the local public administrative authorities, private companies and members of the civil society. Were invited to attend this group: elected and appointed individuals of the local government, business men, business or professional organizations, private entrepreneurs, personalities from various fields, representatives of the church, NGOs, representatives of the media.
This work was conducted through a public meeting where has been initiated the accomplishement of the strategy, where the objectives and benefits of its achievement and the methodology to be used were also presented.

2. The development context analysis and the drafting of the community profile, including here the analysis of the regional, national and international context (in order to develop an integrated strategy within these contexts of development). The SWOT analysis model has been used as the main tool of analysis and presentation, being supplemented with cost-benefit analysis and opinion surveys (at least five surveys / community, regarding major issues involved in the strategy development).

3.The defining of the vision and strategy goals, which was made with the participation of WGD, in order to obtain a general agreement on some principles, on certain economic interests, concerning environmental protection and an appropriate resource management. The consensual definition of the vision and objectives was made setting out the principle that a certain community with specific goals and objectives offers greater confidence to its members, increasing thus citizen participation and the degree of association according to its own interests, which would be more clear after a joint formulation of strategic objectives.

4. The development of policies and action plans. This work involved a transposition of development objectives in practical actions, included in the measure plans developed for each prior area of development. The projects facilitating the achievement of development goals and the action plans required to implement these particular projects have also been identified.

These plans include the main tasks to be completed, an estimated calendar, responsibilities (of different social actors), funds and the implementation and monitoring mechanism. The priorities set by the WGD were taken into account, and the inclusion of necessary projects was made based upon relevance, feasibility and sustainability. In particular, the projects financed by European funds were considered.

Focus groups were put together in order to accomplish this activity (at least five, for each strategy) and workshop-type small meetings (at least ten).

5. The development of the first version of the strategy involved both the reunion of the previously identified elements within a single material and the description of the methodology of implementation, monitoring and update, in order to be presented to WGD. For each community were taken into account: the investment plans / projects already developed / approved, the general urban plan and development documents prepared at a more general level (at the level of Development Region 7 "Center" of Brasov county and the rural development area under the Leader Axis + Program), marketing and business plans known by the local authorities, accessible funding programs, etc. available. This first version of the strategy was subject to a public debate in a public meeting held in the "open door" system.

6. The completion of strategies, the preparation of the adoption by the City Council and the final report of the consultancy team. After receiving comments from the members of the WGD, from other experts in development and the participants in the public debate, was developed the final form of sustainable development strategy, which has been subject to

public debate (as required by the laws in force). The suggestions, recommendations and amendments made were the basis of the final text, which was adopted by a decision of the Local Council.

Regarding the report of the expert team, it included as a distinct section, the strategy implementation monitoring measures to be undertaken by local authorities. The report also included a particularization of possible sources of funding conerning prior areas of development (from European funds and other funding sources).

3. LOCAL DEVELOPMENT STRATEGIES IN ACTION

Thus, three strategies resulted - corresponding to the development priorities of each community, which had for a nucleus two particular elements:

a. The analysis – diagnosis on the current situation, presented as a SWOT analysis, whose content was completed using a series of investigative tools (structured interviews, opinion surveys, cost benefit analysis etc.). Within every content of each development strategies were developed SWOT analysis for each of the areas currently associated with the concept of sustainable development:

I. The economic growth, with an emphasis on improving the business environment and development opportunities in services, industry, agriculture, trade.

II. Providing local public services, focusing on the authorities capacity to fund and provide public service in the following areas: public utilities, education, health, social services.

III. Civil society development, focusing to increase the involvement and participation of citizens regarding decisions.
IV. Qualification and retraining of the workforce, in order to meet new requirements of the European, national and local labor market;

V. Tourism sustainable development along with the protection of natural, cultural and historical resources of the community.
VI. Urban development, with emphasis on promoting urbanism policies and local infrastructure policies set at the local level, within the context of ensuring environmental protection.

b. Elaboration of the development vision, objectives, policies and action plans.
The development vision for each community expresses an ideal target, jointly shared with the planning development that meets the needs and expectations of citizens. After the elaboration of the development vision, the strategy objectives were defined - being identified based on results of consultations within WGD. The objectives were defined and ranked according to the expected time horizon (short, medium and long). Depending on the objectives established, the prior areas of development have been identified (where a special attention was given to areas whose development depends mainly on local resources).

In formulating the prior objectives and areas, the complexity of local factors that may influence sustainable development were taken into account (such as: business environment situation, local economic context and the national one, employment situation, efficiency and equity of public services provided by local authorities; availability of stakeholders to assume roles and responsibilities, expectations and priorities of community members).

Also, in definition the objectives and areas of development were considered the approaches currently associated with sustainable development: environmental protection, proper use and management of resources, sustainable economic development, the need to develop local partnerships etc.

For the implementation of the vision and objectives set by the WGD, proper policies and action plans have been formulated - used in the implementation of the strategy:
- Policies are designed to institutionalize procedures and practices that will lead to the implementation of the strategy's objectives throughout the community. Thus, the effects of the actions and the decisions and behaviours inconsistent with the objectives will be limited. By their very clear structure, the policies will help to keep the strategic vision and the completion of the development objectives;

- the measure plans represent objectifications of policies in each development area, being defined in terms of concrete actions, directly measurable. These plans are working tools for the persons / organizations involved in implementing the strategy, the true "roadmap" developed for each domain / sub-domain of sustainable development.

4. CONCLUSIONS

1. The value of a strategy implementation for sustainable development in rural areas consists in institutionalizing the strategic plan. It is essential to create an organizational and financial base to support this particular plan. Strong links with organizations and programs that could harmonize the strategy, must be created. There are required certain techniques for financial planning and project management, without which no strategic development plan could be accomplished.

2. The existence of measure plans developed for each area has proved a useful methodological option concerning the monitoring of strategy implementation. Each measure plan is observed by a group of local experts, aiming: the accomplishment of responsabilities (self) assumed by local actors of development; the development of project financing documentation set, the adequacy of budget planning. These measure plans are regularly reviewed in terms of classifying operational objectives, the first operation required in updating the adopted strategies.

3. The unitary applying of action plans will ensure the success of integrated planning of community development. Integrated planning is a modern solution for the development of initiatives and institutional, administrative and socio-economic actions, which lead to the optimization of resource use, in the purpose of change management and maximizing the positive impact of change, according to the established strategy.

4. Monitoring the development process of the strategy is an essential action for an early detection of its adjustment needs or of the implementation process development. For a successful strategy implementation, all community stakeholders must be involved (depending on their field of competence / expertise) in designing the process of evaluation and in the establishment of indicators for achieving the concerned strategy, according to socio-economic developments at the local, county, regional or national level.

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ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

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Abstract: *Scientists' activity leads to the increasing understanding of some phenomena, such as: climate changes, the accelerated pace of using resources, demographic trends, environmental degradation, etc. The paper will present some important issues related to the exploitation of the natural resources from the environment within sustainable development.*

Key words: *environment; sustainable development,mineral resources, mineral resources industry (MRI), biodiversity*

1. CAPITALIZATION OF MINERAL RESOURCES IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT

The concept of sustainable development was launched by the World Commission on Environment and Development of the UN in 1987, known as the Brundtland Report[1].

In 1987 *Gro Harlem Brundtland*, as President of the World Commission on Environment and Development, presented the report "Our Common Future", which defined sustainable development as "*the development that meets the present needs without compromising the ability of the future generations to meet their own needs*".[2]

The definition speaks about the need of providing intergenerational equity, but equity within the generations is equally promoted, emphasizing the need of providing equality of the opportunities. Thus, sustainable development implies providing progress on four fronts simultaneously: economic, social, environmental and technological.

Overall resources are available means to be used in a particular circumstance. If we consider the environment, we mean natural resources, which are recommended by the potential offered by the interdependence of the geological and biological factors.

Furthermore, the field of geology allows us to recognize the concept of mineral resources, in fact all the substances located over-terrestrial / intra-terrestrial currently and / or in the future in use.

The mineral resources are the natural accumulations, which could be exploited, encompassing mining products - particularly the iron ore, industrial minerals, construction materials, ornamental minerals and rocks, solid and liquid fossil fuels, underground water and minerals.

The society depends on the availability of the mineral resources and capitalizes it through *the mineral resources industry* (MRI).

[1] The Brundtland Report identifies the most important environmental issues that directly threatens the development of many countries: excessive population growth, deforestation and overgrazing causing significant desertification, destruction of tropical forests threatening plant and animal species, exploitation of fossil fuels and deforestation that cause the green effect and disturb the whole world's climate, acid rain threatening all aquatic and forest ecosystems, erosion of the ozone layer of the atmosphere, etc

The contribution of mineral resources to our daily life is huge: they are used as building materials, sanitary facilities, insulation, paint, electronics / electrical appliances, furniture, clothes, food, cosmetics.

The capitalization of mineral resources stimulates a country's economy, favouring the way the labour employment and the infrastructure development are dealt with, while providing the state with income from the work performed by MRI.

We must draw people's attention to the fact that mineral resources are not renewable and therefore must be used judiciously in the nation's interest. The resources are endless on a cosmic scale and could cover the needs of a population that tends to infinity.

The macro politic-economic element affects MRI because:

- it promotes access to high quality diversified products, in the most productive regions of the world;
- it provides opportunities for the exploitation of the large mineral resources, at low costs of extraction.

Within the field of capitalization the mineral resources in the context of global sustainable development, we face the following issues:

- the global control factors: population growth (from 6 to 8-9 billion in 2025), increased demand for 10 times in a 4-fold increase in population and, in the next 50 years, the demand for mineral resources tends to grow 5 times);
- the differentiated approach, generating gaps between the industrialized countries, is at the heart of the global system.

The industrialized countries, characterized by the New Economy style, have a bimodal trend, i.e. some countries focus either on technological development coupled with imported mineral resources (Western Europe, a region poor in mineral raw materials), or on technological development doubled by MRI (Canada, USA and North America have a great mineral potential).

In this respect we can say that the developing countries have partially lost the occasion of alignment to the latest technological progress and are forced to rely on the MRI, remaining in the position of exporting raw materials to the countries from the core of the global system.

If we look at the structure of the potential of mineral resources from Romania nowadays, we notice:

- the metal-rich deposits are totally exhausted, with few exceptions; there are still some accumulations of precious metal in the Gold Quadrilateral (in the Brad-Săcărâmb and Bucium-Red districts) as well as copper deposits exploitable in small and medium careers;
- the oil reserves cover only half of the domestic needs.

The MRI worked in Romania as a mono-industry generally located in river basins that have suffered significant degradation of the natural environment. As such, the past local mining has left us a legacy that does not fulfil the criteria of economic, environmental and social conditions required by the EU for sustainable development.

Many mines were closed after Romania had joined the EU, due to their inefficient activity, strongly subsidized, as well as because they did not meet the criteria of environmental protection. It must be remembered that: "One of the greatest challenges facing the world today is integrating economic activity with environmental integrity and social concerns".[7]

2. ENVIRONMENT, FRAMEWORK FOR THE MANIFESTATION OF SUSTAINABLE DEVELOPMENT

In his many searches, man has always wanted to know the environment. Its moral duty is to protect the environment in order to ensure the next generations a better future.

People have become aware that it takes knowledge of ecosystems and

resources for a better quality of life. In time ecosystems have undergone changes necessary for an efficient food and energy production and for the many goods that humanity needs.

Unfortunately all these human needs have been representing a danger to the mankind's future. For example, 75% of the marine fish stocks have been emptied due to over-fishing, being at the limit of their biological regeneration; the area covered by forests has decreased by half; 58% of the coral reefs are threatened by destructive fishing techniques; an area of over 65% of soil suffered from degradation.[5]

The development of some new strategies for sustainable development can help us provide real, long-term protection of the environment.

Sustainable development management should draw up complex programmes in order to ensure real and efficient protection of environment in all its forms. These programmes will have to start from a realistic assessment of the quality of life and to be based on the analysis of a system of economic and social indicators, linked with a set of ecological indicators that the scientist N. N. Constantinescu systematised as follows: [4]

- measure of exploitation of natural resources by different activities;
- degree of normality of ecological cycles of renewal of renewable resources;
- evolution of environmental quality.

World's natural resources (oil, coal and gas) have decreased significantly. Unfortunately, human beings forgot that these resources are not renewable or, better said, their rates of regeneration is extremely slow (hundreds of thousands of years), making them practical non-renewable for the today's socio-economic system use.

Mineral resources are also declining, their exploitation prompting many environmental problems (see Rosia Montana).

Romania has reached the acceptable limit of biodiversity loss. We must understand that the loss of biodiversity does not determine immediate visible effects. Strictly quantitative assessment of biodiversity loss leads to the idea that recovery, in quantitative terms, is possible.

In fact, quality losses are irrecoverable (a hectare of forest loss of several thousand square meters of natural grassland, 2-3 species of insects are insignificant for a normal man, a daily consumption of resources).

A hectare of forest is not just a few hundred trees, some shrubs and herbs, but also a complex network of a two-way relationship from the spatial-temporal relationships established and consolidated among the many community members of plants and animals.

Biodiversity conservation and the management of those sectors of the economy based on direct exploitation of biodiversity (agriculture, forestry, and fishing) are traditionally government's responsibility (or governmental agencies' responsibility).

These structures use, primarily, for biodiversity management, administrative procedures and adjustment tools, but they do not use typical market processes, remaining very traditional and far from the requirements of the globalization process (U.S. maintains the state monopoly over forests, mountains, rivers, lakes, coastal areas and life wildlife in general).

Moreover, at least some of the methods based on the market and proposed for biodiversity management have not yet been tested, and the managers' discernment on the use of biodiversity as an object of the market is questionable.

Unfortunately the results of the reconciliation of perpetual growth with the resolving of economic, social and environmental problems are not convincing. Moreover, the improvement of the production techniques and the dematerialization of the economy allow only relative savings of resources, insufficient if production continues to grow absolutely.

Lester R. Brown has tried to launch a project to create economy for our planet (the eco-economy type) and denounced the dominant economic model as being unsustainable. In his opinion, this economic model is just an interesting intellectual exercise, purely intellectual.

At one point Lester R. Brown said: *"... a forest located in the upper basin of a water course may provide services such as flow control and recycling of rainfall inland, services which are several times more valuable than its production of logs. Unfortunately, market signals do not reflect this because the people who cut trees do not have to handle the costs of the reduction of forest services."*

In this context, the eco-economic approach is particularly important for achieving sustainable development aspirations. Thus, the result is the need to overlap ecology with economy, respectively the need to integrate environmental requirements in the evaluation of economic activities.[3] This becomes necessary because the signals the market transmits are incorrect and do not reflect neither environmental damage nor the costs borne by society.

Unfortunately this is reality. During the last decade sustainable development has become a perverted notion and the business world made it synonymous with sustainable growth.

Conclusions

From all the above, I can say that the great changes that have taken place in the world and have caused deterioration in the relationship between human society and natural ecosystems.

It is not enough to propose sustainable development programmes. They are required to be put in practice.

I cannot say that no efforts are made for this. All humanity is trying to teach themselves, become aware of the importance of the environment.

Humanity must understand that the idea of *"economicity"* must be included in all fields.

We all have to understand that technical progress in all sectors can influence environmental quality. Thus, we can create new ways to extend the use of the *"polluter pays"*.

In this problematic context, the approach of the relationship resource-environment is dominant, focusing on those risks related to certain methods of use and exploitation of resources.

Economists and environmentalists around the world have the duty to take into account the pollution, degradation and risks, which the economic activities, the way of production and consumption provoke to environmental causes.

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THE HARMONY BETWEEN WHAT ONE THINKS AND DOES – THE BASIS OF LEADERSHIP. SEDUCTION DOES NOT NECESSARILY IMPLY MANIPULATION

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Abstract: *This paper has the purpose of transmitting information and ideas about the capacity to seduce characteristic of the persons with leadership skills. What impresses, enlivens, fascinates and hypnotizes in a person with leadership skills is the profound side of his/her charm, which works as a magnet wit :the harmony between what one thinks and does.*

The capacity to seduce is characteristic of the persons with leadership skills, as it is innate and it consists of **the personal charm some of us are born with and that we increase by means of cultural polishing up, materializing it in the sensation of dominating charm exercised more or less consciously over other individuals.** The seducer controls the seduced. To be the desired person is a subtle form of control. It is equally true that the **seducer,** as the person seducing others, **seduces himself/herself too**, depending more or less on the strength of his/her desire for power. The stronger the desire is, the more we may speak of a malignant form of narcissism and manipulation.

The seducer's portrayal segregated on genders appears:

- fragile and distinguished as a passive, defensive alternative of charm, even more redoubtable, (in women),
- energetic, fanatic, determined and clairvoyant, as an active and offensive alternative to charm, (in men).

Scientific research in the field of social psychology has demonstrated that, similarly to the world of bees, where the vast majority is made up of nurses and only a minority represents the queens, in the world of human beings, **three quarters of the individuals lack charm**, having nothing seductive in them. This type of people are terrified of inter-human relations that imply proximity, because they regard them as hazardous and therefore do nothing in order to bring their fellow-creatures closer. On the contrary, they do all they can to send them away. The paradox is that these individuals, who do all they can to isolate themselves, consider that the greatest threat that lurks is for them not to be accepted, or to be rejected, abandoned and humiliated by others. This majority of people build a scenario in their minds according to which they cannot be loved, given the fact that they do not deserve to be loved. They are the same people who surrender to the subjective perception that a charming, seductive fellow-creature, the leader, possesses something that they need.

We are currently witnessing the apparition of literature on seduction techniques that promise the impossible, that is to transmit the competence to seduce to anybody, even to those individuals who lack charm, i.e. to certain people who fear the idea of not being accepted by the group they are a part of, who dread rejection, humiliation abandonment, who lack self-confidence, nurturing the belief that they do not deserve to be loved and are not entitled to hope to ever be loved. It is cruel to promise sight to the blind, on condition they attentively read a couple of books.

Undoubtedly, the principles promoted by this type of scientific literature on the seduction techniques are correct, but they exclusively address people born talented and charismatic. Otherwise, persons who unconsciously avoid seduction applying them will turn them into anti-seduction techniques.

Thus, a person who lacks charm, is insecure or has no self-confidence may intend certain gestures to attract others, but by monitoring their accomplishment he/she will make the charm of the interaction disappear and will let show the rigidity and lack of spontaneity. Seduction techniques are for those who try to make it look as if they were born charming, serving as a shield that the false seducers will put between themselves and those whom they wish to manipulate, so that they would feel safe and avoid being attracted or touched, thus losing control.

Similarly dangerous is the excessive use of the genuine native charm, with the purpose of dominating those in the proximity, as an obsessive need for power, case in which the manipulator will seduce himself/herself beyond limits, ending up smashed by the force of his/her own desire for power. This is the situation that designates the concept of exacerbated, malignant narcissism, where seduction operates as a defence system against painful feelings of rejection, abandonment and depression, in an attempt to convince the ill ego that it is attractive, wanted, loved and full of life, by means of confirmation of the personal value regarded as a toll of the manipulated victims, gathered in large numbers on display on "the hunting trophy wall".

Seduction and manipulation are possible manifestations of the individuals' personal strength, both deriving from the innate charm and aiming to influence the other. **The difference is given by the pursued purpose**, which depends on the strength of the individual's personality, expressed in dimensions such as self-confidence, congruence, authenticity and morality.

The seducer might make use of the attraction created in order to exercise his power over those seduced, either by keeping the effect of the seduction to himself, or by giving up on his own glory and orienting his/her strength toward higher prizes. In the first case, we are talking about manipulation, while in the latter we speak of mentors, masters, professors, vibrant leaders, who **deviate their disciples' fascination away from their own person, from their knowledge, to the idea that those whom they have inspire will be able to do things they were not aware they could.**

Without the strong emotions nurtured by the group towards the leader, any activity becomes unattractive.

To manipulate is to use people by seducing them, including erotically, to the end of using them for purposes that are not their own. It is essential not to mistake manipulation for seduction, the latter being most often beneficial for the one experiencing it, as it elevates him/her to another spiritual dimension.

To seduce is to propose another a higher level of existence that relies on such aspects as living more intensely and expecting more from life.

What differentiates a manager from a leader is charisma, that is the individuals' magnetism, that certain '*je ne sais quoi'*, a mystery even for the one blessed with innate charm, based on character traits, which he /she tries to hide and not on something he/she would be convinced to show, as a personal advantage. The leader's charisma relies on authenticity and that is because artifice and control have nothing to do with seduction, as a phenomenon developed in the depths of personality.

What impresses, enlivens, fascinates and hypnotizes in a person with leadership skills is the profound side of his/her charm, which works as a magnet with: **THE HARMONY BETWEEN WHAT ONE THINKS AND DOES.**

2008-2009 Survey

The survey aims to evaluate the charisma of future officers of the Air Force and the Army, military leaders with a degree in 'organizational management'. The analyzed data have been collected by the filling out of the form presented in Figure 1, containing the items of the psychological tests combined, aiming the dimensions that measure the magnetism of the personalities of the subjects from within the two groups.

The instruments used for the data collection

A battery of psychological tests has been prepared, containing the adapted variants of the comp onents below:

Congruence 1

1.	YES	NO	**11**.	YES	NO	**21**.	YES	NO
2.	YES	NO	**12**.	YES	NO	**22**.	YES	NO
3.	YES	NO	**13**.	YES	NO	**23**.	YES	NO
4.	YES	NO	**14**.	YES	NO	**24**.	YES	NO
5.	YES	NO	**15**.	YES	NO	**25**.	YES	NO
6.	YES	NO	**16**.	YES	NO	**26**.	YES	NO
7.	YES	NO	**17**.	YES	NO	**27**.	YES	NO
8.	YES	NO	**18**.	YES	NO	**28**.	YES	NO
9.	YES	NO	**19**.	YES	NO	**29**.	YES	NO
10.	YES	NO	**20**.	YES	NO	**30**.	YES	NO

Answer collection form Figure 1

- Psychological test
  - evaluates the „congruence' dimensions -1- the capability of being happy",
  - The bibliographic source of origin is the 'Corpus of psychological tests to get to know yourself better', by Gilles D'Ambra, Litera International Publishing House, 2008, page 30.
  - The evaluation scale is of 4 points distributed as below:

1	2	3	4
Rarely happy	Sometimes happy	Happy	Very happy

The battery of psychological tests used for the collection of the data needed to verify the hypotheses materializes in the adapted instrument, presented in the succession of items below:

Check the box each time your answer to the statements below is YES:

□ The last time you seduced a man/woman you were very disappointed (he/she was leaving the country the next day, was married etc).

□ You have at least twice so far in your life got sick or had an accident before leaving for holiday, (for instance you broke your arm before setting off to skiing, you injured your leg on a beach-cliff etc.).

□ You have met depressive /alcoholic/intoxicated/violent women/men etc. at least once).

□ You never play the lottery, or you play every week.

□ You find it hard to wake up almost every morning.

□ Compliments make you feel bad.

□ You often lose your belongings (notebook, pen, keys, glasses, book…).

□ In the past 6 months you have at least once had a serious accident (a twist, fracture, burn etc.).

□ For the past year you have been sick at least 3 times (influenza, angina, herpes etc.).

□ You only work and/or look after the house/the children and hardly have a life of your own.

□ You have not laughed in 3 days.

□ When you need help (at work, from your partner, from your children etc.), you have to ask others to help you.

□ You often, at least once a week, doubt the fidelity of your partner.

□ You think someone wants you at this moment.

□ You tend to eat whatever you find and/or tend to eat fast.

□ You feel like you are always making mistakes.

□ At the current date you are not feeling very cheerful.

□ You have a migraine at least once a week.

□ You have been subjected to abuses in your childhood or adolescence.

□ You are very spendthrift or, on the contrary, very economical.

□ The alarm failed to ring at least 3 times when it was important for you to wake up.

□ You often wake up between 1 and 4 am.

□ You have at least twice been betrayed by a friend.

□ You have at least twice lost an object close to your heart (a gift from the spouse, family jewellery).

□ You have taken anti-depressives or anxiolytics in the past 6 months.

□ You are often or never annoyed.

□ You have often got stuck in a crucial moment (final exams, driver's license, job interview etc.) even though you were well prepared.

□ When the doctor prescribes you medication or vitamins, you do not take them.

□ You believe nice people to be boring or uninteresting most of the time.

□ You cannot recall any beautiful evening or watching any movie that you really liked in the past three months.

Interpretation of the answers

Interpretation of items.

The number of checked boxes designates the category that the subject falls under.

Score < 8 points.

The type is very happy

- Characteristics: optimistic / very resistant in the face of ill-fortune for a long amount of time / high capacity of recovery after failure and disappointment / doesn't look for scapegoats and doesn't pity him/herself / considers that the misfortunes and accidents that one survives only make one stronger and more resolute.
- On a scale measuring the individual's congruence through his/her ability to be happy, this subject scores 4 points.

8 points ≤ Score < 15 points

The type is happy

- Characteristics: resistant to stress / optimistic / capable of getting great satisfaction from simple things / is able to self-evaluate correctly / doesn't fear failure / is capable to stay calm and rational when not confronted with discomforts caused by others / is capable to cope with the life's blows.
- On a scale measuring the individual's congruence through his/her ability to be happy, this subject scores 3 points.

16 points ≤ Score ≤ 21 points

The type is sometimes happy

- Characteristics: does not believe in happiness / avoids problems / submits to his/her fate / doesn't hope for the better / is very pragmatic / perseverant in his/her ideas, projects / makes do acceptably when receiving tough blows / diminishes the risks of failure by not nourishing false hopes and limiting the occasions on which he/she might get hurt.
- On a scale measuring the individual's congruence through his/her ability to be happy, this subject scores 2 points.

Score > 21 points

The type is rarely happy

- Characteristics: pessimistic / very vulnerable to any external events / overanxious / makes no effort to become happy / is very prudent / expecting misfortunes to occur any time, he/she is extraordinarily resistant to the lesser or stronger troubles and trials of life / cannot be disappointed / can only be surprised pleasantly.
- On a scale measuring the individual's congruence through his/her ability to be happy, this subject scores 1 point.

The statistic instruments used to measure the probability of error of the results

$$\text{A var age} = \frac{\left[\sum(\text{value} \cdot \text{number of subiects})\right]}{\text{Sample group}} \quad (1)$$

$$\text{S tan dard deviation} = \frac{\sum(\text{value} - \text{a var age})}{\text{number of value} - 1} \quad (2)$$

$$\text{Variance} = \frac{\left[\sum \text{values}^2 - \left(\sum \text{values}\right)^2 \Big/ \text{number of values} - 1\right]}{\text{number of values} - 1} \quad (3$$

The "t" test is applied in its form in which two averages calculated in two separate, independent groups are compared by applying the formula:

Note : Standard deviation = Sd
Standard common deviation = SCd
Sample group=Sgr
Deviation Sample group=DSgr

$$t = \frac{\text{a var age of samplel} - \text{a var age of sample2}}{SCd \cdot \sqrt{\frac{1}{\text{Sample group1}} + \frac{1}{\text{Sample group2}}}}$$

$$SCd = \sqrt{\frac{DSgr1 \cdot (Sgr1 - 1) + D\,Sgr2 \cdot (Sg2 - 1)}{(Sgr1 + Sg2) - 2}}$$

$t_{calculated} \leq t_{critical} \rightarrow$ the null hypothesis is accepted

$t_{calculated} > t_{critical} \rightarrow$ the null hypothesis is rejected

The 't' test is applied in its forms comparing the average calculated in a single sample.

$$SD = \sqrt{\frac{\sum values^2 - (\sum values)^2 / Sgr}{Sgr - 1}}$$

$t_{calculated} \leq t_{critical} \rightarrow$ the null hypothesis is accepted

$t_{calculated} > t_{critical} \rightarrow$ the null hypothesis is rejected

The hypothesis verified within the 2008-2009 study

Two study groups were formed whose subjects are military students. They agreed to take part in the study:

Group 1- made of 13 non-flying, military aviation students (air traffic controllers) and artillerymen of the Air forces.

Group 2 – made of 24 infantry military students of the Army.

The hypothesis we aimed to verify is:

- **Are most of the subjects capable of expressing psychological congruence through their capacity to be in harmony with themselves, which translates into consciously experiencing the feeling of happiness, in both groups or not? This hypothesis may have the significances below:**
- **The null hypothesis: 'optimism, resistance when facing difficulties, great capacity of recovery after effort or failure, or disappointment, the faith that what does not kill you makes you stronger'.**
- **Rejection of the null hypothesis: 'the avoidance of problems, resignation in front of destiny, inability to hope, pragmatism, the limitation of the risk of failure by giving up hopes and the limitation of the occasions in which it is possible to get hurt.'**

Congruence through their capacity to be in harmony with themselves		
Sample 1 (efective=13)		
Score	Efective	%
4	12	92,3%
3	1	7,69%
Sample 2 (efective=24)		
Score	Efective	%
4	15	62,5%
3	9	37,5%

$$\sum values^2 = 4^2 \cdot 12 + 3^2 \cdot 1 = 16 \cdot 12 + 9 \cdot 1 = 201$$

$$(\sum values)^2 = (4 \cdot 12 + 3 \cdot 1)^2 = 51^2 = 2601$$

$$Sd = \sqrt{\frac{201 - 2601/13}{12}} = \sqrt{\frac{201 - 200{,}076}{12}} =$$

$$= \sqrt{\frac{0{,}924}{12}} = \sqrt{0{,}077} = 0{,}2774887$$

$$t_{calculated} = \frac{3{,}923 - 4}{0{,}2774887 / \sqrt{13}} =$$

$$= \frac{-0{,}077}{0{,}2774887 / 3{,}6055512} = \frac{-0{,}077}{0{,}0769615} =$$

$$= -1{,}0005002$$

$-t_{calculated} = -(-1{,}0005002) = 1{,}0005002$

$t_{critical} = 1{,}36$

$-t_{calculated} \leq t_{critical} \rightarrow$ We therefore conclude that a risk of error of 20%, **is admited** in sample 1 - **The null hypothesis: 'optimism, resistance when facing difficulties, great capacity of recovery after effort or failure, or disappointment, the faith that what does not kill you makes you stronger'.**

$1{,}0005002 \leq 1{,}36$

congruence through their capacity to be in harmony with themselves în sample 2 :

$$\sum values^2 = 4^2 \cdot 15 + 3^2 \cdot 9 = 16 \cdot 15 + 9 \cdot 9 = 321$$

$$(\sum values)^2 = (4 \cdot 15 + 3 \cdot 9)^2 = 7569$$

$$Sd = \sqrt{\frac{321 - 7569/24}{23}} = \sqrt{\frac{321 - 315{,}375}{23}} =$$

$$= \sqrt{\frac{5{,}625}{23}} = \sqrt{0{,}2445652} = 0{,}4945353$$

$$t_{calculated} = \frac{3{,}625 - 4}{0{,}4945353/\sqrt{24}} =$$

$$= \frac{-0{,}375}{0{,}4945353/4{,}8989794} = \frac{-0{,}375}{0{,}1009465} =$$

$$= -3{,}714839$$

$-t_{calculated} = -(-3{,}714839) = 3{,}714839$
$t_{critical} = 2{,}81$

$t_{calculated} > t_{critical}$ → We therefore conclude that a risk of error of 1%, **is in sample 2 - Rejection of the null hypothesis: 'the avoidance of problems, resignation in front of destiny, inability to hope, pragmatism, the limitation of the risk of failure by giving up hopes and the limitation of the occasions in which it is possible to get hurt.'**

3,714839>2,81

Sample 1 **Average** = 6,46
Standard deviation = 1,4500287

Sample 2 **Average** = 5,66
Standard deviation = 2,2778072

$$SCd = \sqrt{\frac{1{,}4500297 \cdot (13-1) + 2{,}2778072 \cdot (24-1)}{(13+24)-2}} =$$

$$= \sqrt{\frac{1{,}4500287 \cdot 12 + 2{,}2778072 \cdot 23}{35}} =$$

$$= 1{,}9939974$$

$$t_{calculated} =$$

$$= \frac{6{,}46 - 5{,}66}{\sqrt{\frac{1{,}4500287 \cdot 12 + 2{,}2778072 \cdot 23}{35}} \cdot \sqrt{\frac{1}{13} + \frac{1}{24}}} =$$

$$= 0{,}8 \,/\, 1{,}9939974 \cdot 0{,}3443684 =$$

$$= 0{,}8 \,/\, 0{,}686696 = 1{,}1650435$$

$t_{calculated} = 1{,}1650435$
$t_{critical} = 1{,}69$

t calculat ≤ t critic → **With an error risk of 10% we conclude that** 92,3% în Sample 1 and 62,5% în Sample2 Null Hypothesis is accepted: **'optimism, resistance when facing difficulties, great capacity of recovery after effort or failure, or disappointment, the faith that what does not kill you makes you stronger'.**

1,1650435≤ 1,69

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EMOTIONAL INTELLINGENCE IN THE MILITARY ORAGANISATION

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Abstract: *For years now, teachers, human resource specialists, trainers, recruitment teams, managers and others know what differentiates normal workers from the ones who are different than the rest of the group. It is not about technical abilities – these can be relatively easily learned and it is easy to determine if one person has them or not. It is not necessarily intelligence either. It is something else, something you know it is there if you see it, but it is difficult to explain it clearly. It is about personal abilities.*

After several years of discussions on the personal abilities, the people working in training, teaching, management and recruitment have been convinced. Discovering the essence of what makes people stand out at their work place, has brought this issue to the forefront. From now one, the subjective term "personal abilities" can be replaced with a more exact and objective one – "emotional intelligence".

Those who have never appreciated the ability to "read" people, to understand them or understand their feelings because these were too "soft" and immeasurable, will have a very exact measurement instrument. This is because the emotional intelligence is a type of intelligence or a set of abilities.

Key words: military organization, leader, emotional intellingence.

Which is the role of feelings at the work place?

Let's consider, for examples, feelings such as fear, anxiety or worry. Let's suppose we are talking about a car factory and that the management has decided to grow productivity. Employers will have to work faster than they did before and still keep the same quality. If the imposed speed still stands within reasonable limits, people will mobilize and will become aware of the fact that they will have to be more careful and work harder. If even a more increased rhythm is requested, at a level that employers will consider unbearable, they will begin to worry. They will worry not to make mistakes, not to get hurt. They can ignore these fears and keep on working. If they ignore their feelings, all may go well or, on the contrary, many mistakes may appear and employers may lose their jobs.

Worries, fear and anxiety are feelings that could mean something is not going well. Worries may draw an alarm on future problems. When worries regarding the

increase of production rhythm appear, they can be used in a constructive manner. For example, the sleep hours can be increased to be more rested at work. Or the breaks between different operations may be reduced. Or the management can be made aware of the fact that, as more products will begin to be manufactured, these will have increasingly more flaws.

All feelings are important at the work place, not just fear or worries. Satisfaction, for example, is a sign that things are going well. A feeling of contentment at work may mean a job well-done. It is important to know that feelings contain critical information that one needs to consider if he wants to be efficient.

Where does the emotional intelligence come in the success of work?

The emotional intelligence can not predict by itself the success of work, a satisfying career or an efficient leadership. It only represents one of the important elements.

The quality of being a good user of emotional intelligence also includes the understanding of the fact that it is not and should not be perceived as a replacement or substitute for skills, knowledge or ability acquired over time. Emotional intelligence increases the chances of success, but it does not guarantee it in the absence of necessary knowledge.

Emotional intelligence always helps the individual. It is a good thing to have it. But the other abilities and competences are also important.

Using the emotional intelligence at work

Further on, we shall present several ways in which the emotional intelligence can help everyday work.

Identifying the emotions

- You have to be aware of your own feelings and emotions, not to get “blinded” by feelings;
- You have to be aware of the others’ feelings, because this is a key factor when working with people.

Using the emotions

- Creativity may come from the ability to generate a certain estate or an adequate feeling;
- To feel “for” the others, to be able to be empathetic, these may come from the ability to generate a feeling that others do not have.

Understanding the feelings

- To know what motivates people;
- To understand the others’ opinions;
- To understand and to be able to handle with interaction within the group.

Controlling the emotions

- To always be aware of your own emotions, which contain valuable information and to solve them for solving problems;
- When you are sad, find out what caused the disappointment and solve the problem;
- When you are upset, find out why you are frustrated and solve the problem;
- When you are anxious, find out why you are worried and solve the problem;
- When you feel happy, find out what made you happy and repeat it.

Emotional intelligence in leadership

No creature can fly with only one wing. A talented leader is the one whose head and soul – the ideas and feelings – go hand in hand. These are the two wings that allow a leader to fly.

Without these fundamental abilities, the access is forbidden. However, a leader does not only need an intellect. Leaders turn a vision into reality by motivating, guiding, being a source of inspiration, listening, convincing and more especially creating resonance. As Albert Einstein warned us, "We must be careful not to make from the intellect a divinity. He most certainly has strong muscles, but no personality. They can not lead, they can only serve."[1]

One of the many definitions of leadership claims that this is an influence process of others to fulfil the mission, starting from: a purpose; guidance; and insuring motivation.

What is expected from a leader? To get results.

How? Through people.

These are the questions that are frequently asked in this wide field. Therefore, we can state that leadership happens under the context of interpersonal relations. The better skilled a leader is in handling relationships with the people he leads, the more efficient he is. True leaders give us enthusiasm, stimulate our imagination and motivate us. They can stir up the passion for the things we achieve together and they stimulate all that is good in us.

True leaders use intelligence. They know how to manage their own emotions, same as they know how to perceive and control the emotions of a group, thus clearing up the impact of their own actions and expressions. Therefore, a leader's Emotional Intelligence coefficient is an extremely important element both for the success of that leader and for the success of the organization he manages.

The term of "Emotional Intelligence" contains two basic elements: "emotion" and "intelligence" and they refer to understanding, accepting and giving intelligence to our emotions. A leader's fundamental task is to inspire positive feelings into the ones he leads. From this point of view, the emotional intelligence allows a leader to fulfil his objectives. Each of the four areas of emotional intelligence – self-knowledge, self-control, social consciousness and relationship management – contributes to the resonant

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leadership with an essential set of abilities. These areas are obviously profoundly interconnected, with a dynamic relation between them. For example, a leader can not control his emotions well if he is unaware of them. And if his emotions are out of control, then his ability to control relationships is also affected. Therefore, the EI leadership is built on a self-knowledge basis.

Self-knowledge – often neglected in the military field – is the foundation for all the rest: if we can not detect our own emotions, we will not be able to control them and much less to understand the ones whom we train or with whom we interact. Leaders who know themselves very well are connected to their own inner signals. They notice, for example, how they are influenced by their own feelings and how these affect their professional performances. Instead of letting anger accumulate until it blows, they detect it when it begins to grow and they can see what is causing it as well as what constructive measures they can take. Leaders who do not have such a self-knowledge can lose their patience, but they have no idea why they are the mercy of their emotions. Self-knowledge also plays an essential place in empathy, namely feeling how someone else sees the situation: if someone permanently ignores his feelings, he will not be able to notice the others' feelings as well.

The social consciousness – more especially the empathy – provides the next step towards the leader's basic responsibility: generating resonance. If he knows the others' feelings, the leader can say and do what is best suited, either for settling emotions, calming the anger or joining the others' joy. Adjustment also allows the leader to understand which are the common values and priorities by which the group can guide.

Using the same model, a leader who lacks the ability for empathy will answer without realizing on a wrong tone, his words and actions generating negative reactions. Empathy, which means listening to the others and understanding their opinions, allows leaders to connect themselves to the emotional channels between the people who create resonance. By adjusting, leaders can polish their messages, in order to keep the timing.

Finally, once the leaders understand their own vision and values and they are able to perceive the emotions of the group, the abilities of relationship management may bring the resonance. However, in order to direct a group's emotional tone, the leaders must, first of all, have a clear perspective over their own intentions and priorities – which bring us back to the importance of self-knowledge.

These dynamic relations between the four areas of emotional intelligence do not only have a theoretical, but also a practical importance. They are the key ingredients of the emotional intelligence-based leadership – of the resonance.

Either we are talking about small changes in a company, or the fact that the organization is in a severe crisis, all eyes turn on the leader, waiting for his reaction. This reaction will work as an emotional guide. Through his answer, the leader offers the group a possibility to interpret the events' significance and thus to emotionally react to them. Even if the leader is very good from the point of view of his "technical" abilities, if he

fails to direct people's emotions into the right direction, nothing will work as good as it could have or should have worked.

The leader's emotional role in training subordinates

„Change is not necessary as survival is not mandatory". Charles Darwin used to say that it is not the strongest organisms that survive, but the adaptable ones. This happens in nature and it also applies to the organizations' world, where people are involved. The successful organizations have understood how important the permanent adjustment to a continuously changing environment is.

To be able to make the correct changes in time and to keep or earn competitive advantages, an organization needs the right people and efficient leaders. Leadership is a wide concept, with a wide variety of definitions and perspectives. In fact, anyone who can influence other people's way of thinking, behaviour and attitude, with the purpose of reaching a particular objective, is involved in a leadership act.

Leaders should not necessarily be overly "kind". They must realize the fact that the way they communicate, their style and behaviour affects the state of mind and performance of the people in their team. A leader's emotional art consists, for example, of imposing professional demands without uselessly bothering people. There are moments when a leader needs to be tough. Being a leader means taking decisions without hesitating or bluntly. It means being strong, knowing how and when to say "no" and knowing how to give a negative, but constructive feedback when you are not satisfied with the results of your people. In order to do this successfully, the leader should know he can count on a positive history of the relation with his people.

The trainer Avram explains the phenomenon of low attention given to emotions through that we do things as we have been taught to do them. Unfortunately, nobody teaches people, neither at schools, nor at work, how to handle the problems that occur in the world of interpersonal relations", he says.

In the managerial language, there are typical expressions, such as: "We do business here. Let's leave emotions aside." The existence of an organizational culture which does not allow showing emotions, plus their own belief that talking about them is a sign of weakness, makes employees suppress their emotions. "Anger explosions cause serious damage for us", claims Avram. For example, clients from the banking field have demanded stress and anger management courses. Service companies and more especially that involve a direct interaction with the client are the most affected by emotions. "A man feels irritated, frustrated, upset, disappointed, he has worse performances than an optimistic person, who trusts himself, who feels fulfilled, respected and who receives respect and the attention of people around", adds the trainer. The same thing happens in the military environment where the leader has direct contact with the subordinates and working with emotions is not something unfamiliar to him. Unfortunately, not even here,

the organizational culture does not stress enough on training the leader from the point of view of the emotional intelligence, expressing emotions being considered a moment of weakness.

Are there emotionally toxic leaders? This is the first question that one frequently asks.

The answer is yes, this category of leaders being the opposite of emotionally intelligent leaders. It comes from those leaders who can poison, through the emotions they show and the ones they trigger to the people around him, the emotional climate at work. Those are people who are frequently upset, angry, irritated or anxious. Most of them are so overwhelmed by these negative emotions that they can not even realize what is happening to them and how much they are actually harming the people around and their organization.

In any group, the leader is the one who acts as an emotional guide. His emotional state of mind and the tone he uses in his relation with the others have a huge impact on the organization's emotional climate. Throughout history, the leader of any human group had been the one in which the others searched for safety and preciseness, the one from whom they have taken the emotional signs. The same thing happens in modern organizations: the leader has the ability to influence everybody's emotions.

With regard to the military units, especially when it is about taking decisions in crisis situations or the solving of some problems, subordinates look back to their leader. If he panics and he lets this panic show, the panic will spread throughout the entire organization. If the leader manages to keep his optimism and confidence, these will also transfer to the people in his team, to his subordinates. As a consequence, when you are a leader you can not afford to always show how you feel. You must always analyze which the impact of your emotional manifestations will be on the people you work with. This applies especially in situations when you are upset, discouraged, disoriented, irritated or completely angry. The leader's emotions may lead the subordinates towards panic, fury, hostility, rancour and indolence or towards optimism, involvement and pride.

Even if "the big boss" can not be seen by everybody, his/her attitude affects the emotional state of mind of the subordinates who, in their turn, send it on a hierarchical line, thus affecting the emotional climate in the entire organization.

We all know that emotions are contagious and thus the leader has to have an intelligence of emotions for not negatively influencing the subordinates and for creating a proper environment for their training and for achieving the objectives.

Everybody pays attention to the "boss"!!! Emotional contagion is "a process in which a person or group influences other person's or group's emotions or behaviour, by consciously or unconsciously inducing the emotional states of mind or behaviour attitudes" (Schoenewolf, 1990). Hippocrates, in year 400 B.C. was among the first people who have studied the emotional contagion and used the term "hysteria" to refer to the passing of a state of agitation from one unmarried woman to another.

Being able to influence a person's emotional state of mind in a good or bad way is a normal and natural thing to do. People, as human beings, may "catch" the others' mood, like some sort of social virus. Emotions have also been a very efficient means of communication. They do not need words. Each of us permanently influences the others' state of mind, as they also do with us.

The ways through which the leader manages to have such a big emotional impact on the others are:

- he usually speaks the most during meetings and is more carefully listened to;
- he is often the first one who states his opinion on the subject;
- the others usually refer to the leader's already expressed point of view;
- even when they are not talking, leaders are carefully watched by the others from the group, the non-verbal signals they send being quickly noticed and interpreted by the others;
- the members of the group usually believe the leader's emotional reaction is the best and they shape their own emotional reactions according to it.

Not always, though, the "official" leader is the leader recognized by the group. When the person called leader does not have the credibility of a real leader he will not have the emotional influence we have mentioned over the members of his team. They will automatically look for someone else, whom they respect and trust. This one will become the leader who can shape the others' emotional reactions.

Studies show that 50% to 70% of the factors that influence the way subordinates perceive the organizational climate are directly related to the sate of mind, behaviour and attitude of a single person: THE LEADER. Consequently, the leader's ability to control his emotional moods and to influence the emotional moods of the ones around him is not only a private issue, "it has a dramatic impact on the results of the organization". Affective moods and emotions influence the quality and quantity of people's work. The quality of emotional mood dictates the quality of work. When people are feeling alright, they give their best. Negative emotions, such as anger, frustration, disappointment, envy, grudge, anxiety etc. seriously disturb the work, diverting attention from the activity. From this point of view, emotionally "toxic" leaders are simply a problem in the development of the ones they lead and train.

When people no longer feel good in an organization they riot, they victimize or they leave. It is already common knowledge that when they leave, they often not get out of the company, but rather try to change their boss. Because, as Ralph Waldo Emerson used to say: "Any organization is the extended shadow of a single man".

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SUPPORTING THE LEADERSHIP CAPABILITIES OF YOUNG OFFICERS

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Abstract: *The paper deals with selected aspects of achieving success by newcomer officers after their graduation at military schools. Despite the sufficient level of tertiary military education the graduates – young officers face the necessity of leading soldiers who are more professional and experienced at the military craft after undergoing several military missions then their new commanders are after graduation at a military university/academy. The authors deal with several aspects of how to support the leadership capability of beginners in the field of military leadership.*

Keywords: *military school, leadership, military mission, military university/academy*

INTRODUCTION

Military education has to react to new security threats, novel methods and procedures applied in the armed forces, the changing role of the military in democratic societies etc.. Constantly changing environments in any area of human activities imposes shifts in the priorities of values of young people. These changes are sometimes positive, and sometimes not so much. As of late we can observe that the level of some knowledge, skills and desirable habits including the capability of young people to initiatively control their education is decreasing. Furthermore the physical condition of the young population is generally going down.

Lately the Army of the Czech Republic passed many rudimentary changes. It has become a professional one and its structure has completely changed as well. These changes and the downsizing of military personnel in the Czech Republic have brought new requirements on military professionals reflecting the increasing importance of every individual in the military service. A new political task definition requires systematic changes not only in education and training but in the complex system of preparation of every single serviceman including a generation of new commanders and military experts.

1. THE REQUIREMENTS ON THE EDUCATION OF MILITARY OFFICERS' IN THE NEW ERA

Current requirements put on military officers in democratic countries can be classified within the scope of three roles; first, as soldiers implementing the political will of the nation; second, as commanders responsible for combat tasks followed with maintenance and formation of peace environment in a given military operation; and last but not least, as active participants in building democratic structures in given territory. Each of these roles requires a different type of knowledge, different skills and therefore, different approaches to military training and education.

In a more detailed view of the Czech army we can speak of several principal changes which have brought the perceptibly changed requirements to the military educational system:

- New political assignment of the Army of the Czech Republic and the new role in the state security system;
- Necessity of building structurally new Combat Task Groupings designated to fulfil specific tactical activities;
- Increasing necessity of autonomy of small units;
- Basic service positions are filled by experienced servicemen who have passed several operational missions;
- Age structure changed, (young officers have to command older servicemen).

Today´s decisive requirements substantially influencing the above indicated roles of military officers can be demonstrated by following groups of essential knowledge and skills:

- High flexibility;
- Physical fitness;
- High level expertise in given area;
- Professional control of weapons and equipment.[1]

2. HOW CAN THE YOUNG OFFICER IMPRESS A MORE EXPERIENCED SERVICEMAN?

Every single leader should show his/her dominance or authority to his/her subordinates. The same rule is valid in the armed forces too. Formal authority is gained with military rank and service assignment. Nevertheless the informal one is more important. The young military commander must possess qualities that would be respected and appreciated by his/her soldiers. Long-term experience shows that a possible set of such traits could be based on:

- General knowledge (a commander should be orientate himself/herself in a broad spectrum of human activities - political, cultural, sports etc.);
- High level expertise; (in both theoretical and practical aspects)
- Moral and ethical qualities (a modern leader must understand his/her colleagues, be capable of empathy, have the ability to listen to people and their opinions, be able to develop discussions and lead a common effort in problem solving. He/she must be a decent human being respecting the personality of his/her subordinate. A commander must be able both to praise and criticise.);
- High level of physical fitness; (a commander must be the strongest, fastest, and most resilient? one among his soldiers);
- Foreign languages competency;
- Mental resilience; (Mental resilience is closely connected with qualities mentioned above. Military service hardship is nearly always overcome by strongly motivated servicemen who possess a high level of mental resilience and physical fitness.).

The Army needs self-confident commanders who are prepared for the practical military life in a wide scope. But under the conditions of professional armed forces, there is a broad area in which a young commander cannot compete with their subordinates. It is the level of practical military skills and professional service experience. A professional gunman who deals with his weapon daily must always operate his assigned weaponry better than his commander. The young commander cannot be for example a master at gunnery because his/her role is different. Let us ask the question again:”How can a young commander build his/her natural, informal authority?”

[1] URBANOVA, N. Systém náboru, výběru a přijetí nového vojenského personálu. Diploma thesis, University of Defense: Brno, 2009, 72 p.

3. COMPETENCY OF A YOUNG COMMANDER?

A young commander has to be competent to carry out his/her function since the beginning of his/her assignment. He/she must be equipped with certain competencies (abilities) and with formal power (authority) connected with the performance of given function. The link between competency and formal power cannot be severed. Nevertheless, we can say that formal power in the military environment is clearly given and supported with relevant and specific regulations. But informal competency is something different. It is a matter of upbringing, education and training.

There is a common consensus in the Army of the Czech Republic that all military officers have to be university graduates. This requirement is the result of the expectation that military officers are to be both the official and natural leaders to the rest of the nation in times of major crises. As the society becomes better educated, the requirements on the military officers' education level are growing as well.

The System of study at a tertiary military educational institution – the University of Defence provides a three-level tertiary education for future military officers.

1st Level of University Education	2nd Level of University Education	3rd Level of University Education
BACHELOR STUDY PROGRAMME	MASTER STUDY PROGRAMME	DOCTORAL STUDY PROGRAMME

Fig. 1 Three-level tertiary education

In all the three levels of study the relevant processes of practical preparation are included. Those in the bachelor level have the crucial importance for preparing the new officers on the level of platoon commander to be ready to perform their assigned duties. There is a complex of military practical and field training activities conducted for this purpose. The higher levels of education are supplemented with both military training and short term attachment at military units which provides students with a wider scope of practical experience.

Nevertheless, as mentioned above, the bachelor level is considered to be the rudimentary level for the preparation of new officers.

The bachelor level of education is divided into three phases:

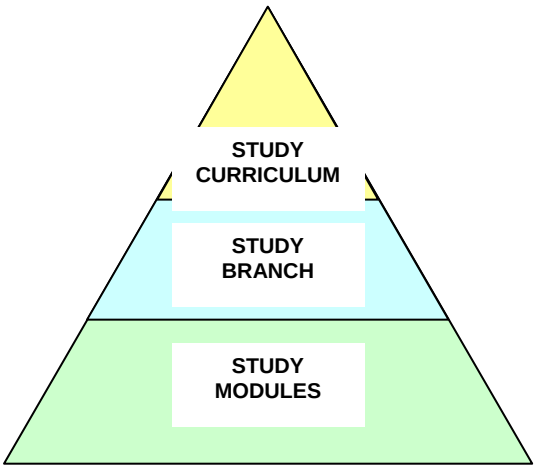

Fig. 2 Three phases of Education in the Bachelor programme

Every single student participating in the study programme has to pass the general curriculum of the Economics and Management study programme. The Subjects that make up the programme are particularly designed to form the student´s general knowledge. The subjects of physical education and foreign languages are covered in this phases well.

The study programme of Economics and Management is divided into two study branches: Military Management and National Defence Economics. These branches are composed of subjects oriented by military branches which form the students' abilities to master the wide scale of essential knowledge necessary for a contemporary military professional of the Czech Army.

In the Military Management study branch, the bachelor´s study programme focuses on

management, especially issues that reflect the requirements of the military department and the wider security community. Along with receiving theoretical knowledge of the management of military systems, students develop their knowledge and skills in the field of procedural management.

The students' basic skills are built together with the theoretical knowledge necessary for military commanders or other experts.

The study of the Military Management branch is divided into the following study modules:

- Mechanized and Tank Units Commander;
- Reconnaissance Units Commander;
- Artillery Units Commander;
- Engineer Units Commander.

Up to this point everything could seem to be in order, without any problems. For all that, again and again we face the objections from the future "employers" of our graduates. It is evident that in many cases, the introduction of this three-level system has been carried out with little attention to the real expectations the labour market (employers) have in relation to young bachelors, masters or doctors in terms of avoiding any subjective approach or attitudinal judgment, the team of scholars of the Faculty of Economics and Management has proposed a research project aimed at looking for the best ways of preparing the candidates for the profession of a military commander.

The project will deal with three phases of preparation of the new commanders:

- Recruitment;
- Professional education and training;
- Leadership skills building.

The importance of good recruitment is generally and chronically known. The current system of recruitment is a result of the continuous development of the recruitment system of the armed forces. Very often other irrelevant interests were taken into account and the quality of future officers has played a secondary role.

Within the project we want to coherently asses all the entrance qualities of potential tertiary military education graduates. We are going to make use of an experiment in the process of recruitment. Making use of talent assessment in a similar way like at the fine arts faculties would be explored within the project as well.

Earlier we noted the tendency of many higher level commanders to look for quick-fix remedies to their problems. The new security environment and new military challenges do not allow us to achieve success through answering complex problems with simple solutions. Instead, what commanders need is a method that will help them generate and test new ways of leadership in an unknown and unpredictable environment. Applicable experience from current operations is a precious commodity. There are only a few commanders who are able to generalize this in the process of lessons learned. Thus the requirement of objectivity was the motivation to propose this project of military research.

The basic goals of the project focus on helping us understand the main matter-of-fact requirements of educational and training processes. The intended project should help us describe, predict, control and explain the subject of tertiary military educational process objectively in terms of appropriate approach to the preparation of new commanders.

The goals of the project of military research are formulated as follows:

- To define the appropriate entrance qualities of tertiary military education candidates and the ways of their assessment;
- To describe the main reasons of the increasing differences between the graduates final qualities and the employers expectations. More precisely, to find efficient ways of how the new commanders can cope with the differences between their

practical military preparedness and the proficiency of their subordinates.

- To project proposes new effective changes in the recruitment system new ways of motivating candidates for choosing the profession of a military officer;
- To propose new features of military tertiary education system practically applicable under the conditions of the University of Defence of the Czech Republic compatible with similar systems in armed forces all over the European Educational Area.
- To define usable criteria for an efficient selection of students for their future specialization with regards to their giftedness, interests, capabilities and other important traits.

The research results would provide us with findings usable for enhancing the system of recruitment, education, training, upbringing and general preparation of new military leaders of the armed forces. We are aware that in most cases academic degrees are just the initial phase of military education. In order for the graduates to respond to the changing requirements of the environment as well as progress in their career it must be complemented with lifelong learning.

Each of the elements of military education has to provide its graduates with skills and knowledge required for a particular phase in their military career and their specific position as well as to build a basis for possible education in a higher stage.

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DEFINING ELEMENTS OF FUTURE GENERATION OF MANAGERS

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Abstract: *A family that places trusting relationships as its highest priority may choose a more trusted successor over a slightly more competent family member who lacks the family's complete trust.*
Larger families that clearly differentiate between family and business roles may select two or more family members for leadership positions.

Key words: *business, family, management.*

1. INTRODUCTION

Beyond the specific job performance criteria, there are other behaviors or characteristics that determine an individual's potential for senior management or leadership roles. These behaviors are related to management style and practices, which may be overlooked in discussions of the successor's performance because they are not quantifiable or always directly linked to a job task.
There are Seven Characteristics (7-Cs) that strongly influence the decision over who eventually takes leadership roles. Figure 1 identifies these 7-Cs. They are conscience, credibility, coaching, capability, commitment, competence and communication.
Conscience is presented as the central behavior because this model assumes that most families would prefer a leader whom they could trust and who demonstrates personal integrity and ethical behavior.
Table 1 presents definitions of the activities that comprise the components of the 7-Cs.
It is unlikely that any successor candidate will possess all of these behaviors or characteristics.
So it is the family and management's responsibility to prioritize their selection criteria based on the family's core values and the business situation.
A family that places trusting relationships as its highest priority may choose a more trusted successor over a slightly more competent family member who lacks the family's complete trust.
Identifying the family's selection criteria and making it part of the family agreement helps the management team and successors to accept and support the outcome of the selection process.
Larger families that clearly differentiate between family and business roles may select two or more family members for leadership positions.

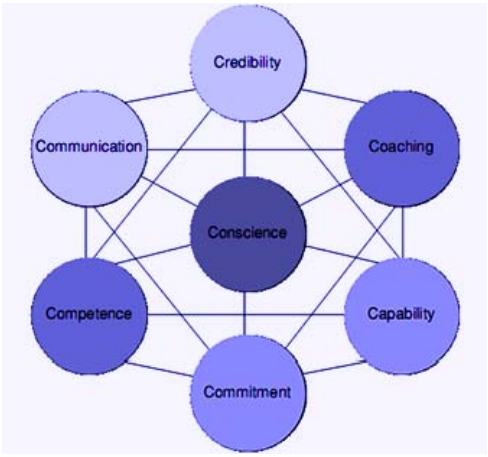

Figure 1. 7-Cs: behaviors contributing to successor performance

Table 1. Definitions of the behaviors contributing to successor performance

1. Communication	The ability to have meaningful relationships based on sharing information behavior would serve as chairperson of the board
2. Competence	The technical ability or skills required to manage the business
3. Commitment	A personal decision to support the family's and the business' interests
4. Capability	The intellectual and emotional talents for future growth as a manager and leader
5. Coaching	The ability to teach and develop other people's skills and talents
6. Credibility	Respect of the family and business based on accomplishments, work performance and personal style
7. Conscience	Demonstrated ethical behavior in dealings with the family and the business

Planning for next-generation relationships

One of the most important responsibilities of a senior family and management in the succession process is creating structures that support positive relationships with and among the next generation.

Families must be realistic about successor relationships and recognize that these relationships are shaped by a combination of genetic and environmental forces, including birth order, gender, family of origin, personality and individual and family experiences.

It is unrealistic for the family to expect that siblings or cousins who have had a conflictual relationship will suddenly work together for the good of the family and business. [16].

In fact, it is more likely that serious conflicts will erupt at the death of the parents, as the siblings attempt to create a new family structure without their parents. At this time, it is likely that old unhealed wounds and hurts resulting from competition, rivalry and parental favoritism will trigger serious sibling conflicts [17].

Competitive tension is often healthy for a business. Siblings who are striving for the presidency, for example, will work hard to turn in excellent, individual job performances. Yet, if this effort becomes a rough and tumble battle – complete with efforts to derail other siblings or cousins – it will have a negative effect upon the company. Unfortunately, siblings' husbands and wives often unintentionally reinforce this sort of unhealthy competition [18].

In successful family businesses, siblings, cousins and the senior generation work to make the effect of rivalry positive rather than negative.

Their family agreements and business policies support this goal.

They use such techniques as: rationalized salaries and promotions; assigning positions based on company requirements and individual career needs; and developing a code of conduct that will govern the next generation's behavior among them.

Table 2.

Rationalize Salaries and Promotions	Several approaches are available to the business based on Family Business Philosophy and on the business itself. One approach is that traditional busi-ness principles will apply. That is, salaries are based on market and performance criteria and one person will eventually be allowed to assume the presidency. This approach puts the business first. While competitive salary schedules encourage performance, they may also produce family conflicts. A second approach puts the family first. Here, the opposite risk comes to the fore – that business performance is sacrificed for the sake of family harmony.
Rationalize Salaries and Promotions	Several approaches are available to the business based on Family Business Philosophy and on the business itself. One approach is that traditional busi-ness principles will apply. That is, salaries are based on market and performance criteria and one person will eventually be allowed to assume the presidency. This approach puts the business first. While competitive salary schedules encourage performance, they may also produce family conflicts. A second approach puts the family first. Here, the opposite risk comes to the fore – that business performance is sacrificed for the sake of family harmony.
Assign Positions Based on Business Needs	Until the moment that one is named president, family members should not be required to report to one another, if at all possible. Each should also have his orher own area or project within the company, from a special project to managing a full division. If they perform well and are rewarded for their efforts, they will feel that they are making valuable contributions to the business.
Strengthen the Employment Provisions in the Family's Code of Conduct	This code is an agreement among family members to act in a manner conducive and supportive of healthy relationships and a healthy business. Often the code will need to be strengthened or expanded to create rules on how to work together and avoid serious rifts.

Table 3. Work or employment issues that the family might want to consider for
the code of conduct include the following topics:

1. Keeping in-laws and spouses up to date on the business performance and plans.
2. Publicly recognizing the various accomplishments of each family employee
3. Spending 'social' time with other family members employed in the business and ensuring open lines of communication with them
4. Maintaining family and work boundaries (not discussing work topics at social or family events)
5. Publicly supporting each other, especially with employees, customers and suppliers
6. Behaving in an ethical and responsible manner related to company activities
7. Sharing publicity and recognition with each other

Summary

The family can provide a positive teaching ground for the next generation of family leaders and senior family mangers. Because businesses and families undertake similar activities from setting goals to sharing decisions, a synergy develops between the two systems and makes it possible to identify family activities that can serve as lessons for future business and family leadership.

There are two critical challenges for family businesses that want to prepare the next generation for leadership responsibilities.

The first challenge is to create effective plans for the development of the next generation's capabilities; the second is to develop family agreements to ensure that the family will successfully address the issues of working together.

Table 4 summarizes the key ideas from this chapter, demonstrating the mutual contributions of developing career plans, Family Agreements and a code of conduct to successful family business careers.

The next chapter examines issues related to family business ownership.

Developing plans to support capable and responsible owners is the third component of the Family Enterprise Continuity Plan.

Table 4. Plans and actions supporting successful family business careers

Family Activities
1. Develop explicit family agreements for family participation in the business through family meetings, family values statement and expressed in the Family Enterprise Continuity Plan
2. Appreciate and adapt to the life cycle forces and life events that create change in the family and business
3. Encourage activities that teach family values, personal and business financial concepts, leadership, and business skills
4. Develop family programs for planning and decision-making that ensure Fair Process
5. Present a balanced picture of the family business" advantages and challenges
6. Protect family boundaries to ensure that family and social time are not invaded by the business
Welcoming Family Members into the Business
1. Communicate the invitation to work for the family business
2. Present the business as a possible career option
3. Make employment conditions clear and base them on the Family Business Philosophy
Entering the Business
1. Focus on providing an exposure to the business and its industry
2. Fill an existing position for which the family member is qualified, based on education and work experience
3. Assign the family member to work with a non-family mentor
4. Encourage training, education, and developmental experiences
5. Encourage exploration of the family and business history and an understanding of the business culture
Managing Sibling and Cousin Relationships
1. Design career paths with separate roles and opportunities for a meaningful contribution
2. Develop business policies on compensation and promotions that are supported by family values and the Family Business Philosophy
3. Update the family code of conduct, specifically addressing work and career issues
4. Encourage sibling or cousin meetings
Selecting a Successor
1. Share planning and decision-making responsibilities with the successor candidates
2. Recognize and accommodate individual and generational differences
3. Provide successor candidates with profit and loss responsibility
4. Develop a performance review and objective feedback system
5. Determine future leadership requirements as a part of the Business Strategy Plan
6. Involve the board of directors and key family members in making the selection

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Security of Crisis Management Workplace

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Abstract:

The world security environment shows, that non-military security risks persist and often even escalate. The risks result from ethnic, religious, cultural and economic antagonisms among governmental and non-governmental entities. Crisis situations know no frontiers and quickly grow into local armed conflicts, in some cases without employing the regular armed forces. They are usually accompanied by terrorism, mass and forcible migration, etc. We have to be prepared for such situations. The events are managed from crisis management workplaces.

The paper deals with the security of crisis management staff. At present the Stationary Crisis Management Workplaces (follow only SCMW) are employed, these are main and reserve ones. The SCMW can be easily located and eliminated. It is required to manage complicated events either in close proximity to an endangered region or directly from the stricken area. The authors propose a solution in the form of mobile reserve crisis management workplaces (follow only MCMW). The MCMW will be variable, mobile and more resistant against elimination.

Key words: *crisis management, non-military security risks, mobile reserve crisis management workplaces*

Humankind in its development always had to manage various emergency events and crisis situation which it threatened, namely in time when industry wasn't at present level. These events come during people's effort to adapt the nature for superior living conditions. In many cases the balance of nature is affected.

We cannot ignore urgency threat of terrorist attacks, because in framework of these acts can be used all sorts of arms and dangerous chemical agents.

The safety risks of non-military character persist and in many cases the risks escalate in the future. This hazard arises from ethnical, religious, cultural and economic antagonisms among state or non-state subjects. Generally these ones are accompanied by mass and forcible migration.

1 Mobile objects of time limited civil protection

To manage emergency situation protected workplaces for workers of critical staffs must be prepared. Usually, it is supposed to manage the situation from stationary workplaces. We also have to be ready to manage activities from reserve workplaces. For bigger flexibility of emergency events management are acceptable mobile reserve crisis management workplaces (follow only MRCMW). MRCMW we can use for managing activities at the formation of critical situation in cases when:

- Stationary Crisis Management Workplace (follow only SCMW) is partially or completely out of order,
- The situation will be necessary to manage from near surroundings or inside the threatened areas,
- The situation the seriously threaten safeness members of critical staffs,
- The organization of humanitarian assist in bigger range,

- The security of the situation requires the management activities from secret places.

MRCMW have to produce a rear for active activity at probably uninterrupted two-shift operation. The workplace must provide useful social and hygienic conditions and protection of critical staff members against weather conditions (cold, dust, bio-pathogens etc.) and on the part of safeness. Such workplace would be protected groceries and hygienic needs for a period of 5 days, independent in production of electricity for operation of technology etc.
The structure of MRCMW is advisable to be created on the principle modular flexible, i. e. to create group of vehicles, containers and tents that will comfort with a needs of be insured critical staff.

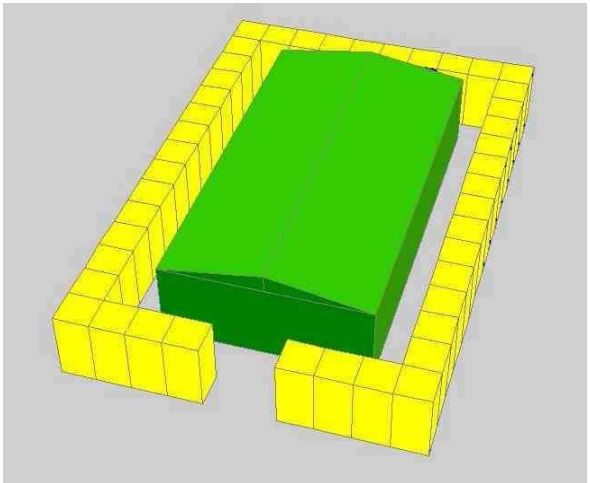
Like mobility of workplace with mobile elements we shall suppose the MRCMW wholly mobile without utilization of stationary objects. It means:

a) to create working place equipment for example: in living containers, and it will be separately stored. In case of need take out either in circulation or all of sudden at the determinate place. There place develop whole workplace.

b) to create equipment working place on vehicles. This workplace may be in form of exchangeable containers being transported on wheel truck with hook equipment arranged for set out containers or in containers. In case of need go on place of determination and take the place.
It is supposed that in practise will be used combination of both alternatives with possible combination of a part of workplace placed in blow - up tents and a part of workplace in containers.
Mobile elements MRCMW can be partially protected, which requires hardened sides of the elements according to degree of robustness. Resistivity of the elements is also increasing specific degree sappers construction of the place (see picture No. 1). In the event of request on secrecy the workplace is ensured by camouflage. It is necessary to be aware of that the lager the degree of robustness is the lower the mobility of the mobile elements will be and vice versa.
The mobile elements MRCMW have to fulfil the requirements on security of communications and information system with possibility of communication with authorities (for example Central Administration of the State, European Union, NATO etc.).

2 Exchangeable truck super-structure according to the European standards

European standards (follow only ES) undefined any special European containers, because in Europe are used containers according to ISO norms, but the norms define exchangeable truck super-structure for combination transport of goods at a road / railway. ES No 452 defines requirements on exchangeable truck super-structure of classes A and ES No 284 defines requirements on exchangeable truck super-structure of classes C. Designation of exchangeable truck super-structure the classes A (resp. C) meaning that the truck super-structure are equipped with lower intermediate elements, whose placing matches the technical needs for containers of ISO series 1A, resp. 1C.



Picture No 1: Defence-wall

The exchangeable truck super-structure of both classes is designed either like wholly encapsulated type, e.g. box-section type or like open type, e.g. plateaux

without or with tonneau cover. These exchangeable truck super-structure are identical for international exchange and transportation by the road and railway, inclusive replacement among those transport modes.

It is possible exchangeable containers use like containers, tank, platform lorry etc. Compliance truck super-structure with container designates above length of truck super-structure, height of tunnel and height of hitch, used blocking and position of tongue blocking as well as acceptable for given to loading.

Construction Requirements for special containers

- The thickness of metal sheet walls, roof and floor must be at least 2 mm.
- If a container has windows they must be equipped with shutters.
- The fire safety regulations for containers are the same as for buildings.
- The wiring of containers must meet safety standards. Electric network connectors must be secured from outside of the container. Containers must be earthed.
- No part of container's accessories must protrude its outside dimensions and indoor equipment must be fixed.
- Containers have to arrangement for safe fixation on vehicles and for handling.
- Doors and other opening parts of container must be equipped with an emergency opening system.
- The conditions for the using of special containers must be in compliance with the Convention on Safety of Containers.

Basic requirements on nuclear, biologically, chemists (NBC) precaution

The MRCMW have to fulfil definite function for management of radiating and chemical recognisance, accumulation and plotting data about radiating, chemical and biological situation. It will be equipped apparatus that it make possible to accumulate data about parameters single agents. The mentioned equipment will predicts an exposure to hazard and evaluate their implication (perform calculation of radiant exposure, predict of volume and sort of dangerous agents etc.), keep on specifications and working map about situation. Quantity and range of function will depend on planned usage and level of management.

Findings and recommendation to technical solving of MRCMW containers

The containers using for MRCMW (ballistic and NBC hardened) with predetermination for critical management should be fulfil definite characteristics as follows.

Would have been equipped apparatus and instruments for:

- organization recognisance, congregation and evaluation data about contamination environment (parameters agent etc.) and possibility prognoses consequences using dangerous materials,
- securing warning workers of MRCMW,
- working required documentation, inclusive maps.

Requirements on special equipment of containers

- Computers,
- Communication media,
- Printers, plotters, scanners, etc.,
- GPS,
- Devices for the detecting of contamination and meteorological situation in the ground layer of atmosphere,
- Other supplementary equipment (for example decontamination set, personal alarm dosimeters, drawing sets, small hand safe etc.).

Utilitarian characteristics of exchangeable truck super-structure following from:

- we can operate in all kinds of drive way, after consolidated field and forest road and in bearding terrain,
- make activities possible to an in the day-time and at night,
- make communication with next mobile elements possible to same, lower or higher - level,
- it is equipped by sources and reserve sources seat power control energy,
- make additional assembly specific arrangement (for examples air-conditioning, heating etc.) possible to ensuring good inner microclimatic conditions etc.

Requirements for Ergonomics, Conditions for Persons´ Stay and Activities

- The construction, deployment and assembly of MRCMW must meet the requirements for safety and fire protection,
- The overpressure of 350 Pa must be maintained in the sealed space of the MRCMW mobile element,
- The design and equipment of MRCMW mobile element must provide basic hygienic and ergonomic conditions for persons´ stay and activities, including filtration ventilating device.

Requirements for safety

MRCMW mobile element must be equipped with resources and protective parameters that securing civil protection according to national norms for safety at work employees.

To placement MRCMW is needed reconnoitre territory for placement. It will be respect the basis needs of activities support (water, electrical energy, sewage, attachment at data and communications network etc.) and pavement bearing capacity, pass ability and next needs.

The place of possible placement MRCMW must especially:

- Enable fast occupation and vacation of position,
- make workable placement of single objects (vehicles),
- generating of conditions for protection and defence MRCMW,
- enable camouflage movement of forces and technical means,
- keep at disposal source of seat power control energy and waters,
- respect environmentalism (solve wastes),
- to be off the overflow land etc.

The robustness of MRCMW should be in compliance with NATO STANAG, e.g. “ENGR 2280/2007”, and use resources for it if requested (see picture No. 1). We can strengthen robustness for example tent construction covering bags construction with sand or by the defence-walls. Should be workplace made on special vehicle body it is possible to make ballistic protection in the production of the workplace etc. Demand on sewage at MRCMW feasible solves with using sewage containers. Independent source of drinkable water is impossible to secure, but ensure drinkable water solved by transport packaged water and supply waters solve by transport waters tank.

Conclusion

Mobile reserve crisis management workplace is appropriate to be created in a combined way. In exchangeable truck super-structure prepare workplace for top members with definite level protection. The workplace in case of need should be served as protection for other members of the critical staff. Next parts of the workplace should be created in blow-up tents. According to the security situation is needed to have ready resources for increasing robustness parts of the workplaces.

Efficient is, that the MRCMW make possible usage the mobile workplace (some vehicle with container workplace) to departure to the place of danger and manage activities from place of incidence. The paper was composed according to the closes of the project No 2A-3TP1/096/MPO and research programme No FEM 401 and No FVT 404.

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INTERNATIONAL CRIMINAL COURT

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Willingness of nations to protect world peace, social and cultural values of mankind, good neighborly relations and cooperation between states led to the creation and organization of forms of research and punish those people or states by their actions affect the social values of the world modern. Need to impose rules of international criminal law and the courts to prosecute those incriminating facts against the world order is an issue and determined that the involvement of all States realize the importance of jurisdiction to investigate and sanction. International criminal courts are and will be a tool for preservation and enforcement of international rules relating to relations between states and their members.

International Criminal Court, international criminal law, criminal law, special issues

International crime

According to the explanatory dictionary of Romanian language by criminal means that social and dangerous offense that is the violation of criminal laws by committing to the guilt of a departure from the criminal law and is punishable by law [1].

In general term meaning the offense is defined as an act of man, an act of conduct, an outward manifestation, is prohibited by law and punishable. By prohibiting such acts, whatever their form of expression, says the society must conduct their social and human values to which actions are prohibited and which are allowed to defend these values. The offense is just committing the act of conduct prohibited by the legal rule against it [2].

For the existence of a crime must be three specific elements: a text of a law prohibiting such acts committed under the sanction of a sentence, a specific offense to be included in the law against it, whether the act was committed by action or inaction, there are specific features of the offense charged.

Offense as a whole is complex in that it is physical - cause physical changes, human - is an expression of each individual's personality, social - affect social relations between the offender and society or the offender and the injured person, morally - policy - expressed attitude perpetrator to the rule of law imposes legal - it violates an obligation to make or not make an obligation to comply.

International legal doctrine offense is defined as action or inaction which is sanctioned by law, that provided material and punished by law and which can be attributed to its author, any fact in issue of law and punishable by [3].

The essential features of the offense are:

- there is a social danger as a result of achieving social values can affect their results from a direct or immediate causal link between the offense committed and the result product;
- there must be a criminal penalty governed by public law text known by both parties, who commits an offense and punished - the court;
- punishable offense to be committed with guilt, regardless of its form (intent, fault, *praeterintention* - intentionally exceeded) [4].

In criminal law each state has its own regulations that condemns acts as deemed necessary to protect its specific values. The

international system is changing the situation to criminalize acts committed radical acts as crimes that regulation must be made by mutual agreement, legal text adopted must be recognized and applied by all countries that participated in drafting his or acceded to the process.

The emergence of international rules on crimes were driven by international relations were between countries, relations that states cooperate in the interest of maintaining a global social order as within each state seeks to maintain the rule of law in that state.

International criminal law is a relatively new branch arising from the global system of law, criminal law charges it is the consequence of those acts that by their action beyond the territorial limits of a State or the issue of committing the offense charged is a state. His appearance was caused by political events and war.

Under international law as international crimes are criminalized those actions which affect world peace and basic human rights.

Analyzing the basic elements of international crime to realize that its existence must meet several conditions, namely:

- there is a social danger related to global threat that is destabilizing the global order of law, global system of social relations, which is threatening consequences of a state, region or continent;
- the existence of a legal text adopted by states and by condemning the acts committed generating global threats;
- the offending act is committed in all forms of guilt.

International criminalization of facts is not recent, it was conceived early in training states, the incidence relations between them and applied in the form of agreements between states. Relations between the countries have brought understanding, agreements between them have even reached the sensitive points, such as understanding how the departure of the war, protecting cultural heritage, protection of wounded and prisoners of war etc.. All these agreements were based on rules of criminal law and rules of public international law.

An act to become international crime must be in addition to all essential elements of an offense charged by a state criminal law that evidence of the International. If by nature a crime covered by the law without prejudice to national social values specific to a state, international crime must affect social values set for the protection between two or more states. International crime is an unlawful act committed by states through physical or legal persons in their own name or on behalf of the state he represents.

Vespasian Pella, great Romanian diplomat, show that international crime is an act or omission punishable by a sentence pronounced and executed on behalf of the Member, and Professor Steven Glaser defines the international crime as a fact contrary to international law so harmful to the interests protected by this law, that Member It assigns a criminal agreement, requiring criminal repression [5].

In international criminal law there is a legal act to define the term to define a criminal offense. International crime can be classified by the criterion of its complexity, general features, features.

Under international law are criminalized and considered international crimes:

- those facts which affect world peace: armed assault, propaganda for war;
- war crimes: crimes falling under this category committed against prisoners of war, the wounded, sick and shipwrecked, civilians and civilian objects, cultural property, use of prohibited means and methods of war, acts which cause damage and cause unnecessary suffering or environmental impact on the environment, acts directed against persons or property protected in international assets;
- crimes against humanity: genocide, apartheid, the use of weapons of mass destruction;
- acts committed by individuals: international terrorism, actions taken against

persons enjoying international protection, capturing or hijacking of aircraft, maritime piracy, destruction of sea cables, illicit drug trafficking, circulation and trafficking in obscene publications, counterfeit currency, slavery and slave trafficking, trafficking in women and children.

International criminal jurisdiction and international criminal courts

Progress of international criminal law in the late twentieth and early XXI for the criminalization of international criminal nature were not accompanied by the results which lead to the creation of international criminal legal institutions and to apply rules of law established.

Punish international crimes are carried out in the short term limits determined by the national criminal courts and by each State. International conventions contain provisions by which signatory states undertake to cooperate among themselves in a common desire to punish criminals. These agreements do not establish rules of law or proceeding except as otherwise provided procedural common law is found in all civilized States law.

Creating an international criminal jurisdiction is as essential to the criminalization of international crimes do not remain a mere theoretical approach and to avoid penalizing those who violate international law to depend mostly by the governments of countries that inspires or encourages such violations or cyclical political interests, outside of justice.

Thus, under humanitarian international conventions aimed at protecting victims of armed conflict, the signatory states undertake to take all measures for the suppression of serious crimes categorized as war crimes. Throughout the Geneva Conventions of 1949 - article 49 Convention I, article 50 Convention II, articles 105, 106, 107, 108, 129 and 146 of Convention IV, article 85 paragraph I of Additional Protocol I, completed in 1977, article 28 of the Convention of 1954, commits signatory states to criminalize national legislation acts of serious violations of humanitarian rules, against persons who commit such acts, to guarantee procedural rights of the accused (trial, defense, appeal, enforcement of sentences). Also been assumed in its obligations and agreements for the suppression of other international crimes as genocide - Convention of 1948, terrorism - Convention of 1937, drug trafficking - Convention of 1961, etc.

In general, the power to proceed to a crime of international criminal law have military courts where the offense has undermined peace and security of mankind or for war crimes. For other crimes court jurisdiction was entrusted to the ordinary courts or specialized.

References to penalties offending national legislation of the States in respect of acts criminalized by international conventions proved to be a way of developing international relations, but not sufficient. Lack of a permanent international criminal jurisdiction and impartial adjudication of jurisdiction for all offenses of international character, is a major failure of international law, missing his mark on the international community and partnership effort to control crime and to punish those which violates international law.

If the alleged misconduct committed by private individuals is nearly eliminated this problem through international cooperation established forms content agreements (eg legal assistance, letters rogatory, extradition), but if the possibility of serious punishment is minimal because these facts are facts committed governments to control, but the real authors of their own governments are not performers. In such cases the question is who has jurisdiction to proceed and implement the execution sentence by sentence. In all international legal practice were not identified cases in which crimes against peace and humanity, violations of international conventions, it shall give its consent as executors of their orders to be judged by its own courts and sentenced. Throughout history there were armed conflicts in which war crimes cases are investigated and prosecuted (U.S. military operations in Vietnam in 1965,

1965 Gongo Belgium, Netherlands in Indonesia in 1949, U.S. business Lay May 1968).

Creating an international criminal court becomes necessary for the criminalization of international crimes may not be purely formal, theoretical and favor strong states who commit such violations committed in serving their interests.

The problem of creating international criminal court was set for the first time in the last century by the famous voice Gustav Moynier Swiss lawyer who in 1872 proposed creating an international tribunal for the suppression of crimes committed against law of nations. According to Swiss lawyer the court had jurisdiction to prosecute war crimes committed against the provisions laid down in the Geneva Convention of 1864, the composition of the court to be composed of five judges appointed by the warring states (two) and neutral states (three). The idea was welcomed not successful because it was considered that the court would interpose national courts of criminal jurisdiction to proceed.

Another attempt to create an international criminal court was to create an International Criminal Court of the Environment which had jurisdiction on all crimes relating to terrorism and environmental pollution of natural resources to the survival of humanity. And this attempt to hit the position of States which have invoked the provisions of national law and issued assumptions that contradicted the effectiveness of such courts.

On July 17, 1998 in Rome at the UN conference, 120 states have adopted statutes poiectului the International Criminal Court. Statute entered into force in 2002 showing that it responds to needs of the entire international community. International Criminal Court has international legal personality conferred with jurisdiction to exercise the responsibilities of the territories of all Contracting States. Romania has ratified the statute on March 28, 2002.

Adoption statutes are compiling an international legal principles in place for the first time when setting up the Nuremberg and Tokyo tribunals - set up to prosecute war crimes in World War II. Determination to end the killings happened in World War II, the purposes and principles of UN Charter, against the policy of states or threat of force against the territorial integrity or political independence of a state was the starting point will manifest State - Parties establishing the International Criminal Court.

The International Criminal Court jurisdiction falls the most serious crimes:

- genocide, defined as any act committed with intent to destroy in whole or in part a national, ethnic, racial or religious by the killing of their members to achieve serious physical or mental harm to members, subject to intentional group living conditions leading to total or partial physical destruction, measures to prevent births within the group, forcibly transferring children from one group to another;

- crimes against humanity, these being understood that those acts are committed both in a generalized or systematic released on civilians: murder, extermination, enslavement, deportation, sentenced to forms of detention, torture, rape, enforced prostitution, pregnancy or forced sterilization or other forms of sexual violence of great gravity, persecution of a group for political, racial, national, ethnic, cultural, religious or gender or other criteria based on universally recognized as inadmissible under international law, crime aparheid acts causing unnecessary suffering and seriously affect physical and moral integrity;

- war crimes defined as intentional murder, torture or inhuman treatment, biological experiments, willfully causing suffering, serious physical reach, destruction and appropriation of property not justified by military needs, coercing prisoners to serve a foreign army, deportation or illegal detention, hostage taking, launching deliberate attacks against civilians and civilian property, launching deliberate attacks against humanitarian and peacekeeping launching deliberate attacks that can provide obvious that losses will occur civilian lives and damage, killing or wounding enemy combatants after they surrendered, wearing of uniform or military

marks specific enemy with intent to cause loss of life or serious injury to the opponent, the establishment by the occupying power of population transfer policy in the occupied zone to another, launch destructive attacks against religious buildings, educational, artistic, scientific, historic monuments, hospitals, internationally protected targets, not military, prisoners subjected to medical or scientific experimentation destruction or seizure of enemy property without cause, order the citizens of a country in execution of military action against their own country, looting, use of poisons and gases axfisiante, humiliating and degrading treatment, use of civilian hostages in order to protect military targets, starvation, deliberate attack against buildings and vehicles using the Red Cross and Red Crescent insignia, enrolling young people under 15 years;

- the crime of aggression.

The actual work of the Court began in 2003, the Court having its seat in The Hague.

In addition to international cooperation among the signatory States shall cooperate with the International Criminal Court international intergovernmental organizations. The Court shall cooperate with the UN, UN Security Council. It may bring before the Court certain situations where war crimes were committed. There are also criticisms about the relationship with the UN Security Council, in that art. 16 of the Statute provides that "no investigation and no prosecution can not be employed or conducted under this status during the twelve months following the date on which the Security Council made a request in this Court by a resolution adopted in the head. VII of the UN Charter. The request may be renewed by the Security Council under the same conditions. Assume that made such an interposition in the independence of the Court which would be an independent institution. According to the article quoted above Security Council may request the Court to postpone the onset of an investigation for a period of 12 months. Since the Security Council is a political organ arises indepentenței total impartiality of the International Criminal Court and its work..

In article 27 of the International Criminal Court statute expressly provides that "this statute applies to all equally without any distinction based on official capacity." This covers the fact that an official capacity, whether head of state, government, State government, parliament, does not prevent criminal liability, nor constitute grounds for the mitigating circumstances. Immunities granted to a person under the domestic laws of a state does not prevent the Court from exercising jurisdiction. Court is competent to judge and punish individuals guilty of the offenses listed above, regardless of their formal or informal.

International Criminal Court may be brought by a state prosecutor - a party to the Statute, UN Security Council and automatically. To enter a case it is necessary that the offense has not been investigated by a State with jurisdiction that the person may not have been prosecuted for the same offense to present particularly serious offense. As there are cases in law and criminal liability in the International Criminal Court legislation such cases are: awareness of mental illness that prevent the criminal act, the state of involuntary intoxication caused awareness and prevent the criminal act, self-defense, coercion by threat of death or serious physical achievement, others from committing crime, ignorance that a given order for execution was illegal. The Court's view no one can be responsible and not be punished for a crime her power only when the material element was committed intentionally and knowingly. Facts of the legal jurisdiction of the Court are imprescriptible.

The sentences of the International Criminal Court may be sentenced to up to 30 years in prison, particularly serious crimes and life imprisonment. It also may be added imprisonment ordered to pay a fine, confiscation of profits and assets derived directly or indirectly from a crime.

Enforcement of imprisonment sentences be carried out within the State designated by the Court, it can not be modified by national courts.

By establishing the International Criminal Court, international courts have been established with special jurisdiction and duration of temporary work, fixed an issue on zonal or a clearly defined period. To settle these cases was once strictly for reasons that have been created.

Between international criminal court is found:

a) International Military Tribunal at Nuremberg. It was established following the agreement in London in 1945 and was intended primarily prosecute and punish persons who have committed war crimes during the conduct of the war. Court is known to settle lawsuits filed against the Germans during World War II leaders accused of committing serious crimes against humanity. Court was established as a result of agreement between parties that promised to surrender to trial war criminals whom they captured. He was right to give the decision the decision was made punishable by death and life imprisonment or temporary.

b) international criminal tribunal to prosecute and punish violations of international humanitarian law in the territory of former Yugoslavia. It was created in 1993 by resolution number 808 of the UN Security Council, the tribunal is a court set up ad hoc proceedings within its jurisdiction being limited to acts committed in the former republics on a strictly limited period, until 1 January 1991 when restoring peace. Court proceedings and to rule on violations of international humanitarian law provisions established by the Geneva Conventions (genocide, crimes against humanity, ethnic cleansing, deportation, extermination, mass killings, etc.). Court had no jurisdiction to apply the death penalty.

c) International Criminal Tribunal for the Prosecution of Persons responsible for committing crimes of genocide and other serious violations of humanitarian law in the territory of Rwanda or neighboring states. It was established by UN Security Council resolution, jurisdiction and procedure are similar to court proceedings for the former Yugoslavia. Noteworthy is that if this court were punishable crimes nationwide.

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SECURITY PROPERTY IN ROMANIAN CRIMINAL LAW

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The concept of heritage has a larger property than the concept itself as not only includes the actual possession of goods but also all rights and obligations of economic value. Given a particular social value in relationships heritage is protected through legal means including a series of prosecutions. The close relationship between heritage and the person ordered the legislature, in addition to the human values they protect by criminal law, to protect and heritage as an attribute of personality and complex rights and obligations which can not belong only to owners - individuals or legal entities.

Security, wealth, crime, criminal, special issues

The concept of heritage

Patrimonial nature of social relations is one of the important areas of the fabric of society, having a role in the complex process of development of any type of their social system.

In Romanian law concept of heritage is defined literally. Civil Code and other law texts use the term wealth, but does not define (Civil Code uses the content of art. 781, 784 and 1743 term assets in the text referring to "separation of the assets").

In the economic sense means all property assets which are assets of a person [1]. In legal terms this definition is correct if by good we mean material things that make up a person's wealth and the rights deriving therefrom. So in this sense, heritage could be defined as a person's rights assemblies resulting from the possession of material things.

In the legal sense, means all property rights and obligations of a person can be measured in money, that represents a monetary value. Heritage is not a set of material things, body, provided its existence is to be a sum of values.

Rights and obligations of persons, whether legal or physical, not economic content and are not likely a physical assessment, cash can not be contained in heritage.

The property consist of a series of characters that you define as a whole:

- is a legal or legal universality, because it meets two elements, that is a mass of property, rights and duties assessed in money and goods are distinct universality in the sense that any changes would not alter the universality they suffer because they are elements of property only in termss of their monetary value;
- only people can have a heritage as only they can have rights and obligations;
- everyone has a heritage as any person having rights and obligations valued in money, and if no material assets, tangible, has the legal capacity to acquire them;
- a person can only have a single property, so property is of unique character;
- assets can be divided into several tables of goods, each table may have different legal regime (appropriate their property, common property, inherited property);
- assets can not be separated from the person as long as the person exists.

In conclusion heritage is an independent legal universality of its component elements, namely the rights and obligations which form the content of the whole, it being possible to reduce, increase or disappear, the assets remaining in its essence as an abstract entity independent from its.

Making heritage functions involves committing a number of transactions and legal acts concluded by owner property, valued in money transactions and covering exit and entry of goods. Transactions are the heritage conservation provisions, administration and disposal. Conservation acts are those actions necessary acquisition or retention of an asset, a right and Conservation Act should be without a personal heritage. Acts of administration are those who maintain and bring into value goods, they look normal operation and use of property income. Manage an endowment means taking all necessary measures and commit all the acts necessary to give the property of the composition to best use and preserve them in the best conditions. Disposal of shares are those that bring a change in the composition of assets by passing a good or right for a person.

The Romanian legislation does not define the term heritage although the Civil Code is uses therein. Since assets are identified in the legislation as all valued a person, in addition to rights and obligations, it is assimilated and the notion of ownership.

Thus, the Romanian Constitution, Chapter rights and fundamental freedoms, the content of art. 44 paragraph 1 provided that the right to property is guaranteed, and across paragraphs 2 of the same article states that private property is guaranteed and protected equally by law, regardless of its owner. Also, the content of art. 136 of the Constitution of Romania is a classification of property in that it is public and private. Moreover, following the same law further states that „public ownership is guaranteed and protected by law and belongs to the state or administrative units – regional" - paragraph 2, and „private property is inviolable, as the organic law" - paragraph 5.

Here's the supreme law of the Romanian state itself is one that protects a person's property and impose a series of coercive measures to preserve protection, individuation and universality of it.

In addition to the Civil Code, Family Code - particularly in rolling succession, Penal Code used therein heritage without defining the term literally. Thus, in Chapter IV - Offenses against the dignity, find title III - Crimes against property.

For the purposes of criminal law heritage is protected by a whole set of rules including the criminalization of acts affecting its exercise of rights and obligations arising from it.

Criminalization of acts affecting property

Security and protection measures are implemented by the Romanian heritage by criminalizing acts of high social danger that the consequences affect social values relating to the assets of a person, whether natural or legal.

All offenses punishable under Title III - Crimes against property of the Romanian Penal Code (theft, aggravated theft, robbery, piracy, breach of trust, fraudulent management, deception, embezzlement, asset ownership found destruction - a simple form and qualified negligence, disorder possession and concealment), have the same legal object, that social relations on the heritage. It is important to note that the purpose of criminal law heritage is seen in the text of incriminating items as assets in their materiality covered property rights and allow the owner to fulfill economic obligations. These texts of law on the goods as material entities, and their action or inaction against infringe upon the rights on that property.

In criminal law text property owner is not always the owner of the goods to which the offense committed. Criminal law not only protects property rights, it also relate to the legal possession that protects equally. For example, the owner who is renting a property can be charged with theft or destruction of property or

negligence. This means that the legitimate possession or ownership is protected even against the owner.

In addition to social relationships patrimonial nature of criminal law in Title III protects content and social relations that depend on compliance with the essential attributes of the person, namely freedom, honor, dignity, life, health and bodily integrity. They are also concerned to be protected social relations based on respect for the confidence with which people operate with each other in certain relations on the belongings in their heritage and social relations for subsistence must not encroach on the integrity of physical assets any assets.

Material object in crimes against property is the object both in its materiality and social values which indirectly prejudice, that the essential attributes of a person. Also, material object of these offenses can be established agricultural and forestry fund, monuments, crops, etc. topographical signs and markings. (eg if the crime of destruction - art. 217).

Active subject of crime is not defined in a generic sense. It can be individualized for each crime separately. Therefore, active subject property owner may be even (if the crime of destruction), provided that the asset has been put into service under the conventions. Also, if the crime of destruction of fault (art. 219 paragraph last) have an active subject individual, that „management personnel a means of transport" or „staff providing direct security of such shipments".

Active subject can be part owner of the property in case of individuals or property on shares - part.

Crimes against property are likely to be committed in all forms of participation: co-authors - where an offense under the criminal law was committed directly by two or more persons having the status of authors, provocation - is that a person (inflammatory) who willfully causes another person by any means (instigated) to commit an offense under the criminal law, complicity - the act of a person who intentionally, facilitates or helps in any way, including the promise to conceal goods from the commission of the offense or to encourage the offender, even if, after committing the crime, the promise is not fulfilled [2].

But there are some features of participation in offenses against property. The offense of robbery (which is theft with violence) if the perpetrators are co-authors have made each one different element of the scheme, that is, for example, some have made violence and other theft itself. If abuse of trust for the co-authors are required to be satisfied provided that the property has been entrusted the perpetrators, in their joint care. Also, if fraudulent management coauthors there only if perpetrators were required for conservation and management of common goods in care.

Passive subject of these crimes is mainly damaged the property owner, which may be natural or legal person. Given the complexity of committing these crimes can occur adjacent to a passive subject who was also injured by committing the offense charged. For example, if a property was stolen or destroyed by the tenant that he had commissioned, we have the passive subject property owner (as owner) and its user, provided that the property has been sent to service following an agreement, arrangement. Another feature on the subject of a meeting liabilities of robbery and piracy offenses. Thus, in addition to the person whose property was injured, the longer the person against whom a liability as the subject turned the violence exercised by the offender.

It can be said that the subject is related liability in these crimes only when the violence was directed against another person outside the legal owner of the property.

All these crimes have a common position given the existence of a good owned or detention of a person, whether owner of the property or only the owner of the service. Goods which are not somebody or abandoned property are not protected by Articles and regulations of Title III content.

Material element of these offenses are committed by actions and inactions. Immediate

consequence is to achieve social relations brought about the heritage of the person injured.

It should be noted that all offenses under this title shall content intentional, except the destruction of the fault (art. 219 Criminal Code) in which content is expressly provides so.

Crimes against property is usually aimed at the office, but for some facts tracking is only prior complaint by the injured party (art. 210 - theft between spouses or close relatives, art. 213 - breach of trust, art. 214 - fraudulent management , art. 216 - acquiring the property found, art. 220 - disturbance of possession).

Each item of Title III of the Criminal Code to criminalize acts which affect the property presents some particular issues.

Thus, if the offense of theft and aggravated theft (art. 208 and 209 Criminal Code), the main feature is given by the state of possession and custody of one or more movable. Possession is usually exercised ownership and possession result in default protection to protection of property rights. It may be legitimate, in that it is protected from anyone, even the owner who may be guilty of stealing his own property only if they have been taught under a convention. Possession may also be illegal, meaning that a stolen property itself may be a material object of another robbery, but not when the act was committed by the legal owner of the property was originally stolen. Another essential requirement for the existence of crime is as good to be mobile, ie move, there's the possibility of transport from one side to another without changing its properties and value.

If the offense of robbery (art. 211 Criminal Code) is the essential condition to be a deprivation of a movable made violent threats to remove traces of crime or for the offender to ensure escape. Thus, if the offense we have two tasks, first, the main - their theft - say, second, secondary - the use of violence, threats, making the victim unable to defend or unconscious.

Crime of piracy (art. 212 Criminal Code) has two activities in its content, the main one - looting, which is to exclude some or all goods sold on the ship, or committing a theft, but much larger scale, so more serious and one secondary - committing acts of violence that occurs in any acts committed against persons or property located in the vessel (impactor, injury, destruction, etc.). Another essential condition for this offense is that it is committed against a ship „is in the high seas or in a place that is not subject to the jurisdiction of any State". If the offense were committed in another place in the high seas or not in the jurisdiction of any state where we have the elements of the offense of robbery.

Article 213 which criminalises the abuse of trust has therein movable requirements that are held for any purpose by the offender or to falsely aibe possession or to refuse reimbursement owners. So the essence of abuse of trust is just that every owner who abuses the trust granted when an owner has entrusted to good use. Assets can be in a state of co-ownership if the offender is indivisible or not the rate - to use part for a divisible good.

Article 214 on criminalizing fraudulent management therein „pricinuirea damage a person in bad faith during the administration or preservation of its property by one who has or shall have care management or preservation of those goods".

Since the first reading of the text of the law can be observed several distinct elements namely that to be committed „in bad faith", „during the administration or preservation of property", „the one who has or should take care administration or preservation of those goods". So the subject who commits the offense can only person entrusted with the care of property. Between it and the property owner must be a legal relationship which covers only the administration or preservation of goods to their respective owners or a third party (for goods of a minor). Management and conservation are obligations that are contained in a legal content. They are not legal and moral obligations as arising from the content of the legal relationship ended and that involves some conduct on the part of that has materialized in this duty of care provisions of the economic interests of the other

part of the legal relationship, ie one who has entrusted property.

A good administration requires the completion of acts that would put the value, service or goods entrusted to recovery. Conservation involves security measures, protection of property and maintain property values. Management, which is prerequisite to the crime situation, not be confused with management interests of another person referred to in the art. 987 Civil Code (business management) as if art. 214 Penal Code active subject receiving the goods with the obligation to administer or maintain and for the provision of the Civil Code there is this obligation [3].

Material element of the facts is an action or inaction adversely affecting the assets to be managed and preserved under a legal relationship. For example, who has obligations of management and conservation appropriating sell goods and their value - the action or not take action to conserve supplies leading to their degradation and loss of value - inaction. Whether we are dealing with an action or inaction, the result is a material damage to property holder - the subject of liability. Any act of poor management or conservation that harm may be a material element of the offense of fraudulent management.

Form of guilt for the offense of fraudulent management derives from the very text of the law, "in bad faith" which characterized the attitude of the perpetrator, that it can not only intentionally commit the act regardless of its form (direct or indirect).

Deception, provided by art. 215 Criminal Code, has the essential character patrimonial social relations involving trust and good faith between the subjects of a legal act patrimony. Relevant issue is to present the true facts of a false, misleading the other party to a legal act by false presentation of a state of fact or presentation of an actual state of affairs to be false. Binding between the action of deceit and damage caused must be a causal relationship.

If art. 215^1 - Embezzlement, in the text meet different elements of other crimes under Title III. Thus, the active subject is an „official" who „manage or operate" entrusted property after completion of a legal relationship. It is important to note that the legal subject of this offense is usually given by the social relations that require the officials to adopt a dignified and honest behavior in the conduct of relations service in certain private institutions or units operating within the law.

Official term that appears in content of the crime of embezzlement is defined by art. 147 paragraph 2 Criminal Code as: „by official means .... any employee who has a commission in the service of another legal person ...". Covering the period of official text of clearly defined and definite positive active subject position can not be otherwise.

Another condition resulting from the official text of the law is to manage „money, securities or other property". Criminal Law does not define the term as manager or administrator, but in accordance with normative acts which regulate the management and administration, the manager understand that person employed under a legal relationship which is responsible for receiving service, maintenance and release of money , securities or other property in property unit where they operate and which is paid. Management function derived from the official duties, she is under a legal dobâdeşte work and gives the holder rights and obligations which it conducts in direct contact and rolling in cash, securities or other property. Official with management tasks running three types of service activities: receipt, retention and clearance of goods [4].

In criminal legal doctrine actually meet manager concept [5]. This notion is attributed to the official who, although not as main tasks of service management, exercise, however, in fact, specific actions that function. Criminal legal practice has many solutions that we retain the manager that the employee actually occupies, for example, the position of treasurer. Thus, by virtue of his duties specified in job descriptions, the cashier is required to receive goods intended to be sold, to keep them up to the counter to pay

them and release them in exchange for money which is the selling price fixed by his employer. Deed a cashier who receives and keeps them on his property and failure to release them in exchange for money or release them without receiving money, which means their value meets the elements of the crime of embezzlement [6].

Last condition in the text that criminalises Embezzlement is the servant to administer, the alternative for managing (managing or administering). Administrator, in the context of criminal law, is that official or employee who is responsible for carrying out acts of service provision on the status and movement of goods from the patrimony of the unit referred to art. 145 Criminal Code, that public authorities, public institutions, legal entities of public interest. Stewardship is a management activity which involves performing acts of planning, supply, delivery etc., a heritage property. In criminal practice in different case was treated as the accounting manager can commit embezzlement unit through, for example, acts of poor service, under which goods are removed from management under various pretexts to oneself and to himself.

Ownership of the property found offense (art. 216 Criminal Code) has the particular item status when seeking his property. Good found is not owned by the perpetrator, was found by chance in a place where they could learn without supervision. Good to be in possession of someone, should not be abandoned.

Act of destruction, with all three of its forms (art. 217 - simple destruction, art. 218 - destruction qualified and art. 219 - destruction of fault), is essential act of destruction itself, bringing the state of disuse, degradation, prevention or removal of conservation measures. All these texts of law on the patrimonial character of integrity, materiality and use of the property.

Disorder of possession (art. 220 Criminal Code) is another act which security is essential heritage and protecting the right to use a property as part of the property.

Concealment (art. 221 Criminal Code), last offense under Chapter crimes against property, is essential to hide the truth about the facts of an asset. Relevant is that the crime of concealment can exist if not committed another criminal act by the criminal law and if the concealment was not pursued obtaining material benefits no matter who they are.

Romanian legislation, in addition to crimes against property punishable by Romanian Criminal Code, there are a number of laws concerning the protection of heritage and find content which including penal legislation. These laws relate to different categories of goods that make up an endowment. Relevant content of all legal acts concerning the existence of a heritage is to create conditions for the protection and preservation of its unspoiled and social relations involving.

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NATO'S OPERATION PLANNING PROCESS MANAGEMENT

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Abstract: *The author of the article describes the NATO operational planning process and specifies how the control of that process optimization using selected software application.*

Key words: *Operational planning process,*

1. INTRODUCTION

Planning is a function of command at all levels and is a prerequisite for the successful conduct of military operations. It is an activity of the mind that is guided by a process. Planning is the process of determining a course of action to take, chat the course of action is intended to achieve, the manner in which the course of action is to be prosecuted and the resources that will be required to facilitate that prosecution.

Joint planning is a complex process that increasingly requires the timely coordination of activities at the strategic, operational and tactical levels.

NATO Planning is found in MC 133/3. Planning in NATO will be conducted at a number of levels and hence the plans explained below will be developed at all levels of the NATO military command structure.

Joint operation planning blends two complementary processes. The first is the **joint operation planning process (JOPP)** which is an orderly, analytical planning process, which consists of a set of logical steps to analyze a mission, develop, analyze, and compare alternative COAs, select the best COA, and produce a plan or order.

The second process is **operational design**, the use of various design elements in the conception and construction of the framework that underpins a joint operation plan and its subsequent execution.

2. JOINT OPERATION PLANNING PROCESS

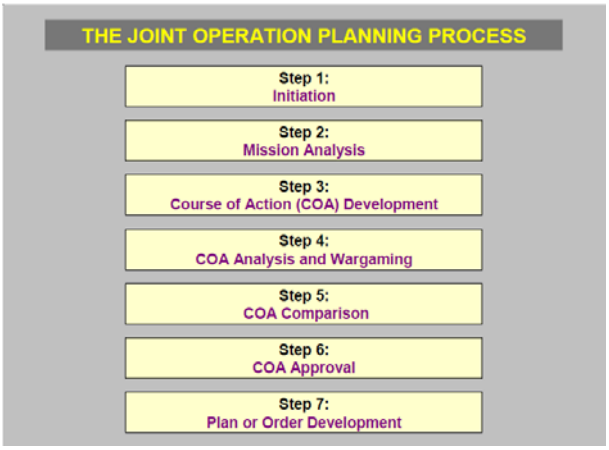

Fig. 1 The Joint Operation Planning Process

Joint operation planning must be flexible and responsive to dynamic conditions. Commands and organizations must be able to rapidly and accurately process and integrate data to provide actionable information to commanders and their staffs across multiple command echelons. Policies, procedures, and tools related to joint operation planning continue to evolve with the ever-changing operational environment.

Planning requires cooperation between combatant commands and Services and interaction outside traditional military “stovepipes” with the interagency community, multinational partners, and other interested

parties. Enhanced by automation, standardized joint planning processes, procedures, and terminology enable integrated and collaborative plan development and refinement.

The commander is the focal point of decision making and execution during military operations. Commanders play a critical role in the planning process. Once given a mission, objective, and/or tasks in the higher headquarters plan or order, commanders form their initial situational understanding using their experience, judgment, and initial staff inputs. From this they develop an initial picture of the military end state and a construct for how to reach it. This provides the basis for their initial commander's intent statement, planning guidance, and commander's critical information requirements (CCIRs). The commander continues to refine these during planning until the plan or order is published.

The role of the staff is to support the commander in achieving situational understanding; in making decisions in a given situation or making decisions faster and better than a thinking, adaptive enemy in an environment of uncertainty; in disseminating directives; and in following directives through execution. The staff's effort during planning focuses on developing effective plans and orders and helping the commander make related decisions.

Throughout planning, staff officers prepare recommendations within their functional areas, such as system, weapons, and munitions capabilities, limitations, and employment; risk identification and mitigation; resource allocation and synchronization of supporting assets; and multinational and interagency considerations. Staff sections prepare and continuously update staff estimates that address these and other areas. The staff maintains these estimates throughout the operation, not just during pre-execution planning.

JOPP underpins planning at all levels and for missions across the full range of military operations. It applies to both supported and supporting JFCs and to joint force component commands when the components participate in joint planning. This process is designed to facilitate interaction between the commander, staff, and subordinate headquarters throughout planning. JOPP helps commanders and their staffs organize their planning activities, share a common understanding of the mission and commander's intent, and develop effective plans and orders.

STEP 1 INITIATION

JOPP begins when an appropriate authority recognizes a potential for military capability to be employed in response to a potential or actual crisis. At the strategic level, that authority — the President, SecDef, or CJCS — initiates planning by deciding to develop military options. The JSCP, CPG, and related strategic guidance statements (when applicable) serve as the primary guidance to begin contingency planning. Below the strategic level, crises are reported to the NMCC in an operational report. Whether or not planning begins as described here, the CCDR may act within approved ROE in an immediate crisis.

Particularly in CAP, the JFC and staff will perform an assessment of the initiating directive to determine time available until mission execution, the current status of intelligence products and staff estimates, and other factors relevant to the specific planning situation. The JFC typically will provide initial guidance, which could specify time constraints, outline initial coordination requirements, authorize movement of key capabilities within the JFC's authority, and direct other actions as necessary.

Planning is continuous once execution begins. However, planning initiation during execution is still relevant when there are significant changes to the current mission or planning assumptions or the commander receives a mission for follow-on operations.

STEP 2 MISSION ANALYSIS

The Joint Operation Planning Process mission analysis is to understand the problem and purpose of the operation and issue appropriate guidance to drive the rest of the planning process.

A primary consideration for a supported CCDR during mission analysis is the national strategic end state-the broadly expressed political, military, economic, social, informational, and other conditions that should exist after the conclusion of a campaign or operation. At some point, the CCDR also must consider multinational objectives associated with coalition or alliance operations.

In response to the initiating planning directive, the commander and staff analyze the assigned mission to accomplish the following:

- Assess the scope of the assigned mission, end state, objectives, and other guidance from the next higher commander,
- Determine military objective(s) and the specified, implied, and essential tasks,
- Determine initial desired and undesired effects and key assumptions,
- Analyze the operational environment with respect to mission accomplishment,
- In a crisis action situation, determine time available from mission receipt until probable receipt of a deployment or execute order,

The primary inputs to mission analysis are the higher headquarters planning directive, other strategic guidance and initial staff estimates (see Figure 2). The primary products of mission analysis are a restated mission statement and the JFC's initial intent statement, CCIRs, and planning guidance.

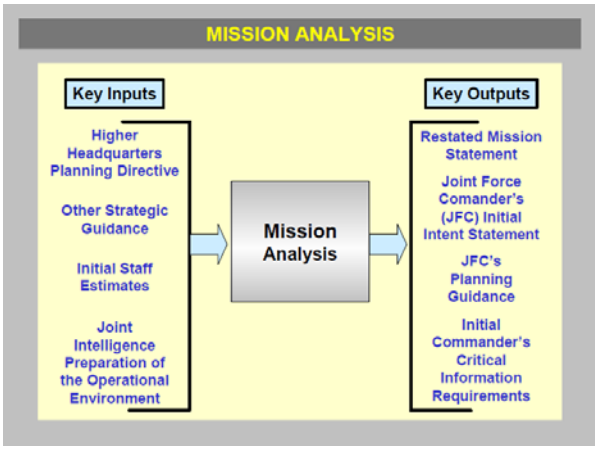

Fig. 2 Mission Analysis

STEP 3 COURSE OF ACTION DEVELOPMENT

A COA consists of the following information:

- what type of military action will occur,
- why the action is required (purpose),
- who will take the action,
- when the action will begin,
- where the action will occur,
- how the action will occur (method of employment of forces).

COA determination consists of four primary activities:

- COA development,
- analysis and war gaming,
- comparison,
- approval.

To develop COAs, the staff must focus on key information necessary to make decisions, using the data from mission analysis. The staff develops COAs to provide options to the commander. All COAs selected for analysis should be valid. A valid COA is one that is adequate, feasible, acceptable, distinguishable, and complete.

Embedded within COA development is the application of operational art. During COA development, the commander and staff continue risk assessment, focusing on identifying and assessing hazards to mission accomplishment. The staff also continues to revise intelligence products. The adversary's

most likely and most dangerous potential COAs are considered at this point and throughout COA development.

STEP 4 COURSE OF ACTION ANALYSIS AND WARGAMING

The commander and staff analyze each tentative COA separately according to the commander's guidance. COA analysis identifies advantages and disadvantages of each proposed friendly COA. Analysis of the proposed COAs should reveal a number of factors including:

- Potential decision points.
- Task organization adjustment.
- Data for use in a synchronization matrix or other decision-making tool.
- Identification of plan branches and sequels.
- Identification of high-value targets.
- A risk assessment.
- COA advantages and disadvantages.
- Recommended CCIRs.

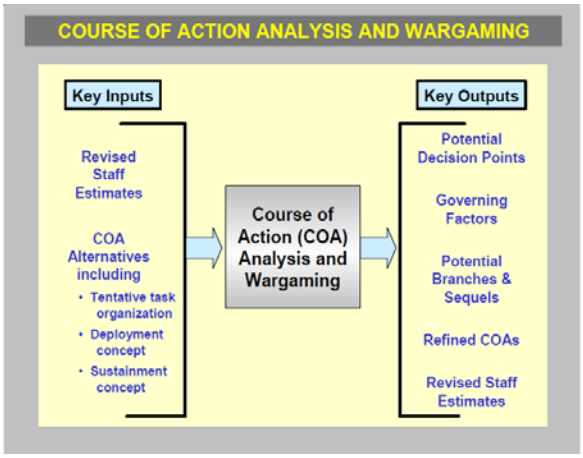

Fig. 3 Course of Action Analysis and Wargaming

Wargaming provides a means for the commander and participants to analyze a tentative COA, improve their understanding of the operational environment, and obtain insights that otherwise might not have occurred.

Wargaming stimulates thought about the operation so the staff will obtain ideas and insights that otherwise might not have occurred. This process highlights tasks that appear to be particularly important to the operation and provides a degree of familiarity with operational level possibilities that might otherwise be difficult to achieve.

Wargaming can consist of:

- Prepare to wargame.
  - Gather tools
  - List and review friendly forces
  - List and review enemy forces
  - List known critical events
  - Determine participants
  - Determine enemy course of action (COA) to oppose
  - Select wargaming method Manual or computerassisted
  - Select a method to record &b display wargaming results
    - Narrative
    - Sketch & note
    - Wargame worksheets
    - Synchronization matrix

- Conduct wargame and assess results.
  - Purpose of wargame (identify gaps, visualization, etc.)
  - Basic methodology (e.g. action,reaction,counteraction)
  - Record results

- Output of wargaming.
  - Results of the wargame brief
    - Potential decision points
    - Governing Factors
    - Potential branches & sequels
  - Revised staff estimates
  - Refined COAs
  - Feedback through the COA decision brief

STEP 5 COURSE OF ACTION COMPARISON

COA comparison is an objective process whereby COAs are considered independently of each other and evaluated/compared against a set of criteria that are established by the staff

and commander. The goal is to identify the strengths and weaknesses of COAs so that a COA with the highest probability of success can be selected or developed. The commander and staff develop and evaluate a list of important criteria, or governing factors, consider each COA's advantages and disadvantages, identify actions to overcome disadvantages, make final tests for feasibility and acceptability and weigh the relative merits of each.

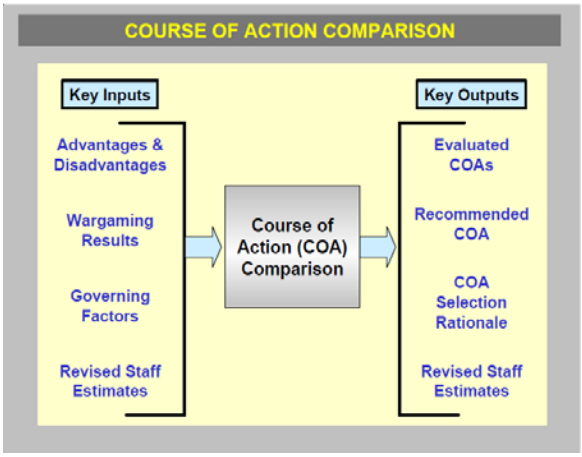

Fig. 4 Course of Action Comparison

STEP 6 COURSE OF ACTION APPROVAL

The staff determines the best COA to recommend to the commander. The staff briefs the commander on the COA comparison and the analysis and wargaming results, including a review of important supporting information. This briefing often takes the form of a commander's estimate. This information could include

- the intent of the next two higher commanders;
- the current status of the joint force;
- the current JIPOE;
- assumptions used in COA development.

The commander selects a COA or forms an alternate COA based upon the staff recommendations and the commander's personal estimate, experience, and judgment.

STEP 7 CONCEPT OF OPERATIONS DEVELOPMENT

During plan or order development, the commander and staff, in collaboration with subordinate and supporting components and organizations, expand the approved COA into a detailed joint OPLAN or OPORD by first developing an executable CONOPS — the eventual centrepiece of the operation plan or order.

The CONOPS clearly and concisely expresses what the JFC intends to accomplish and how it will be done using available resources. It describes how the actions of the joint force components and supporting organizations will be integrated, synchronized, and phased to accomplish the mission, including potential branches and sequels.

The staff writes (or graphically portrays) the CONOPS in sufficient detail so that subordinate and supporting commanders understand their mission, tasks, and other requirements and can develop their supporting plans accordingly. During CONOPS development, the commander determines the best arrangement of simultaneous and sequential actions and activities to accomplish the assigned mission consistent with the approved COA. This arrangement of actions dictates the sequencing of forces into the OA, providing the link between the CONOPS and force planning.

3. THE TOOL FOR OPERATIONS PLANNING FUNCTIONAL AREA SERVICE

The Tool for Operations Planning Functional Area Service (TOPFAS) is a decision support and planning tool that supports the development of operational planning products according to NATO's Operational Planning Process (OPP) as defined by MC 133/3 and the Bi-SC Guidelines for Operational Planning (GOP) in a distributed and collaborative manner.

The TOPFAS tools support both Advance and Crisis Response Planning through all phases of the operational planning process.

Fig. 5 Logo of Tool for Operations Planning Functional Area Service

TOPFAS provides a common database and framework for the NATO operational planning as well as a common repository of the operational plans and the audit trail for the force requirements.

TOPFAS is NATO's Tool Suite for Knowledge Development, Operations Planning and Campaign Assessment to support its new Comprehensive Planning Process. TOPFAS development has been going on since 1998 using the spiral development approach. Iterative prototypes have been fielded since 2003.

Requirements capturing and prototyping activities are performed by NATO C3 Agency under Bi-SC guidance and direction. Its utility has been validated through experimentation, exercises and field trials in ongoing operations. Industrialization of the prototype capabilities is undertaken by the NATO Security Investment Programme (NSIP). TOPFAS Version 4.0 is the operational capability delivered by the industry in September 2009. TOPFAS is being fully rolled-out to Allied Command Operations (ACO) structure starting from August 2009.

TOPFAS consists of:

- Systems Analysis Tool - SAT
- Operations Planning Tool - OPT
- Campaign Assessment Tool – CAT

Operation planning identifies ways and means of achieving the desired end state through objectives by coordinated actions synchronized in time and space.

The operational planning process in itself is a highly creative process, including brainstorming techniques and the application of concepts that are not easily translated into bits and bytes. Other demands on the software functionality are driven by the quick response requirements in a real planning situation. Related to this, a further challenge arose from an early user requirement that TOPFAS should include all OPP computer support requirements.

For the rest, the stages and steps of the NATO OPP is build into the TOPFAS software in the form of a Planning Wizard that guides the planner through the process and the associated TOPFAS functionality.
A further challenge in the system design, and especially the database, is that the OPP and hence

TOPFAS is a joint planning tool. This means that the air, land, maritime and other service specific issues are all addressed within a common framework. A typical example of the issues that arise is the representation of military units.

The primary users of TOPFAS will be the NATO Strategic Commands, Combined Joint Planning Staff, Regional Commands and other NATO military headquarters with designated operational planning tasks.

TOPFAS Planning Functionality

The user software supports the activities and preparation of all planning products through the planning stages:

- **Initiation** based on the initiating directive and including the receipt of planning inputs and preparation of the database.
- **Orientation** with focus on the mission analysis, operational design and the

identification of assigned and implied tasks and planning factors.

- **Concept Development** with identification of the preferred course of action (COA) to be developed into the concept of operations (CONOPS) including force requirements.
- **Plan Development** with the refinement of the CONOPS and detailed planning based on the actual forces and capabilities provided by the nations.
- **Plan Review** for further assessment, large-scale war-gaming and exercising, including the adaptation of the force requirements to the changing operational environment.

TOPFAS support the planning process with graphical tools to the greatest possible extent; i.e. graphical layout of the operational design, phases and tasks, geographical mapping tools for the specification of operational and environmental factors.

4. CONCLUSION

JOPP underpins planning at all levels and for missions across the full range of military operations. It applies to both supported and supporting JFCs and to joint force component commands when the components participate in joint planning. This process is designed to facilitate interaction between the commander, staff, and subordinate headquarters throughout planning. JOPP helps commanders and their staffs organize their planning activities, share a common understanding of the mission and commander's intent, and develop effective plans and orders.

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THE ECO-INDUSTRIAL PARKS' DESIGN

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Abstract: *Achieving sustainability is one of the most important objectives of all political and social entities. But adequate projects of industrial systems are necessary in order to implement sustainability in the economic area, projects which should be nature-friendly. One of these symbiotic systems is the eco-insudtrial park, which means both implementing the concept of industrial technology and developing co-working relations between companies. Designing eco-industrial parks is not easy, especially because the economic benefits are visible in time, and not right away. From this point of view, the analysis of the industrial park design is necessary in order to avoid abandoning the project even before starting its implementation.*

Keywords*: sustainability, industrial symbiosis, eco-industrial projects, eco-industrial parks*

1. Introduction. Sustainability of the industrial systems. Sustainability or sustainable development, perceived as being focused on the state of the environment is, according to the Brundtland/WCED report, the type of „development that meets the needs of present without compromising the the ability of future generations to meet their own needs" (WCED Report, 1987:54). Actually, the aspects touched by sustainability, also known as „the Brundtland principles", are those related to the environmental, economical and social areas it influences. Sustainability is also one of the most important goals of the European Union, caused by the constitution of the European Union as an internal market , but also by its contribution to the sustainable development of the planet (The UE Treaty, art. 3, par. 3 and 5). According to these ammendments, the European Union takes action focusing on the development and aggrandizement of democracy and the rule of law in less developed states. These target the following phases: sustainable economic and social development, gradual integration in the world economy; campaign against poverty (Profiroiu, Popescu, 2003:29). On the other hand, as long as sustainable development is one of the most important goals of the European Union, its environmental politics will focus, according to the deffinition in the Brundtland report, on achieving reproductibility and viability of the environment protection process. (Profiroiu, Popescu, 2003:39). This can be achieved by: including environmental policies into sector policies of the European Union; creating prevention measures; setting the principle of „who creates pollution pays"; fighting pollution; taking responsibility.

As long as the degradation of the environment is the collateral result of industrialization, the issue of sustainable designing industrial systems is highly important and according to the goals of the environmental policies, which focus on integrating the environmental policies into sector policies.

The present industrial systems can be generally considered as non-sustainable, as high quality irreplaceable or finite resources are continuously being diminished due to different consumer activites. This is all caused by the effects of the transformation of the resources into emissions and waste, which leads to the conclusion that this high level of consumership cannot be sustained by the existing resources, unless replacement solutions are found.

The reducement of the resources quantity and deterioration/destruction of the vital functions of eco-systems are two major areas targetted by the environmental sustainability.

On one hand, we do not need to bring more and more substances to the sufrace from underneath the earth crust. Also, we should not

increase the quantity of human waste, as non-dagradable waste, but we should also not systematically deteriorate the physical foundation of productivity. Projecting the near future, Ernest Lowe predicted the development of sustainable economic strategies to a level of business standard, starting from the area of industrial ecology, and also the unprecedented development of eco-industrial parks.

This, the new perspective brings new industrial development directions into light, such as (Mirata, 2005:32):

- major growth of productivity of material resources (eco-efficiency);
- ecologic re-designing of industrial systems, inspired by biological systems;
- economy of services and fluxes
- investements in the natural capital.

These directions only become manifest if we become aware of major issues related to interactions within industrial systems and within industrial systems and the environment:

- understanding the way industrial systems interact with each other and with the environment;
- the necessity of influencing the evolution of industrial systems by considering the sustainable systems;
- the necessity of closing material and energy fluxes;
- understanding the qualitative/quantitative tranformations within the interaction industry-nature and assimilating these into the dynamics of resource fluxes;
- the necessity of re-designing a new paradigm related to the relationship between industry and nature.

The sustainability of industrial systems can be designed in a symbiotic environment, which will be furtheron analyzed. This implies a certain profile, presented graphically by Maltin (2004, *apud* Mirata, 2005:86):

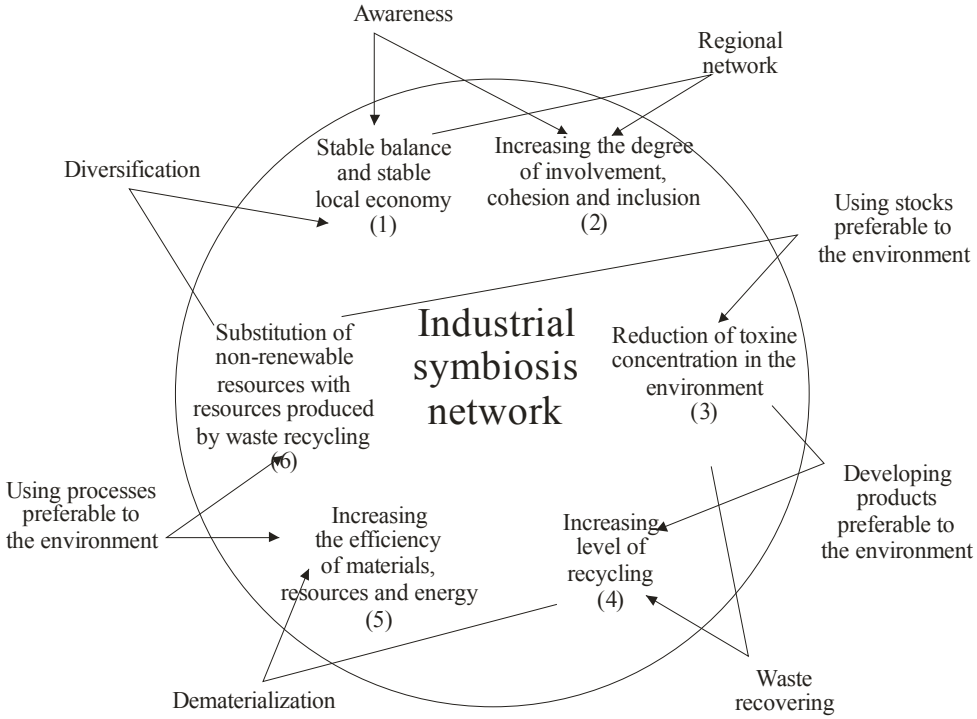

Fig.1 Industrial symbiosis network

2. Idustrial Ecology. As long as the future of industrial policies, including those of the European Union, is to be regarded according to the reconstruction of a new environment for companies, where these should exist, develop and promote innovation through dynamic policies in the field of research and development, one solution is that of designing eco-industrial parks, because „a successful industrial policy is essential for the sustainable development" (Profiroiu, Popescu, 2003:158). Eco-industrial parks are the result of the

implementatino of sustainable industrial development, based on the concept of industrial ecology. Linking the two directions of development, we can discuss the issue of building EIPs based on the concept of material, energy and waste management. This cannot be performed in the absence of a high process technology and in the absence of viable partneships between different social actors with decisional power in sustainable development.

The concept of eco-industrial parks relies on the intention of industrial ecologization, which in its turn relies on the concept of industrial ecology. This concept was first mentioned by Frosch and Gallopoulos in a study published in a special issue of *Scientific American* in 1989 (*apud* Ayres, 2002:49) as a pattern for implementing sustainable economic development. This was defined as „the study of the physical, chemical and biological interactions and interrelationships both within industrial and natural ecological systems" (Garner, Keoleian, 1995, *apud* Fleig:2001:1).

Industrial ecology implies finding strategies and methods of minimizing the negative impact of industrial systems on the environment, by exploiting resources, using products, by-products and waste, as shown below:

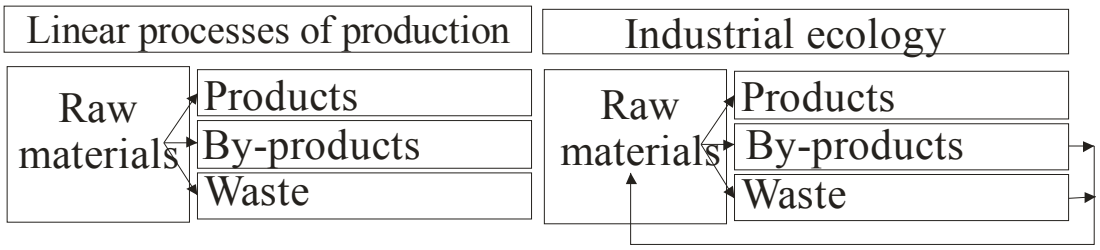

Fig.2 The relationship between inputs and outputs in the case of industrial ecology

Industrial ecology (IE) is thus a new branch of study dedicated to the concern for sustainability of industrial systems. Obtaining resources in a cyclic manner and facilitating the fundamental exchange between industrial systems leads to industrial symbiosis. This is one of the sub-areas of industrial ecology, involving synergy relations between the activities of different economic agents and leading to profit due to the efficient use of resources. Non-replaceable resources and eco-systemic services, including the human resource, involve different forms of natural capital, while the issue of depreciation of the latter is highly problematic.

As long as there are possibilities to develop additional synergy relations in the industrial areas (which continue to be unexploited), the issue of their use becomes important from two different points of view: first, to obtain higher profits, and second, to achieve a common use of energy, raw materials, by-products and waste and to produce ecologic products.

Eco-industrial parks are the result of the implementation of the concept of industrial ecology, in addition to the collaboration between companies. „The industrial analog of an eco-system is an industrial park (or some larger region) which captures and recycles all psychical materials internally, consuming only energy from outside the system, and producing only non-material services for sale to consumers" (Ayres, 2002:49).

3. Concepts and terms in the area of industrial eco-systems. Industrial parks vs. eco-industrial parks. Many developers of industrial parks describe their projects as EIPs, but in fact not all of them include industrial symbiosys on all levels; industrial parks built on ecologic projects, the ones hosting ecologic companies or companies producing ecological products are not necessarily eco-industrial parks. (Andrews, 2002:483). The eco-industrial prak is therefore more than a network of exchanges, more than a way of recycling, more than a group of companies developing environmental technologies,

producing ecological products, more than a usual park built around a single major environmental issue, more than a park with infrastructure and neighboring buildings more than a development area (industrial, commercial or residential).

Unlike these, virutal eco-industrial parks (VEIP) are regions „in which industries are not necessarly co-located, but linked through exchange of *waste* and collaboration at different levels" (Cohen-Rosenthal *et al.*, 1996, apud Fleig, 2000:3). Eco-industrial parks with companies situated in the same location are more affected by planning than those consisting of virtual company networks.

Strongly connected to EIP and VEIP are the terms industrial eco-system (IES) and industrial symbiosis (IS). The industrial eco-system, as designed by Frosch and Gallopoulos represents a system where the consumption of energy and materials is optimized, in which the process of generating waste is minimized and the resulted products are materials for other processes.

IES are attractive theoretical concepts, which are still considered options which might lead to immitation of nature. Industrial eco-systems involve ballancing industrial inputs and outputs and adapting these to the constraints of natural systems, dematerializing industrial outputs, developing new replaceable energy suppliers for the industrial production, adpoting new national and international sustainable development policies, and creating new structures.

4. Industrial symbiosys. Eco-industrial projects. Industrial symbiosys, defined for the first time by Manahan, is a relation of high interdependence between at least two companies which exchange materials and energy in a mutually profitable manner, each of them contributing to the wellbeing of the other. Symbiosys is a term taken over from biology, which refers to the strong link, due to vital reasons, between two species or two types of organisms. Industrial symbiosys is thus the relation between different economic actors, which contributes to obtaining mutual benefits: „the symbiosis need to occur within the strict boundaries of a 'park', despite the popular usage of the term 'eco-industrial park' to describe organizations engaging in exchanges" (Ehrenfeld, Chertow, 2002:335). According to Valdemar Christiansen, former CEO with one of the key-companies in Kalundborg, industrial symbiosys represents „a cooperation between different industries by which the presence of each... increases the viability of the other(s)" (*apud* Mirata, 2005:41). Usually, industrial eco-systems exist between companies situated in a so-called eco-industrial park. They exchange energy, water, materials, but they can also exchange information and services (like transportation, distribution, marketing, etc). In order to achieve industrial eco-systems there is also the possiblity of transcending the definite area of the industrial park, by cooperating with *over the fence partners.* There is also the possiblity of achieving such an exchange specific to the industrial symbiosys between local companies situated in the same location, even if there is no industrial park designed within that specific area.

In order to develop industrial symbiosys it is neccesary to achieve coordination between the different components of the system. It is necessary to coordinate functions related to the informational and organizational areas (regarding human resources), in addition to implementing policies in the technical, informational, economic and organizational areas, in order to achieve a proper development milieu (Mirata, 2005:52).

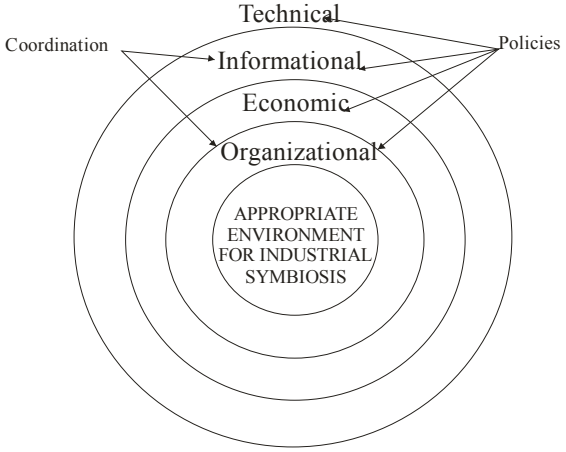

Fig.3 Different levels of industrial symbiosis

The technical level designed targets technical complementarity and compatibility,

the informational level leads to exchanges ensuring the functioning of companies and maintaining the synergetic potential, the economic level is related to the attractiveness of the business dependant of the political factors which ensure the relational synergy between companies, and the designed organizational level targets the strategy viability and the extension of the decisional level.

Actually, the goal is the satisfaction of local needs with local outputs, thus saving the efforts of developing relations and exchanges. This leads to the development of organizations/structures/entities able to induce „regional awareness raising, capacity building and learning" (Mirata, 2005:VI).

The achievement of industrial symbiosys depends on a set of factors which influence or limit the feasibility of IES networks:

- characteristics of regional economy: dynamics of local/regional administration, key political influences, the possibility of accessing alternate options, the influence of strong agents on the market, the industrial strucure, the dependence upon certain implementation methodologies, the realities of the market economy;
- organizational elements: the human dimension of implementation as a key-determinant, the decisional factor, the organizational culture, trust, the type of management, the ballance between reality and the desired future, the positioning of eco-industrial systems at the outskirts of business interests.

According to Lowe (2001:10), there are three categories of eco-indutrial projects: eco-industrial parks, EIP, *by-products exchange,* BPX and *eco-industrial networks,* EIN. If EIP involves development patterns and by-product exchanges, shared property and legal regulations (in the states where this is implemented), management and maintenance responsibility and control, BPX involves „a set of companies seeking to utilize each other's by-products (energy, water, and materials) rather than disposing of them as waste", while EIN is consituted of „a set of companies collaborating to improve their environmental, social, and economic performance in a region". Lowe's vision is different of that belonging to Cohen-Rosenthal: one can use the term of virtual eco-industrial park (VEIP) only to describe a regional BPX. By-product exchange (BPX), also covered by the terms *industrial eco-systems* (IES), *by-product synergy* (BPS), *industrial symbiosis* (IS), *industrial recycling network* (IRN), *green twinning* (GT), *zero emissions network* (ZEN) are the core of the EIN network.

EIN cannot include EIP, conventional industrial parks or even isolated companies, and the structure of such a network is presented below.

5. Designing eco-industrial parks. Imperatives and patterns. From this broad perspective we might admit that eco-industrial parks involve the existence of:

- exchange pattern of by- products;
- a business group specialized in recycling;
- a group of companies producing ecological products;
- an industrial park;
- necessary buildings and infrastructures;
- a mixt development plan (industrial, commercial and residential).

To sum up, one might consider that eco-industrial parks involve an ecological design of infrastructure and plants, prevention of pollution, clean production[1], energetic efficiency and partnerships between companies. Eco-industrial parks function not only to achieve a minimum impact on the environment , but also to achieve a certain level of performance: „The goal of an EIP is to improve the economic performance of the participating companies, while minimizing their environmental impacts" (Lowe, 2001:1). Eco-industrial parks are object of a high-level projection. Behind the cooperation within the eco-industrial parks, there are high-level

[1] The concept of *clean production*, developed on the Kyoto protocol, was designed to help industrialized states to assume their obligation to reduce gas consumption; the concept was later extended to an expert-level within the symposium in 1999 at the Institute of Environmental Technology (Apini) at Kaunas University of Technology, by the United Nations Environment Program (UNEP), according to IICPH (2000)

networks and structures. It is imperative to achieve legal regulations on a regional or national level in order to achieve collaboration on a local level. (Bringezu, 2002). Eco-industrial parks can have their origin in ideas of entrepreneurs on a local level or on a higher level (regional, national, transnational). Thus, a series of setting up patterns might be created: (Chertow, Lowe, 1999, *apud* Fleig, 2000:10):

Table 1 Models of eco-industrial parks

MODEL	DEVELOPER
Ex-nihilo model	Public entity developer
Anchor tenant model	Public entity developer company
Business model	Developer
Stream model	Public entity developer companies
Business-stream model	Public entity developer companies
Redeveloping model	Public entity companies, park management

One can also acknowledge the existence of three models of cooperational systems (Ayres, 2002:57-58):

a) the *common ownership* model, which involves a vertical integration, in which ine single corporate entity has most of the suppliers or all the suppliers and totally manages the business;

b) *keiretsu* model, specific to japanese economy, regarding the compact commercial groups (Gilpin, 2004:193)

c) the *top-down* company cooperation model, specific to families of suppliers with long-term contracts, who cooperate.

The models of existence are strongly connected to the development scenarios of eco-industrial parks, as follows:

a) The basic scenario, targetting production activitties of EIP members;

b) Prevention of pollution, involving a series of activities to prevent pollution, implemented by all EIP members;

c) Prevention of pollution and industrial symbiosys, involving the development of symbiotic relations between EIP members and within the exchange of partners;

d) Attracting new EIP members, through the entry of new members and the development of new symbiotic relations;

e) Collocational and combined services strategy, involving partner exchanges within the EIP in order to produce environmental services in the same localtion and in the same decisional milieu (EIP management).

When designing eco-industrial parks, one should take in consideration a set of distinctive elements, like (Lowe, 2001:7):

- integration in the natural systems;
- implementation of energy systems;
- accomplishing material fluxes and waste managementfor the entire site;
- accomplishing the *water cascading* system;
- designing an efficient management of the whole eco-parc, by:
  - o keeping the company mix necessary for the interdependence relations and mutual support;
  - o supporting the growth of the performance level for each company and for the eco-parc seen as a whole;
  - o using a shared operational and informational system (*a site-wide information system*)
  - o building and rehabilitation of infrastructure.

6. Conclusions. The implementation of an eco-industrial park involves the projection of benefits not only for the environment, but also for the different public categories with which EIP interacts as a distinctive entity[2], but also the implementation of the physical achievement of these benefits: for the companies developing business within the park: the opportunity of decreasing production costs by increasing the efficiency if the materials and energy, by recycling waste and elliminating practices which regularly lead to pernalties; for the community: economic

[2] Takahashi (2003:90) identifies a set of benefits of the eco-industrial development: continuous betterment of the environment conditions, respect of the community, rational use of resources, decrease of waste quantities, betterment of the image on the market, high performance on the job, reduction of operating costs, innovative environment solutions, betterment of the environment efficiency, increasing of natural eco-system protection, recruiting high quality companies, minimizing the impact on infrastructure, incomes from selling by-products.

development of the community, turning the community into a point of attraction for corporations and companies, designing an economic development program of the layout area; for the environment: reduction the sources of pollution, of the waste quantity, of the need for natural resources, water management, etc.

The economic advantages of the companies are not visible on a short term. The first aspects to be perceived are connected to the immediate losses and high design and implementation costs of the eco-industrial park. Thus, designing and implementing EIPs also involves a set of risks, which are more visible, at least at first, than the targetted benefits/advantages.

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TECHNICAL AND ENVIRONMENTAL COST SAVINGS IN OPERATION BY TRADITIONAL AND INNOVATIVE METHODS

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Abstract: *The paper deals with the possibilities of cost savings search in military equipments' operation at national area as well as area of missions. The first part is focused on traditional possibilities connected with realization of preventive maintenance, technical maintenance according to newly prepared methodology for missions. Other part of the paper is non-traditional access searching of savings by modernization ways of obsolete equipments and mostly next cut-down of expenses by reduction of diesel. The main idea is in adding an additive "ENVIROX" to diesel and verification of its effect on technical and environmental abilities at templates of the army truck engines.*

Key words*: Preventive maintenance, technical maintenance, cost price of operation, "ENVIROX" additive.*

1. INTRODUCTION

Searching for savings in current situation in the world, when the crisis affects every day life, every field and even the army, is an obligation of every single one of us. The operating of vehicles and equipment has of course its saving options as well. There are obviously traditional methods of searching for savings. The effort is to lower the purchase cost of certain equipment. The purchase cost has been recently lower but it could be considered as fixed. When the equipment is bought and put into operation there is an effort to find savings mostly in operation costs.

Ways and mainly methods of operational cost savings are traditional and innovative. Traditional methods of cost savings are especially carrying out prevention of failures and subsequent repairs. The principle therefore inheres in preventive character of carried maintenance. The Army of the Czech Republic uses a valid maintenance system which includes checking before departure, preventive maintenance after use, basic maintenance and technical maintenance. In civil environment and with newer vehicles the term service maintenance is used. This maintenance is of course carried out in imposed intervals. Another part of traditional methods of cost savings is the recommendation of producer regarding appropriate use of equipment. This includes correct technique of driving and use only of vehicle that does not show any sign of failure of defect [1], [3].

Innovative methods may include for example savings in fuel consumption by adding artificial additives. One of the possible additions is an additive with trade name "ENVIROX". Its nature enables to cut consumption of fuel oil by 5-12 %. The principle of savings in fuel consumption could be seen mainly in its ability to bond higher amount of oxygen and therefore

increase the efficiency of burning at current consumption cut.

In the following article we will refer to cost savings by traditional methods at first and then to lowering costs by innovative methods in the second part.

2.TRADITIONAL METHOD OF OPERATIONAL COST SAVINGS

As it was already indicated in the introduction, searching for lowering costs in carried out maintenance is mostly concerned. The reserve seen is mainly realization of technical maintenance in foreign missions i.e.in the field. In this case within the framework of solving the project was found that if outer conditions in which the mission takes place are considered, it is be possible to include these conditions as coefficients. In that case the technical maintenance will be carried out less often, therefore the there will be cuts in expensed on oil replacement and other service refilling. Or the maintenance in tough conditions will be carried out more often and this will prevent many possible repairs caused by failure of vehicle parts. This would represent savings in recent times of expensive spare parts.

Stated methods were implemented in research for vehicles Tatra 815 which are used by Army of the Czech Republic in missions. Given relations were deduces from this research:

The above stated stages are influenced by many external conditions: Distinctness of the climate: the temperature, mainly its absolute differences also big ups downs between day and night. Then it is the dustiness especially in the desert or semi-desert conditions, the sand causes huge problems. High humidity is usually the germ of all kind of an aggressive corrosion. Quality of terrain has to be included as another aspect deteriorating the operation mainly for the consequences it has on preventive and corrective maintenance.

The maintenance coefficients

Equation for calculation technical maintenance (TM) in missions

$$TM_{MIS} = TM_{PT} * k_C \quad (1)$$

Where:

TM_{MIS} - Amount kilometers [km] for technical maintenance in mission

k_C it is the global coefficient of mission influence by external conditions

TM_{PT} Amount kilometers [km] for technical maintenance in peace time

Equation for global coefficient

$$k_C = k_{TEM} * k_{UM} * k_{DU} * k_{TER} * k_{OTS} \quad (2)$$

Where:

k_{TEM} – Coefficient of temperature influence during mission is done by table.

k_{UM} – Coefficient of humidity in mission conditions, it is done by table.

k_{DU} – Coefficient of dusty conditions during mission, it is done by table.

k_{TER} – Coefficient which considers the terrain influence in mission conditions, it is done by table.

k_{OTS} – Coefficient considers influence of others unpredictable conditions during mission, as heavy duty conditions, extreme influence of desert as dusty wind, tornados, monsoon rains or extreme sun shine. Design of this coefficient is in range $0{,}99 - 0{,}4$.

Note: By using tables [3] is possible to design all coefficients and to figure out the global coefficient. Usually it is possible to use methodology which is presented by developed chart – Fig. 1 and realized type of maintenance.

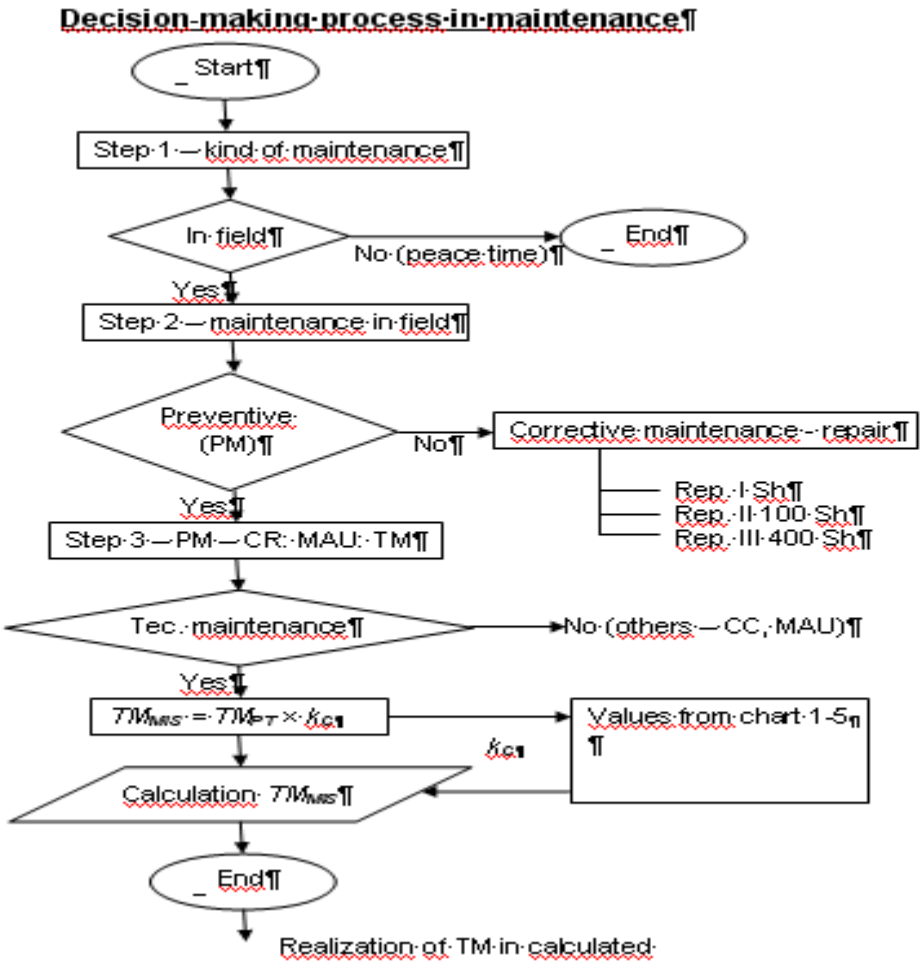

Fig. 1 - Flowchart for methodology of technical maintenance

3.INNOVATIVE METHOD OF OPERATIONAL COSTS SAVINGS USING FUEL ADDITIVES

Innovative methods of operational cost savings were monitored in long term on some of logistic units in ACR in years 2006-2009. Recently in is much easier to monitor the operation of vehicles at individual units or in the whole ACR because the informational system of logistics (ISL) was launched. Thanks to ISL it is possible to check how many vehicles are in operation at any unit, what distance it covered by given date, what is its fuel consumption etc. ISL serves as a support tool for planning and evaluation but is also a tool used for checking and punishing errors made by person responsible for operation. In the ISL you can find information about which equipment is being used and which is not. There is also information about how long the equipment is not transparent and what procedure was done for it to be operational again.

For example vehicles that are not in use for longer period than a month have to be stored. Those that are not in use due to defect are supposed to be reported and request a repair. These reasons are to be respected.

As an example for an innovative cost saving can be stated a logistic troop of one of the ACR battalions. The number of covered kilometers was monitored as much as the fuel consumption (in this case diesel) and the operational cost savings by lowering the fuel consumption by adding “Envirox” additive. The fuel consumption was lowered by 8% and therefore it led to operating cost savings. Simultaneously it leads to lowering the environmental pollution of the air by

lowering the produced pollution from engine exhaust fumes. Therefore every fuel consumption savings are appreciated and have double effect.

Some practical experiences are seen from collections of dates which were collected in 4 yeas periods. From the table Tab.1 is obvious that in columns are calculated dates and in table Tab.2 are dates for 4 ears period and charts Fig 2 – Fig. 4 present economical and ecological contributions of this effort.

Tab. 1 - Logistics company Hran., 2006

P. Č	A	B	2006 C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
										RL								
1	AUT.AV	364-4	2 418,0	420,0	17,4	0	10 332,0	33,6	386,4	826,6	0,84	9,01	3 183,0	18,24	3 178,7	1 122 962,4	6 435,1	
2	AUT.PV:	402-9	777,0	206,0	26,5	0	5 067,6	16,5	189,5	405,4	0,84	9,01	3 183,0	18,24	1 559,1	550 786,3	3 156,2	
3	AUT.PV:	400-7	12,0	20,0	166,7	0	492,0	1,6	18,4	39,4	0,84	9,01	3 183,0	18,24	151,4	53 474,4	306,4	7
4	DÍLNA Ň	251-7	343,0	165,0	48,1	0	4 059,0	13,2	151,8	324,7	0,84	9,01	3 183,0	18,24	1 248,8	441 163,8	2 528,1	
5	P-V3S P(	386-8	90,0	232,0	257,8	0	5 707,2	18,6	213,4	456,6	0,84	9,01	3 183,0	18,24	1 755,9	620 303,0	3 554,6	6
6	AUT.T8I	377-9	3 247,0	2 440,0	75,1	0	60 024,0	195,2	2 244,8	4 801,9	0,84	221,21	3 138,0	93,39	453 392,0	6 431 644,8	191 412,1	
7	AUT.T8I	380-9	8 229,0	5 326,0	64,7	0	131 019,6	426,1	4 899,9	10 481,6	0,84	221,21	3 138,0	93,39	989 658,1	14 038 909,9	417 811,9	
8	AUT.T8I	391-4	6 639,0	4 052,0	61,0	0	99 679,2	324,2	3 727,8	7 974,3	0,84	221,21	3 138,0	93,39	752 928,1	10 680 747,8	317 869,7	
9	AUT.T8I	392-4	3 088,0	2 331,0	75,5	0	57 342,6	186,5	2 144,5	4 587,4	0,84	221,21	3 138,0	93,39	433 138,0	6 144 329,5	182 861,4	
10	AUT.T8I	403-2	1 246,0	956,0	76,7	0	23 517,6	76,5	879,5	1 881,4	0,84	221,21	3 138,0	93,39	177 640,5	2 519 939,5	74 995,9	
11	AUT.T8I	370-3	363,0	202,0	55,6	0	4 969,2	16,2	185,8	397,5	0,84	221,21	3 138,0	93,39	37 534,9	532 455,8	15 846,4	4
12	AUT.T8I	379-2	936,0	1 455,0	155,4	0	35 793,0	116,4	1 338,6	2 863,4	0,84	221,21	3 138,0	93,39	270 362,9	3 835 263,6	114 141,3	43
13	AUT.T8I	391-0	37,0	27,0	73,0	0	664,2	2,2	24,8	53,1	0,84	221,21	3 138,0	93,39	5 017,0	71 169,8	2 118,1	
14	AUT.T8I	424-2	9 024,0	8 972,0	99,4	0	220 711,2	717,8	8 254,2	17 656,9	0,84	221,21	3 138,0	93,39	1 667 144,7	23 649 474,2	703 831,9	
15	AUT.T8I	495-4	2 438,0	2 087,0	85,6	0	51 340,2	167,0	1 920,0	4 107,2	0,84	221,21	3 138,0	93,39	387 798,8	5 501 165,0	163 720,1	
16	JEŘÁB :	413-4	2 688,0	3 371,0	125,4	0	82 926,6	269,7	3 101,3	6 634,1	0,84	221,21	3 138,0	93,39	626 387,1	8 885 686,3	264 446,9	107
17	JEŘÁB :	024-4	12,0	40,0	333,3	0	984,0	3,2	36,8	78,7	0,84	221,21	3 138,0	93,39	7 432,7	105 436,8	3 137,9	8
18	AUTOBI	372-2	8649	2742	31,70	2	67 453,20	219,36	2 522,6	5 396,26	0,84	39,32	3 138,0	35,41	90564,97	7 227 692,6	81 559,1	0
19	AUTOBI	320-9	9207	2952	32,06	2	72 619,20	236,16	2 715,8	5 809,54	0,84	39,32	3 138,0	35,41	97501,02	7 781 235,8	87 805,5	0
1	Totally		59 443,0	37 996,0	63,9		934 701,6	3 039,7	29 717,8	63570,34					6 004 394,7	100 193 841,7	2637538,57	175

Tab. 2 - Logistics company Hran.4 years running

O. Nu	Place	Years	C [km]	D [l]	E [l]	G [Kč]	H [l]	I [l]	J [Kč]	O CO [g]	P CO_2 [g]	Q No_x [g]	Note, MH
1	Hran	2006	60 301	37 996	63,0	934701,60	3039,68	34956,32	74 776,13	6004394,68	100 193 841,7	2637538,57	175
2		2007	120 743	73 855	61,2	1816833,00	5908,40	67946,60	145346,64	9575600,23	194 897 530,8	4337006,51	257
3		2008	111 328	58 346	52,4	1435311,60	4667,68	53678,32	114824,93	7769688,01	126 619 385,8	3304757,12	51
4		2009	168 425	77 697	46,1	1911346,20	6215,76	71481,24	152907,70	7342705,26	206 464 877,6	3461673,86	774

Legend

A – type of vehicle (truck, wheeled vehicles); ***B*** – militarily identification number; ***C*** –total number of driven kilometers; [km]; ***D*** – fuel consumption in liters [l]; ***E***- average consumption of fuel in liters [l]; ***F*** – norms of European Union; ***G*** – total price of fuel consumption in Czech crowns [Kč]; ***H*** – 8% saving of fuel in liters [l] when is used additive ; ***I*** – fuel consumption cut by 8% because of additive influence in [l]; ***J*** –8% -of saving fuel in Czech crowns [Kč]; ***K***- fuel density in [kg. dm^{-3}]; ***L*** – factor Ef_{CO} [g .kg^{-1}]; ***M*** – factor Ef_{CO2} [g .kg^{-1}]; ***N*** - factor Ef_{Nox} [g .kg^{-1}]; ***O*** – amount of created emissions of CO in [g]; ***P*** – amount of created emissions of CO_2 in [g]; ***Q*** – amount of created emissions of NO_x in [g] ; **R** – number of vehicle running hours .

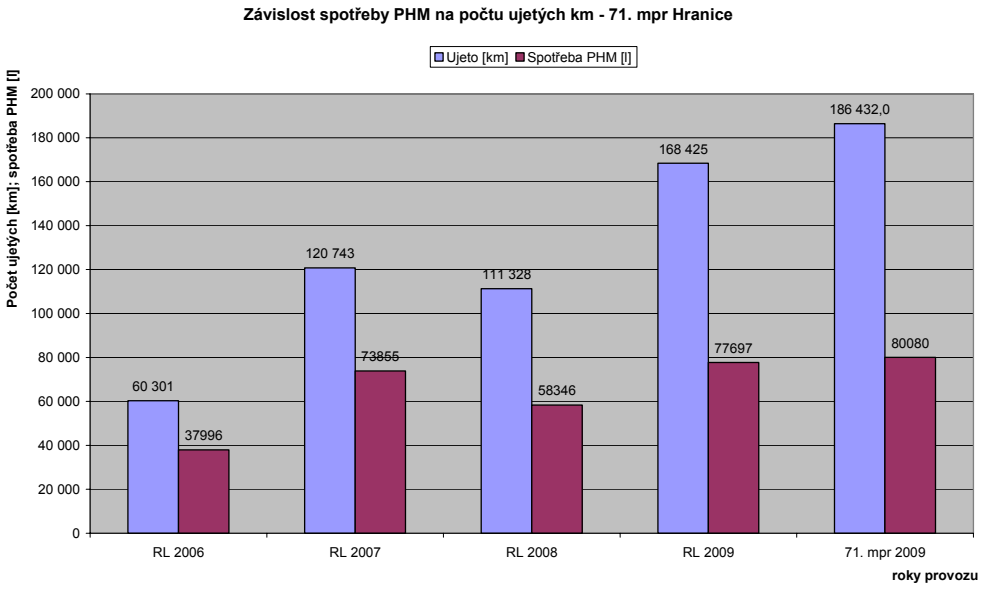

Fig. 2 - Relation of fuel consumption and number of running kilometers

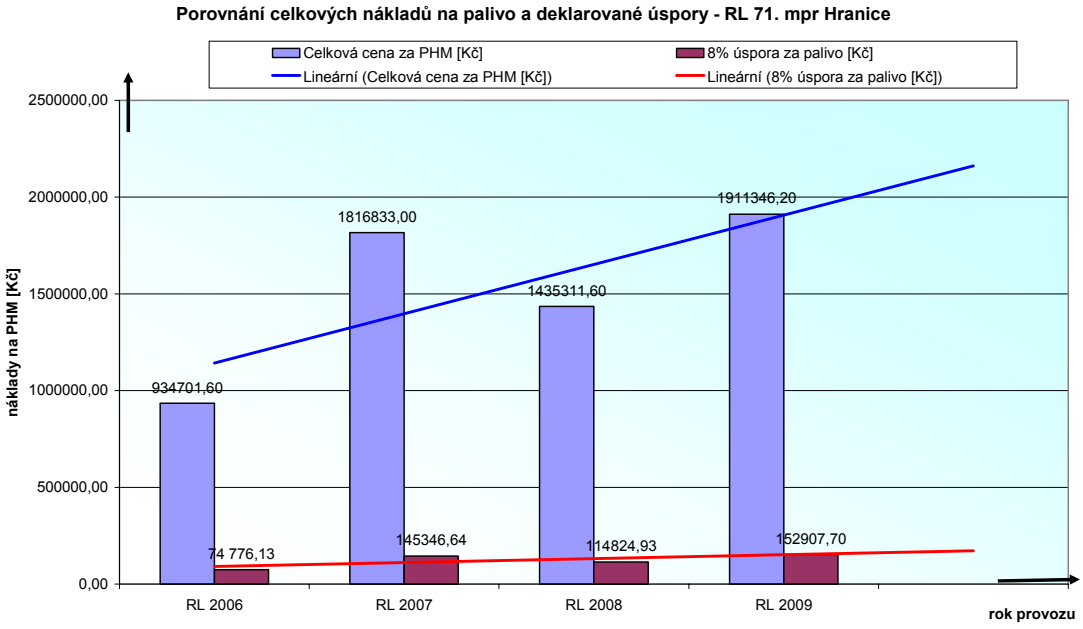

Fig. 3 - Comparison of total fuel price and 8% saving of fuel in [Kč]

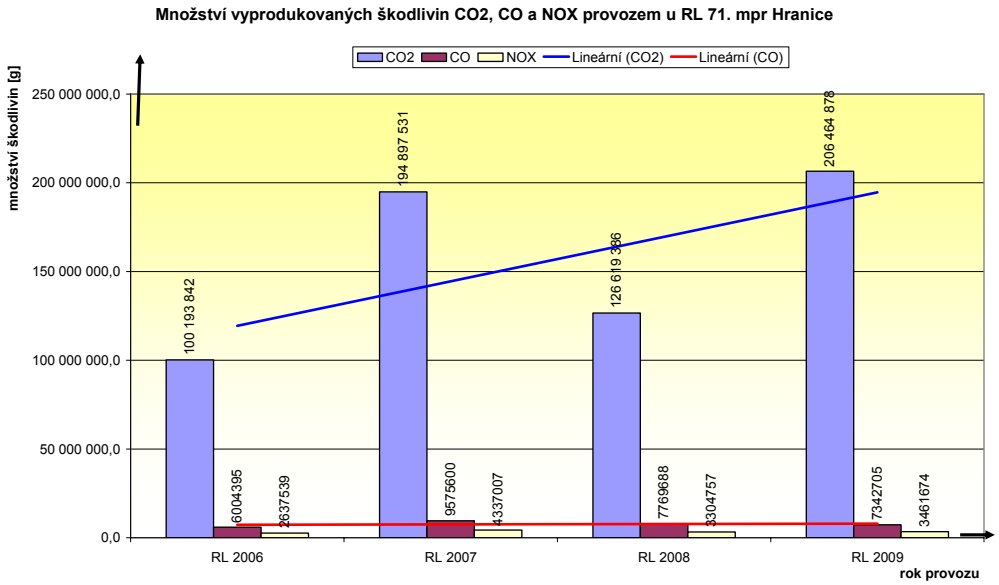

Fig. 4 – Amount of turned out of harmful substances [g]

4.CONCLUSIONS

- Frequency of maintenance providing, or corrective maintenance are realized according to the insinuated methodology which is seen from developing diagram, there is necessary to involve influence of coefficients, which are ensure on the base of practical experiences from units in abroad and units operating on Czech territory.
- The total coefficient of surrounding conditions is possible to find out as multiple of 5 –th partial coefficients [3]. This first part presents 5 years work of team experts which bring new technical knowledge for maintenance mostly in field. TRADITIONAL AND INNOVATIVE
- Innovative view of the problems of transport supply cycle are beneficial primarily by recommendation to implement new more economical and ecological vehicles with less gasoline consumption in operation. The vehicles are more frugal to environment also thanks keeping of valid Euro Standards.
- Next new finding for ACR sounds as reduction of fuel consumption by additive "ENVIROX" with main accent to evaluate influence to technical part of equipments (engines mostly), influence to fuel by itself, fuel tanks or reservoirs but mainly to life environment.

This is the topic of current long term project of defense research under identification number *OVUO FEM 200 902*.

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SYSTEMS, METHODS AND MODERN TECHNIQUES IN FAMILY BUSINESS DEVELOPMENT

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Paper coordinated by prof. drd. eng. ec. Marius BENŢA

Abstract: *Family business helps all its members and management understand the critical factors for longterm business growth and helps long-term building.*
Adopting the Parallel Planning Process (PPP) is a chance to reorganize the expectations, change and conflict.
Many families businesses are driven by an expanded set of goals related to family stewardship and legacy.

Key words: *business, family, management.*

1. INTRODUCTION

Planning for business growth while transferring ownership and management across generations presents many challenges in today's complex business environment.

Family businesses must cope with endless industry related and organizational decisions while simultaneous planning for the management and ownership transitions driven by individual and family life cycles.

Rather, they are related to predictable transitions that occur as both families and businesses grow and mature.

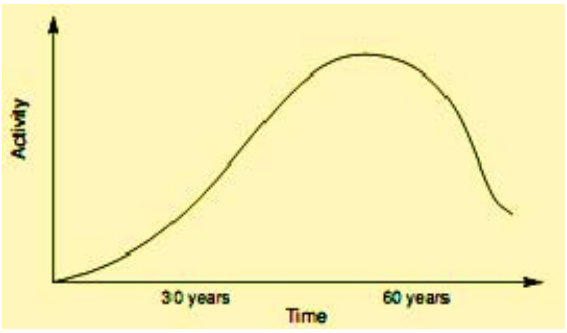

Figure 1. The human life cycle: the biological imperative

Families and their businesses must address life cycle change because it is a biological inevitability [3].

Figure 1 depicts the human life cycle from birth, through growth and development, to the highly productive adult years and then phase-down. In a family business, managers and owners have the biggest influence during their adult years, from around age 30 until
they peak in their 60s or 70s.

All businesses face challenges created by industry and organizational life cycles.
Figure 2 demonstrates the conflicts that occur when different family members experience life transitions at the same time.

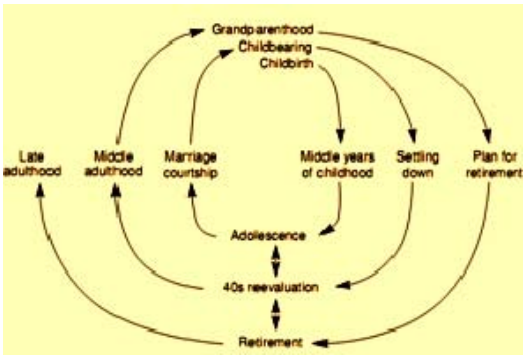

Fig. 2 The family life cycle spiral

A management transition for the senior and successor generations has significant implications for the family firm.

Figure 3 presents the overlapping life cycles of two generations in a family business. The senior generation must move through several phases: planning the strategy, growing the business, mentoring the successor, letting go of control and supporting the transition. Each of these phases creates the potential for conflict and blocked careers if either generation stops or delays the process.

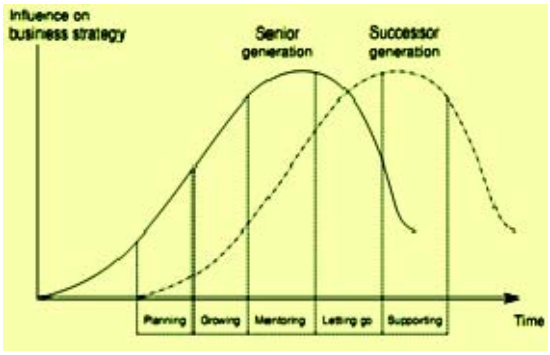

Figure 3 Individual life cycle influences on family business transitions

Life cycle models are used in the field of family business to explore planning and organizational issues.

For example, Gersick et all proposed a family business developmental model that includes three overlapping subsystems: business, ownership and family.

Their model recognizes the interrelationship of these three subsystems and presents three developmental stages for each [4].

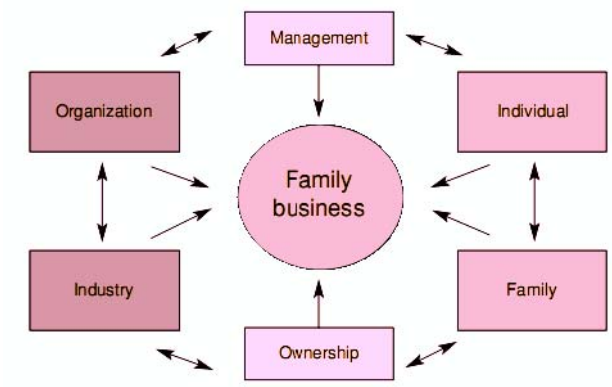

Figure 4 Four life cycle forces influencing family business planning

Ownership is not a life cycle, but rather an Ownership Configuration influenced by life cycle forces and family decisions.

This model proposes that family business can be structured with six Ownership Configurations that result from life cycle forces and family decisions:

Entrepreneurship	Owner-managed	Family Partnership	Sibling Partnership	Cousins' Collaboration	Family Syndicate

The planning implications for these different Ownership Configurations are discussed in figure 5 which elaborates on the four life cycle forces that create the unique challenges of family enterprises.

This frame work integrates industry, organization, family and individual life cycle forces to demonstrate their combined impact on the family business Ownership Configurations.

Applying life cycle thinking to human and business development is a challenge.

Human life cycle events follow a life pattern that evolves over an average of 70–80 years. Industry and even organizational life cycles are much less predictable. A new computer software product may move through the industry life cycle from introduction to decline in a few months.

For these reasons, there will not always be clear linkages between the different life and business cycle transitions.

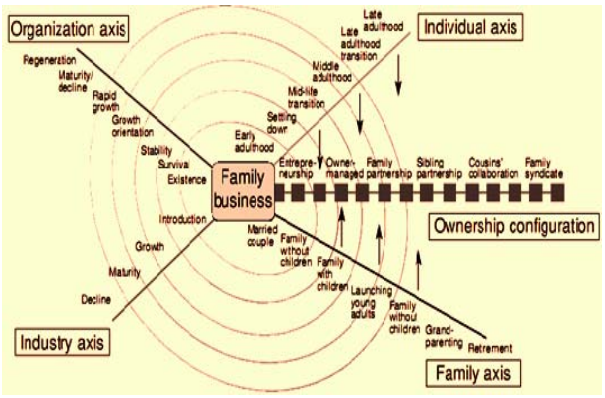

Figure 5 Life cycle forces influencing family businesses

What is important to understand is that life cycle forces shape individual, family, organization and market behaviors.

Different life cycle situations and combinations require different planning and strategies.

Actual or anticipated life cycle transitions are the starting point for the PPP.

A change in any of the four life cycles presented in Figure 5 means that the family and business plans require new thinking and possibly revision.

Figure 5 depicts all of the possible phases that may occur within each of the four life cycles operating in family businesses.

Families face additional pressures when life cycle transitions occur in two or more life cycles at the same time.

When this happens, planning also becomes more challenging.

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TRANSFORMATION OF ARMED FORCES IN SLOVAK REPUBLIC AND DEVELOPMENT OF HUMAN RESOURCES

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Abstract: *Author in this article analyze transformation process in Armed Forces of Slovak republic in view of human resources development. Author reacts on nowadays chosen problems and needs of managerial education member of armed forces with perspective till 2015. They give practical recommended like to ensure development of human resources and show on perspective educational activities of military professionals.*

Key words: *transformation, professionalization, development of human resources, key competencies*

Introduction

The core of all transformation changes in the world have to be certain values which humanity demarcated in the name of noble ideals of non-violence, equation and freedom. Therefore, the United Nations Organization accepted the development program for which avowed all member countries, counting Slovak Republic. It is rather more the International strategy for development accredited by General meeting of United Nations Organization (Strategy for Development). This document aims its attention to the human by fact, that its basic postulate is the restriction of poorness and the development of human resources.

There are many definitions of the problem of human resources. One of them with which we can identify is: „*Human resources are the main drive unit of the progress because the modern economy requires 'thinking labour power' equipped by intellectual competencies for creative attachment of technological conditions, economical and cultural changes but also for equipment of modern human by adaptability, flexibility, creativity, initiative and bussiness posture, because otherwise he cannot operate with safety in constantly changing labour world."*

The knowledge that human with his knowledges, competencies and abilities is the phenomenon which the only is able to ensure unbelievably rapid changes in the development of the society, rise up also in Europe. The approaches to solution of problem of human as carrier of societal development, his tutoring and education within Europe are very important and critical also for formation of approaches to this problem in Slovak Republic because Europe is the geographical and political area in which Slovak Republic realizes crucial spheres of its existential interests and needs.

The ambitions to non-conceiving and enhancement of the system of tutoring and education relate in full range to military education because it is the integral part of social, global education. In the branch of Ministry of Defence is the dominant basis the fact that fulfilment of requirements for transformation and reform of Armed Forces of Slovak Republic dependent on readiness and ability of its members to fulfil the tasks of reform and execute the tasks with quality, liability and creativity in new armed forces after reform.

Only on reqiured level of education and knowledge, equally prepared and trained military professionals will be able to fulfill tasks of building and functioning of armed forces in their new understanding. In this connection we cannot miss the sphere of *lifetime education*. We can search for parallels in approaches to problem of lifetime education in civil sector and also in department of defence.

The value and task of expert education and preparation for allowance generally is increasing in the present. Also in Armed Forces of Slovak Republic is accent on primary education which creates conditions and assumptions for further and lifetime

education. The dominant sign is the fact that people enter such education system voluntary purposely that the chance to success consists only in them. They are conscious of fact that mastering advanced military technologies, to improving and orienting in information explosion and to achieving high flexibility of military-professional activities demand their continual education during whole period of their career of professional soldier.

In Armed Forces of Slovak Republic similarly as in other organizations have to be applied principles of development in such way that the development especially of managers-leaders contributes to successful fulfillment of goals. The development of members of armed forces would deliberate their present and future needs. By development of managers their competencies are improving and their succession and career growth is ensured. The process of development would be *anticipating* (so the managers could contribute to longterm goals fulfillment), *reacting* (oriented to the solution or prevention of perfomance problems) or *motivating* (corresponding the individual aspirations related to the career). Single goals of managers development could be following:

- to ensure that the military managers would understand what is expected from them, therefore it is needed to arrange goals with them which will serve for evaluation of their performance and level of their competencies needed for special roles,
- to increase competencies of military managers in their present roles and positions as the instrument for greater responsibility,
- to recognize military managers with potention, to lead them to incorporate and realize the plans of development and to ensure sufficient development, education and experience which would prepare them for more difficult responsibilities everywhere in armed forces,
- to ensure succession in managerial positions and to create the system which would examine this succession continuously.

The transformation in Armed Forces of Slovak Republic

Before we start to explain developing and education processes which are running in Armed Forces of Slovak Republic from the view of the development of human resources in more detail, it is necessary to handle especially with *transformation* of Armed Forces of Slovak Republic which significantly influence the whole developing and education process and has permanent character.

In passed years was running the transformation of armed forces in four key scopes: *structure of armed forces, personal management, education and training, modernization of armed forces*. In the first area there was running the reorganization of command structures, especially of General Staff. There was created the structure of headquarter of ground forces, air forces and forces of training and support. Very important part of reform of armed forces was the reduction of infrastructure and radical reduction of count of military bases. Also very important component of trasformation was creation of the models of Armed Forces of Slovak Republic – Model 2010, 2015, 2020. In single models is indicated the development and orientation of all scopes of Armed Forces of Slovak Republic in inscribed time horizonts.

In the sphere of personal management were selected the resources and realized programs for ensuring of decreasing of count of military staff in higher ranks, as well as for decreasing of count of civil employers of defence branch. Gradually was established full professionalization of armed forces which accentuates to raising of young generation flow to armed forces. The important factor of professionalization was acceptance of more laws. Important is for example Act no. 346/2005 Coll. on state service of Professional soldiers but also many others.

In the view of personal management and management of human resources there appear the need to develop long-term plan of the structure and development of Armed Forces of Slovak Republic. The main goal of the reform of military staff was to settle unified *System of personal management* for all military staff. This integrated system of management of military staff includes all aspects of sustainment of forces – *entrance, development, Office positioning, reimbursements and career exiting* (lifetime cycle).

The *system of management of military staff* enables to managers and users in all levels to understand new personal system and to see that it is integrated, effective and available to military staff. It provides adequate depth of details for orientation of development and implementation of many components which

it includes. It describes functions, processes, systems and responsibilities for whole network of management of military staff. Its most important value is *to provide consistent view to modern and effective system of management of military staff which is designed in such way that it manages military staff in equity, fairly, equivalently, steady and following uniform standards.* Very important part of personal management system is the *centralization*. Centralized management of military staff in Armed Forces of Slovak Republic fills basic principle of military staff management and includes following imperatives:

- the reform of centralized management of military staff settles unified system of personal management for military staff.
- centralized system of office positioning will ensure equal opportunities of professional development for military staff and that qualified military staff with right competencies is positioned (following needs of Armed Forces of Slovak Republic) at right time.
- centralized system of service evaluation will assure that Professional soldiers will observe specified regulations and standards in compliance with their rank, competencies and level of their experience.
- centralized system of promotion judges all professional soldiers of the whole armed forces in such way that it ensures that the most qualified with greatest potention are selected to manage Armed Forces of Slovak Republic.
- centralized information system of personal management insures stable, exact and early flow of information about counts of staff and evidence of staff.
- centralized program of recruitment and staff care ensures observation of unified qualification standards and provides aimed use of personal and financial resources for completion of specified goals.

- To decrease count of high ranks in present structure and to increase recruitment of professional soldiers. Specifically, new structure has to contain less higher officers and more lower officers / non-commissioned officers and professional soldiers.
- To develop military staff with accent to leadership, career development and competitive selection for promotion to higher ranks. Inspired leadership and meaningful training are basis of efficient military units and necessary for successful modernization of defence branch.
- To develop effective *system of personal management* which will enable continuing professionalization of armed forces.
- The system must be „driving engine“ which supports (1) wage according to the rank, supporting professional development, ensures stable system of redemptions and eliminates subjectivity of the wage; (2) fully professional armed forces and deletion of mandatory military service will ensure higher training of soldiers and higher preparedness of units; and (3) enhancement of programs of life quality including social system for soldiers, contributions for living, accommodation and other programs for the enhancement of recruitment, growth of public support and the maintenance of force for sustainment of quality staff.

Personal capacity on planning levels is personal preparedness. So the first task of personal management is ensuring of continual occupying of Armed Forces of Slovak Republic by professional soldiers with required competencies and rigth ranks. For impletion of this requirement was elaborated apart from other principles also the system of professional development through training, education and classification to positions with rising severity which produces the leaders of high quality.

Professional development of dependets of Armed Forces of Slovak Republic

The development and education of dependents of Armed Forces of Slovak Republic begins already in the entrance process to armed forces. This process has certain structure, graphically presented as follows:

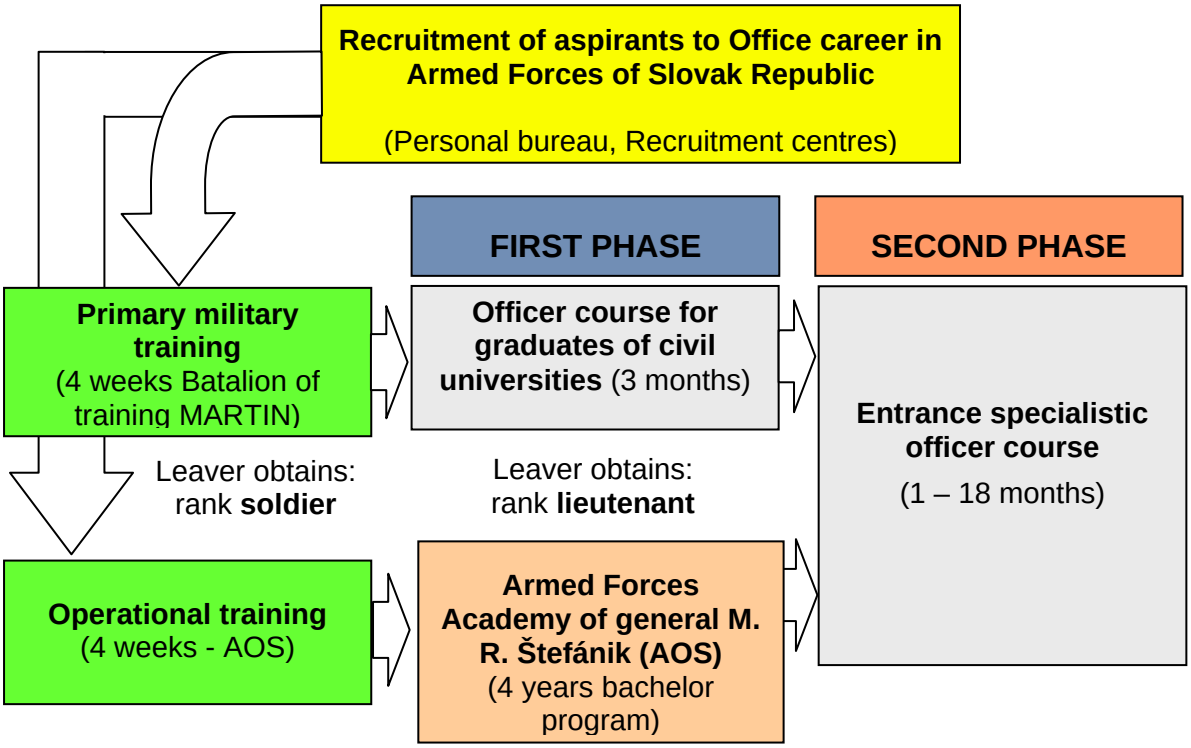

Figure 1: State of set-up of military educational system, career and expert education in defence branch. Source: System of management of military staff of Armed Forces.

The first phase is *recruitment* and after it entrance process and primary entrance training. Therefore have to be paid attention for ensuring of fact that the persons concerned who are accepted for preparatory state service were mentally and physically competent and motivated to become professional soldiers. Initial administrative, health and psychological testing of potential military candidates is performed in Centres of staff selection in Nitra or Košice.

The second step is contraction of *service relation*. The entrance of personnel to Armed Forces of Slovak Republic requires to sign by official commitment before acceptance of classification to military training. This formal commitment is signed also in recruitment centres. After successful graduation of entrance administrative process, health precaution and psychological examination in Centres of staff selection and after signing of service relation of preparatory service is to candidates assigned military rank and expertness. The soldiers (crew) are send to receive centre which is dislocated in training base of primary entrance training in Martin. The arrival to receive centre indicates the beginning of primary entrance training. The soldiers who took and finished individual operational and special training are assigned to units of Armed Forces of Slovak Republic. The officers after specific period nominate soldiers for further special training. By training soldier obtains the competence to execute various procedures, technics, apply tactics and adjust interoperation of various types of weapons and units.

The important element of development of armed forces dependents is the education of *non-commissioned officers and warrant officers.*

Nobody becomes trustworthy, competent officer immediately, non-commissioned officers have to be formed and developed. They are formed progressively by carefully suggested sequence of schools and courses in formalized structure (e.g. Entrance non-commissioned course, Improved non-commissioned officer course, Higher non-commissioned officer course etc.) as parts of their education and training, by obtaining work experience and individual activities. This is denoted as „pillars of professional development“. Forasmuch as professional development interferes to all three pillars it ocurrs cyclical repetition of training, obtaining operational experience, evaluation of reached results of activities, to feedback and to enhancement of professional activity. As the officers advance in their careers they have to develop them to be able to withstand

new challenges (promotion, functions with more responsibilities, further more exacting commitments).
The program of professional development of non-commissioned officers includes the delegation of responsibilities, competencies, rendering of accounts for wide range of tasks and rigorous performing of commands and regulations of leaders of Armed Forces of Slovak Republic.

The important group in Armed Forces of Slovak Republic are *warrant officers*. The goal of professional development of warrant officers is preparation of high specialized and skilful technicians who insure traffic, maintainance, administration and managing of equipment, support activities or technical systems in Armed Forces of Slovak Republic. The warrant officers would become technical specialists of Armed Forces of Slovak Republic. It is required from them that they prove technical knowledge, critical judgement and skills by solving of operational problems in complicated and highly technical environment.

The process of professional development of warrant officers is the combination of courses indifferent to military specialization and courses oriented to military specialization which ensure continuous and progressive training during warrant officer's career.

The *program of education of officers* consists of academical programs provided in Armed Forces Academy of general M. R. Štefánik in Liptovský Mikuláš, which result is obtaining of academical title. It ensures completely integrated sequence of training, positioning and specialized programs of further development of officers from rank of lieutenant to general with aim to assure that they will be able to fulfill the requirements of defence. The education of officers is the systematic process assigned to acquirement ad development of knowledge, intellectual habits and academical competencies. The concrete subjects in specific disciplines and study specializations provide to officer academical fundamentals for critical thinking in the way that he is able to act as a leader and manager in Armed Forces of Slovak Republic. Inseparable part of education of officers is forming of their value sights, minds, interests, needs, expectations as well as personable intellectual fundamentals and abilities. The goal of training and education program of officers is to prepare generally educated officer leaders who are qualified from tecnical and tactical aspect and have leader skills, knowledge and military behaviour.

The course of basic training of cadets (for graduates of Armed Forces Academy 4 weeks)
In the course of basic training of cadets the cadets submit the training in basic military skills, code of conduct, discipline, personal appearance, military motions, ceremonies and physical preparation. All students who enter Academy have to take in it. Its purpose is the examination of their emotional stability, endurance and ability to organise and execute activities under stress.

Entrance special oficcer course (VODK) (for graduates of the course of basic training of cadets and for applicant for professional service). It is the course for obtaining of military specialization which prepares designated lieutenants for leadership, tactical and technical skills in the way that they will be able to train and lead units of size of platoon in military operations. New officers are prepared there for filling of responsibilities which are needed for providing all matters of personal, administration and logistic requirements of units of the platoon size.

Officers course for graduates of civil universities. It is designated for the graduates of civil universities obtained for the service in Armed Forces of Slovak Republic for officer positions in some chosen military spcializations (physicians, lawyers, psychologists etc.).

The preparation of leaders is organized as career courses oriented to the development of leader competencies required for execution of command and staff functions.

The package of career courses is composed from:

- *Warrant officer course (PrK)*
- *Primary command-staff course (ZVŠK)*
- *International staff officers course (ISOC)*
- *Higher command-staff course (VVŠK)*
- *Course of national security (KNB)*

Warrant officer course – it is the qualification assumption for the warrant officers ranks. The graduation of the course would the professional soldier be able to afford valuable guidance to the commanders in the questions of operation and maintainance of equipment, attendance of technics and requirements of technical

training of units. He would be able also to lead small technical units.

Primary command-staff course (ZVŠK). By its graduation the professional soldiers obtain special eligibility for the ranks captain and major. The profil of graduate is characterised as follows:
- the graduate of the course would be able to fulfill duties on command-staff positions,
- he sustains analytically evaluate the situation and consequently contribute for his sphere to the preparation of background papers in planning and decision process,
- he understands laws, military regulations and service aids for efforting of the function on specific command level,
- he knows the system of doctrines of Armed Forces of Slovak Republic and principles of NATO defence standardization,
- he is able to present his opinions, knowledge and experience etc.

The course runs three months in the area of Armed Forces Academy in Liptovský Mikuláš.

International staff officers course (ISOC) is separate qualification for the function of member of international staff with planned rank of first lieutenant to major. The course is dedicated for the officers from NATO, Partnership for peace and perspectively from other countries. The preparation of officers is assigned for staff work in multinational staff by planning and leading of military activities during NATO operations in respect of the whole spectra of conflicts and it runs in english.

Higher command-staff course (VVŠK) prepares *selected* officers in more exacting spheres of military profession as well as for leading of operations in time of peace, conflict and war. The officers are prepared for filling the tasks of higher staff officers in planning and organization functions in operational staff, General staff of Armed Forces of Slovak Republic, Ministry of Defence of Slovak Republic and to command the operational units on the level of battalion, squadron. By the succesful graduation of the course obtain the professional soldiers expert qualifications for the rank of lieutenant-colonel and colonel.

The profil of graduate is characterised as follows:
- he is able to command and manage the units on the level of battalion, wing,
- he handles the responsibilities of staffer on tactical and operational level,
- he manages using of fiscal resources with accent to economy, effective and efficient using of public financial resources,
- he is competent to work in multinational staff environment,
- he knows and uses operational art and tactics for the function on certain level of command and management,
- he is able to present his experience, opinions and knowledge etc.

Course of national security is oriented on complex study of national and international security, defence policy and strategy of state security and defence. The goal of course is the consolidation and development of independent and concept thinking of course participants, acquirement of competencies, which are needed for fulfillment of tasks related with creation and realization of security and defence policy. The course for Armed Forces of Slovak Republic (NATO, EU) runs 8 months. Following cross-section of education activities realized by Armed Forces Academy the course is concerned to development and education activities oriented to improvement of theoretical knowledge in the sphere of special and managerial competencies.

Development of military managers competencies

The development and education of military managers means in practice – *improvement of performance, effectivity of succeeding of work goals through increasing of competencies, abilities and actual knowledge*. Thereby following specified requirements would improve also their *professional and career growth*.
Achieving certain standard of development of military managers is not simple process. Also in military environment often appear the questions of fundamentals and character of management processes and activities. What qualification should have military manager for managing of military organization and leading people?

The qualification of management could be sensed as collection of conjunction of manager ability to manage (certain personable assumes), competencies for managing (use the theory and practise in managerial activity) and managerial behaviour and observance of manager. In practise we meet such key criterias of manager qualification, which are related to

such competencies as *decision-making, planning and organizetion, communicativeness, leadership, the art to delegate, ability to listen, creativity and also high standard of work performance*. The requirements to manager can be derived also from managerial functions and competencies in dependence on their positions in various levels and groups of management. In this direction would each institution conceive its own relevant education projects for its managers.

The effectivity of managerial preparation and education is markedly influenced by selection, understanding and qualification of used methods and forms of education of managers. Therefore were the courses oriented on understanding of present managerial competencies of military manager. From practical competencies there were especially *leading of people, effective communication, team work, delegation, creativity, implementation to practice, persuasion and influencing of people*.

The main characteristics of effectiveness of knowledge of military managers would be oriented to analytical, decision and organizational knowledge, leading of people and important are also specialistic know-how.

In present period are worked the lists of general managerial competencies as they were formed by Management Charter Initiative. It is for example *assertive behaviour and observance, strategical approach, ethical behaviour, communication, orientation on results, impact to others, motivation and influencing of people, self-management, obtaining and interpretation of information, thinking and decision making* etc.

There exist many opinions about competencies which managers will need including military managers to their success but there is no ideal model of characteristics. To the question why military managers have to improve their competencies as they already have obtained certain level of education we can answer as follows. Military managers are not developing because they need to be generally more qualified but because they need to obtain competencies required for achievement of demanded level of performance in armed forces.

From marked information started also our Department of Management by the creation of courses for military managers but also for employees of defence department. We set in the development of managerial competencies by executing and preparing of more single courses within the lifetime education of managers with form of modules under the name „Key competencies of manager".

The whole course (100 hours) is divided into 5 modules which are oriented to:

- effectivity of manager work – effective manager,
- team cooperation – creation and building the team,
- communication of manager,
- psycho-hygiene of manager – stress encompassment,
- etiquette of manager and social protocol,
- new trends in education of managers.

The life and the practice show that we took the right direction, the course participants present publicly their satisfaction with gained practical skills and our feedback analysis from courses and personal experience of this form of education confirms this fact.

We can forward a lot in this form of education and this is the advisability of these activities especially realization of development of managerial theory in daily practice.

Conclusion

The development of knowledge, intelectual habits and skills of military staff can be considered as systematic process which has permanent character. Concretely the programs of education and development in selected disciplines and study specializations afford to particular groups of military staff the continual forming of their value opinions, postures, interests, needs, expectations as well as personable intelectual fundamentals and abilities. In addition, the development and education of military staff is the assumption of its growth during whole career. The task of personal management in this sphere is unfungible because it must continually react to new tasks, requirements and claims which are permanently posed on armed forces.

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SOME LEGAL ASPECTS REGARDING INFORMATION SECURITY AND COMPUTER CRIME

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Abstract: *This paper approaches a number of legal aspects regarding prevention and protection against the various forms of computer crime or cybercrime. Computer crime (or cybercrime) can be defined in various ways which determine the conditions, circumstances and situations that are specific to an action or activity with the purpose of influencing the functions of computer systems. An important section of the paper deals with the effort that is undertaken worldwide regarding prevention and limitation of computer crime in its various forms. The paper presents a comprehensive list of international organizations and along with the recommended measures and procedures for this purpose. In the final part, the paper offers a synoptic presentation of concrete cases. Statistics reveal a growing trend in cyber crime between 2005 and 2007 however 2008 is characterized by a decreasing number of cybercrimes as is illustrated by the graph.*

Key words: *cybercrime**,** data security, data integrity, international organizations, legislation.*

Computers have been strongly impacting on everyday life, on the manner of development undertaken by the business environment, by communication, by administration etc.

Despite the manifold advantages brought along by their use, the computers have entailed the possibility for illegal action coming up. They have facilitated classical trespass perpetrated, such as theft or fraud.

In this paper, several legal aspects will be approached, related to computer crime.

1. CONCEPT OF COMPUTER CRIMINOLOGY

Several ways exist so as to define the concept of “computer criminology”.

A first definition would be: "any illegal action wherein a computer constitutes the instrument or the object of the crime, to put it otherwise, any trespass whose means or purpose is influencing the function of the computer".

Another definition is: "any incident connected to computer technique wherein a victim underwent or might have undergone a detriment and whereof the author obtained or might have purposefully obtained a profit".

If "computer criminology" stands for "the totality of the deeds perpetrated in the area of state-of-art technologies, during a well determined period of time and on a specific territory", "computer delinquency" might be "the totality of the deeds of penal nature perpetrated in the computer space".

2. CONSTITUTIVE ELEMENTS OF COMPUTER CRIME

The constitutive content of computer crime are the overall specific, typical and essential characteristics of the object, subject, of the subjective and objective sides of the crime, displayed under the hypothesis of the incriminating norm (the norm that settles the specific content of every crime and the applied abstract penalty, being provided in the special part of the Penal Code, or in special penal or non-penal laws, however with penal dispositions).

Object of the crime

a) Judicial object of the computer crime

The mentioned element is protected by the penal law. The distinction exists within the specialized literature between the generic judicial object, common to a group of crimes, and the special judicial object, specific to each and every crime.

In the case of computer crimes, the generic judicial object is represented by the information security and by all social relations constituting round this value.

b) Material object of the computer crime

Through material object of the crime, there is understood that material entity wherein some values protected by the penal law are incorporated and against whom the criminal activity is directed.

In the case of computer crimes, the material object must not be mistaken for the material means used in perpetrating the crime, which is, in this case, the computer.

Knowing the material object is very important, from two standpoints:

1. as the material object, in guise of material expression of the social value protected through incrimination contributes to determining the specific judicial object, rendering thereby possible a correct judicial framing;
2. as the prejudice brought through the incriminated action aims at the material object, and the nature and seriousness of this damage constitutes a criterion of judicial individualization for the penalty.

Subjects of computer crime

a) Active subject

The active subject may be the natural person having reached the age of 14 years old and having perpetrated or participated in guilt in perpetrating a deed stipulated by the penal law. He/she may be both general active subject and special one.

b) Particularities of the author of the crime perpetrated through the computer

The main active subjects of the computer crime are deemed to be the hackers, they being sometimes concisely and depreciatively catalogued as "computer swindlers".

The hacker may be defined in several ways:

- „person who likes to explore the details of the programming systems and the manners of expanding their capabilities;
- person capable of being appreciated («hack value»);
- person who can make rapidly create software;
- expert as regards a software;
- person who likes the challenge or intellectual emulation of creative exceeding or limit avoidance;
- intruder who attempts at discovering precise information with much curiosity and insistence"

Purposes of an attacker:

1. rendering more difficult or slower the normal activity of a service through delaying the answer temporal units or through perturbing the access to resources, up to completely blocking the activity;
2. inserting distorted sequences in the data sent by a service towards its users, up to completely embezzling the service towards a resource controlled by the attacker;
3. obtaining illegitimate access to private services or with limited access;
4. capturing information manipulated by services of private or secret nature;
5. modifying the configuration of the machines providing certain services;
6. installing special software, which execute on the attacked servers different actions for the attacker’s benefit, such as collecting passwords etc.;
7. replacing special software, which are part of the attacked machine set-up, with others, which seemingly execute the same actions as the original ones, however working for the attacker’s benefit;
8. simply deleting certain software or information from the attacked servers, up to the overall software destruction of the attacked machines, or up to hardware destruction.

c) Passive subject

The passive subject of the crime is the natural or judicial person against whom the

criminal activity is directed; this one may be both general and special.

d) Characteristics of the victim from the crime perpetrated with the computer

In the case of the computer crime, the special passive subject usually is the natural or judicial person owning the computer system whose functioning parameters were modified, or another natural or judicial person who is affected through the manipulation of the owned data or who is of interest for the attacker, or for those resorting to his/her services.

4. CRIMES THAT MAY BE PERPETRATED WITH THE COMPUTER

As progresses have been marked in the field of information technology, the means for perpetrating computer crimes have also widely extended.

Different methods may be defined, which are used in the criminal activity based on computers, ranging from data alteration or modification after having been entered therein, up to recording instructions with self-camouflaging in the software and intercepting communications through computers.

"Computer viruses" illustrate the sabotage potential as regards military and political computers and communications. Unauthorized, secret entering may bring about endless trouble and power commutations in unexpected manners.

As regards computer delinquency, there may be noted the computer attractiveness for its informational content. Consequently, computer has been increasingly growing into an instrument for computer delinquency.

The crimes that may be perpetrated of our days make the object of some activities developed on national or international level.

5. INTERNATIONAL STEPS TAKEN AGAINST COMPUTER CRIME

Organization of United Nations: Resolutions 55/63 January 2001 and 56/121 January 2002 as regards fighting against the use of information technology to criminal purposes.

These resolutions invite the member States:

- to take common efforts in fighting against computer criminality
- to adapt national legislations to this purpose
- to collaborate on international level and to exchange information in this field
- to train the staff within the competent institutions to face the requirements of this activity
- to protect by law the confidentiality and the integrity of the computer systems
- to preserve the electronic data and to allow the rapid access in case of investigations
- to ensure in useful time the investigation of the computer crimes, the proof collection and the information exchange
- to train the population upon the prevention and protection means against computer crimes
- as far as possible, to adapt the computer systems in order to help detecting criminal actions, to gather proofs and to ferret out the malefactors
- to find solutions towards combating computer criminality that should not affect individual liberties and likewise the citizens' right to private life.

At the same time, these resolutions delegate the responsibilities for the future plans and actions in the field of computer crime combating, to the Commission of Criminality Prevention and Justice in Penal.

Organization for Economic Cooperation and Development: OECD greatly contributed to the development of international cooperation against computer crime, forwarding recommendations to the States to adapt their national legislations so as illicit deeds and crimes connected to the computer environment should have a similar juridical definition on international level. These recommendations were meant to create a unitary judicial frame on international level for fighting against computer crime.

Group of Eight: G8 laid between the years 1998 and 2000 the bases for effective cooperation, creating an international network of contacts that includes experts and institutions capable of intervening and of facilitating the immediate investigation upon the penal deeds connected to computer criminality. In June 2001, the Council of Europe recommended all European States to join the network of contacts created by G8.

European Union and Council of Europe:

- 2005/222/JHA – In the year 2005, a Frame Decision of the Council of Europe as regards the attacks upon computer systems recommends the member States to deem as trespasses, the illegal access to computer systems, the illegal interception and altering of the computer data, and likewise imposes a few rules as regards international cooperation. This is the first document meant to render uniform on European level, the efforts of fighting against computer criminality.
- The directive 2006/24/EC of the Council of Europe and of the European Parliament as regards the storage of the data generated or processed by the suppliers of electronic networks and services destined for the public constitute themselves in the first document on international level meant to facilitate the gathering of electronic proofs upon computer crimes.

OSCE – Organization for Security and Cooperation in Europe: Through the decision 7/06 it recommends the member States to become part in the Convention for Fighting against Computer Criminality, of the Council of Europe, and encourages the States to join the network of contacts G8 as regards computer delinquency. This decision is also important through the fact that it grants equal importance both to computer crimes and to gathering electronic proofs.

Interpol: Interpol was the first institution to organize international reunions of the experts in computer delinquency. Having 184 members throughout the world and its role being to facilitate the international cooperation of the police organisms, Interpol has laid unceasing efforts in the fight against computer crimes. To this purpose, it created an international network of contact points meant to identify experts from all countries capable of offering assistance in investigating computer crimes. However, the role of the Interpol in investigating and fighting against illicit computer deeds is limited by the manner wherein this organism is constituted. Its temporal units of reaction are not sufficiently rapid for gathering the proofs in computer field because of the volatility of the data communicated to the computer systems, volatility which imposes reaction times of the order of the seconds or of the minutes so as to gather proofs.

Convention as regards Computer Crime (Council of Europe): ETS 185 – of the 23rd of November 2001 from Budapest – is the first effort towards an international treaty as regards computer criminality. The Convention was signed by 46 countries, whereof 4 were not members of the council. Among them, 24 countries (inclusively Romania) ratified the convention, the United States being the only non-member State ratifying the convention. The Convention introduces new channels of communication in the fight against this type of delinquency and defines a common set of standards for incriminating the illicit facts connected to information technology.

At the date of the 23rd of November 2001, the member States of the Council of Europe (benefiting from the help of Canada, United States, Japan and South Africa – in guise of observers) drew up and signed the „Convention upon Cybercrime".

Subsequently, in the 28th of January 2003, the "Additional Protocol for the Convention upon Cybercrime, as regards **incriminating** the deeds of a racial and xenophobe nature perpetrated through computer systems" was forwarded to the purpose of being signed by the member States. Romania also signed this Additional Protocol in the date of the 9th of October 2003.

The Convention and the Additional Protocol settle the basic frame for inquiring and legally penalizing the crimes perpetrated through and with the computer, as well as for

the inter-State cooperation, necessary for stopping this scourge.

The Convention brings to the forefront the necessity for the penal incrimination of deeds such as:

- illegal access to a computer system,
- illegal interception of computer transmissions,
- computer fake,
- computer fraud,
- infantile pornography on the Internet,
- infringements of the property rights and other related rights etc.

6. LEGISLATIVE MEASURES ADOPTED BY ROMANIA

The Parliament of Romania endeavored to transpose these directives through the **Law 161/2003** as regards some measures for ensuring the transparency and for exercising public dignities of public positions and, in the business environment, for preventing and punishing corruption, more exactly, through the Title III of the Book I (Prevention and Fighting against Computer Delinquency, art. 34 - 67).

The purpose of this normative act is preventing and fighting against computer criminality, through specific measures of prevention, discovery and sanction of the crimes perpetrated through computer systems, the human rights and the protection of personal data being observed (art. 34).

For the prevention and discovery of the computer crimes, the law requires the concurrence of the authorities and public institutions with competences in the field, of the suppliers of services, of the non-governmental organizations, of the representatives of civil society promoting policies, practices, measures, procedures and minimal standards of security as regards computer systems, of the Ministry of Justice, of the Ministry of Administration and Internal Affairs, of the Ministry of Communications and Information Technology, of the Romanian Service of Information and of the Service of External Information (that has to constitute and continuously update the database as regards computer delinquency), of the National Institute for Criminology.110.

7. CRIMES AGAINST THE CONFIDENTIALITY AND INTEGRITY OF THE DATA AND COMPUTER SYSTEMS

Crimes against the confidentiality and the integrity of the data and computer systems

A. Computer crimes Law **161/2003**

- ***Access with no** right **to a computer system*** [art. 42 paragraph (1)].

Prison from 3 months to 3 years or with fine

- *Perpetrated so as to obtain computer data* [art. 42 paragraph (2)]

Prison from 6 months to 5 years.

- *Perpetrated through infringing the security means* [art. 42 paragraph (3)]

Prison from 3 to 12 years.

Objective side

The material elem. through whom the **crime** is effected consists in an **action,** which is "access with no right" to a computer system.

Subjective side

The deed may be effected through direct or indirect **intention**

Forms

The crime is susceptible of tentative (art. 47).

Modalities

The deed may be perpetrated through a multitude of factual modalities.

Existence of crime

- Art. 35 paragraph (1) lett. a): The fact must be effected "with no right" and must be directed against a "computer system."
- Art. 35 paragraph (1) lett. d): Aggravating variant: necessity of fulfilling a condition connected to the purpose of crime perpetrating " obtaining computer data"

B. Computer crimes Law **161/2003**

- ***Intercepting, with no right, a transmission of computer data** which is not public and which is destined to a computer system, proceeds from such a system or is effected within a computer system.*" [art. 43 paragraph (1)]

Prison from 2 to 7 years.

- "***intercepting with no*** right ***of an electro-magnetic*** emission *proceeding from a computer system containing computer data, which are not public* " [art. 43 paragr. (2)]

Prison from 2 to 7 years.

Objective side

The material element consists in an action, more precisely in „intercepting" transmissions of data or of electromagnetic **emissions** (program transmitted through the interaction between the electric currents and magnetic fields).

Subjective side

The deed may be effected through direct or indirect **intention**

The crime is susceptible of tentative, which is punished (art. 47).

Modalities

The deed may be perpetrated through a multitude of factual modalities.

Existence of crime

- The interception must be with no **right**.

C. Computer crimes Law **161/2003**

- ***Modifying, deleting or deteriorating the computer data*** *or restricting the access to these data, with no* ***right*** [art. 44 paragraph (1)].

Prison from 2 to 7 years.

- *Unauthorized data transfer from a computer system*" and "*unauthorized data transfer from a means of computer data storing* [art. 44 paragraph (2)]

Prison from 3 to 12 years.

- Data retrievable in a means for storing computer data [art. 44 paragraph (3)]

Prison from 3 to 12 years.

Objective side

The material element through whom the crime is perpetrated may consist in one of the following modified actions (altering the initial form of the computer data), deleting (removing the computer data from the computer system or other devices whereon they are stored), deterioration (modifications brought to the content of the respective data, having as consequence the impossibility of using these data to the purpose of their generation) or through restricting the access (using specific methods that affect the destination area of those computer data).

Subjective side

The deed may be effected through direct or indirect **intention** .

The crime is susceptible of tentative, which is punished (art. 47).

Modalities

The deed may be effected through the action of modification, deterioration or access restriction or in the variant stipulated by paragraphs (2) and (3), through unauthorized transfer. The deed in itself may be effected through a multitude of factual modalities.

D. Computer crimes Law **161/2003**

- "*The deed of seriously perturbing, with no right, the functioning of a computer system through the introduction, transmission, modification, deletion or deterioration of the computer data or through the access restriction to these data* " [art. 45]

Prison from 3 to 15 years.

Tentative is punished.

Modalities

Serious deeds of computerized **sabotage** or even computer terrorism.

Existence of crime

- Consists in one of the following operations: introduction, transmission, modification, deletion, deterioration or restriction to functioning of a computer system.

E. Computer crimes Law **161/2003**

- *To produce, sell, import, distribute or render available, under any form, with no right, of a computer* ***device*** *or software, designed or adapted to the purpose of perpetrating one of the crimes stipulated at art. 42 - 45* [art. 46 paragraph (1)].

Prison from 1 to 6 years

- *To produce, sell, import, distribute or place for public benefit, under any form, with no right, of a password, access code or other such computer data, which allow total or partial access to a computer system so as to perpetrate one of the crimes stipulated at art.42-45* [art. 46 paragraph (1)]

Prison from 1 to 6 years

- *Possessing, with no **right**, of a computer device, software, password, access code or computer data from those stipulated at paragraph 1, so as to perpetrate one of the crimes stipulated at art. 42 - 45* [art. 46 paragraph (2)]

Prison from 1 to 6 years
Tentative is punished**.**
Computer crimes Law **161/2003**

- *The deed of introducing, modifying, or deleting with no right, computer data or of restricting with no **right** the access to these data, there ensuing inadequate data to the truth, to be used so as to produce a judicial consequence.* (art. 48)

Prison from 2 to 7 years.

- *The act of causing a patrimonial damage to a person, through introducing, modifying or deleting computer data, through access restriction to these data or through impeding a computer system functioning so as to obtain a material benefit for oneself or for another* . (art. 49)

Prison from 3 to 12 years.
Tentative is punished**.**
Infantile pornography through computer systems

Considering the wide extension of this phenomenon in the internet network, the legislator decided the express **incrimination** of infantile pornography, perpetrated through computer means

- *Production to the purpose of disseminating, offering or rendering available, spreading out or transmitting, acquiring for oneself or for another pornographic materials with minors ... or possessing, with no right, pornographic materials with minors.*(Art. 51)

Prison from 3 to 12 years.
Tentative is punished**.**

CONCLUSION

In fighting against computer criminality, a well settled legislative frame is necessary as regards preventing, discovering and punishing these **deeds.** Through the international acts whereof it is part, Romania is under compulsion to develop a legislative system specific to this type of **crimes**. All the more, older crimes are being perpetrated of our days through state-of-art means (computer theft), at distances of thousands of kilometers, the international cooperation being vital for fighting against this scourge. Recently, mass-media has announced a new generation of viruses having been created, which attack GSM terminals and, unfortunately, is but the new **direction** of these attacks. **The Law 161/2003** is a start, however to keep up with the huge delinquency diversity, which only requires a keyboard and a mere mouse click, the legislative activity should not stop here.

Computer criminality is an ever-rising phenomenon, which clearly affects the image of Romania beyond its borders.

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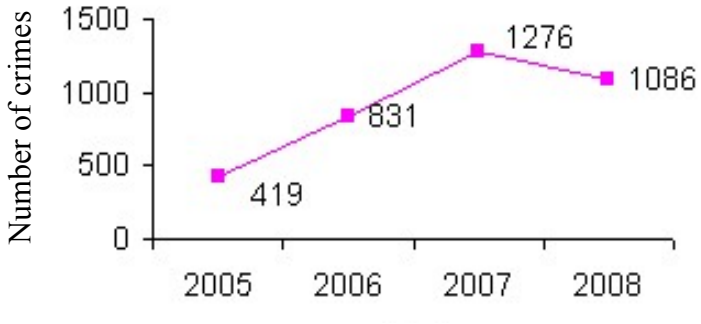
Computer crime evolution



According to the statistics, a rising trend may be noted as regards computer crimes and also as regards the persons under research, during the period 2005 - 2007: from 419 crimes and 345 inquired persons in 2005, to 831 crimes in 2006, to 1.276, during the year 2007.

In the year 2008 a diminution of the number of crimes was noted throughout our entire country, in the field of computer crime. A number of 1.086 crimes were noted, a number of 617 persons being inquired, where of 81 kept or arrested.

In the first nine months of the year 2009, in a number of 78 files wherein deeds of computer criminality were noted, there was disposed to sue at law 390 persons (where of 241 under arrest) for perpetrating **639** crimes.

A reorientation of the criminal groups may be noted which, in the past, dealt with another type of crimes, towards the computer crimes, as they consider them much more attractive and may bring forth more money, much more rapidly and much more simply.

Among the motives wherefore these groups reoriented, the high incomes obtained very shortly may be mentioned, as well as the transnational character of this type of crime, through the fact that they may perpetrate part of the crimes in Romania and not only.

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MANAGEMENT ORGANIZATION USING ENTERPRISE RESOURCE PLANNING

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Abstract: ERP (Enterprise Resource Planning) has undoubtedly become an important business application to all industries. It has almost become a must for all organizations irrespective of the type of business manufacturing or service. In many cases the packaged ERP product does not provide the entire solution for the business process. Agility allows the project management methods as well as the system to be adaptively tailored to the business needs. Web enabled ERP services and wireless ERP, provided with maximum security, will be prefered for one reason that they can be easily run in Microsoft application and platforms.

***Keywords**: ERP, informatics system, management, decisions*

1. Introduction

Enterprise resource planning (ERP) software solutions have been implemented by many companies in their efforts to integrate and control their order management, purchasing, supply and logistics functions. Managing ERP systems knowledge has been identified as a critical success factor if businesses, their suppliers and logistics providers are to retain control of their business and not be controlled by their systems. Although knowledge has been attributed as a key driver of ERP success, there has been very little work conducted to date that assesses the methods employed to manage ERP system development and operation knowledge. Thus, the objectives of this study are to better understand knowledge management practices for operating ERP systems and detail how organisations can better manage their ERP systems knowledge, putting them back in control of their companies. Managing comprehensive information technology applications, such as ERP systems is a knowledge-intensive task. ERP literature suggests that systems knowledge must be carefully managed throughout the ERP lifecycle in order to maximise benefits. There is a strong financial and operational motivation for companies to better leverage ERP systems knowledge and make this knowledge available to those involved in the ongoing management of the system. Disregarding the importance of knowledge has become costly and many firms are now struggling to capture their current systems knowledge, identify knowledge requirements and develop a strategy to bridge this divide.

Organizations had to implement ERP throught their systems irrespective of the fact whether they help in all the functions or in one particular function. This was proving to be a big hurdle to the firms. In addition this remained as the main disadvantage or setback of ERP. They had to purchase the whole applications even if it meant that most of them would be idle except for the core function. The latest ERP software programs have overcome this menace. They offer need based applications. The firms need not be worried even if these Software Programs were not available. They were given the liberty to purchase and install Software Programs pertaining to that particular function. This advantage has helped to increase the scope of ERP not only among large firms but also small and medium business as well.

2. Exploring ERP fundamentals

Enterprise Resource Planning systems (ERP) encompass a wide range of software products supporting day-to-day business operations and decision-making. ERP systems serve many industries and functional areas in an integrated fashion, attempting to automate operations from the supply chain management, inventory control, manufacturing scheduling, sales support, customer relationship management, financial and cost accounting, human resources and many other functional areas in an organization.

Organizations adopt ERP systems for a variety of reasons. Two of the most prominent reasons for ERP adoption have been cited as: process standardization and process automation. While most organizations historically employed numerous disparate information systems to supply the breadth of functionality of an ERP system, ERP systems provide a standardized and integrated, process focused environment that is difficult to attain and viably maintain with stand-

alone, custom-built software systems. Especially due to its processoriented automation, the ability of ERP systems to disseminate information in real-time can substantively improves managerial decision making in organizations

MRP1 is the predecessor of enterprise resource planning application. ERP has become the talk of the day not only with regards to management and information systems but also for the whole business. MRP1 the acronym of material resource planning was the first business application that set foot in the ERP family. The credit of computerizing the business processes solely goes to MRPI. MRP1 functioned with the objective of increasing the business profit by enriching the business. The analysis of MRP 1 reveals that it is made on the basis of finding out the quantum of materials that have to be given in order to gain the said optimum productivity levels depending on other parameters like production capacity and factors. In addition MRP II boasts of the following four elements: response (any process is bound to achieve progress if and only it receives valuable criticism from reliable sources and more so preferably from end user.), allocating reserves (everybody will know what is expected from them within the stipulated deadline), matching the requirements and software extensions programmes. MRP II has not yet lost popularity inspite of the intervention of ERP.Many organizations still consider it as a part of the manufacturing process. ERP has a big challenger from its own community. Its successor ERP II has been talked about much.

ERP helps to integrate the datas in an organization under one common platform. The purpose behind is not only to ensure transparency but also to facilitate tracking down information regarding the status of a particular order or its dispatch and so on. If a company succeed in this it will definitely achieve ERP benefit.

An organization has to do meticulous planning, devise strategies before going ahead with ERP. ERP can cut down costs; improve the quality of working time and by and large. In short it helps in making the maximum use of technological advancements. For instance the executive in the Sales Department will be able to respond to a customer query immediately by making out the status of the product's delivery which would not have otherwise been possible but for the intervention of ERP in the organization. ERP has enabled organizations to do away with laborious and time consuming process. A strong understanding of ERP basics will help to know ERP benefits.

The company have to properly understand ERP fundamentals in order to derive the maximum outcome. These are crucial factors deserving attention when it comes to ERP. The services of ERP cannot happen all on a sudden in an organization. It is a long drawn process .The spade work that needs to be done may require a couple of months and even years depending on issues like volume of the organization. Meticulous planning will definitely help to achieve ERP benefit. Companies have to be vigilant enough more so when it comes to the question of choosing the appropriate platforms and ERP softwares.This issue becomes crucial when it comes to the point of corporate amalgamation. The softwares used by the different companies have to be brought under one common platform.

The objective of the selection process is to find a package that is flexible enough to meet the company's needs. Or in other words, to find a package that can be customised to obtain a "good fit."

The best method for preparing the selection criteria is to conduct a requirements analysis—find out what the company needs. The requirements must reflect those factors that the company considers indispensable for the successful running of the business according to the company's work culture and practices. Given below are some examples of the selection criteria[5].

- The package should have multilanguage and multi-currency support.
- The package should be international and should have installations in specified countries (basically in countries where the company have offices). The vendor should also have a local presence in those countries.
- The package should have at least 'x' number of installations out of which at least 'y' should be in your business sector.
- The cost of the package with all the necessary modules should be less than 'x' euro.
-The package should have the facility to do an incremental module addition. The company should have the facility to buy the core modules initially and then go in for the additional modules as and when desired.

All vendors will have customers for whom their products have failed. Getting those names and the reasons for the failure is more important than the success stories. Also, while vendor representatives are well prepared for the success stories, the

questions about failed implementations usually reveal points and issues that the vendor is trying to downplay. So it is important to ask about failed implementations.

-The vendor should provide implementation and post implementation support.

-The vendor should give a commitment on training the company employees on the package.

-The package should have the capability of interfacing with other systems that the company is dealing with—banks, suppliers, customers, etc.

- The package must be customisable and the customisation process should be easy

- The vendor's policy and practices regarding updates, versions, etc, should be acceptable.

In this way, the issues, concerns and expectations that the company has, regarding the package, can be consolidated and made into a list. Then the items in the list should be placed into the 'vital-essential-desirable' categories. Then, using this list each package should be evaluated.

What is extremely relevant for the degree of development of the ERP market in Romania is the fact that only 20% from the implementation cases covers all the functions of the business. Where the functions are partially covered, the highest degree of coverage is by far that of financial and accounting. The accounting and financial activities are found in approximately 80% of all ERP implementations. There is a second echelon which is payment, analysis and reports, production, retail, marketing. A weaker implementation of strategy modules is noticeable which demonstrates once more the "basic level" at which ERP systems are understood and implemented.

Table 1

THE MOST FREQUENTLY IMPLEMENTED MODULES	
Accounting Module (accounting, financial analysis)	77,2%
Payroll Module	60,4%
Reporting and Analysis Module	57,8%
Manufacturing Module	49,1%
Marketing and Sales Module	48,9%
Fixed Assets Module	42,6%
Budgets and Projects Management Module	34,4%
Manufacturing Processes Launch and Control Module	32,8%
All Modules (full integrated solution)	19,9%
Supply Module	15,2%

Source: Study AgoraMedia&Sensimark, 2009 [3].

3. Applying Agile Methods to ERP

Modern project management is heavily influenced by the belief that a project management process can be improved by scientific methods These include the beliefs create the myth that[1]:

- Clear–cut investment opportunities with an explicit purpose, beginning, duration, and end can be identified early in the project.
- Low opportunity costs for each business or technical decision exist, in most instances with a reversible decision process.
- Feasible, suitable, and acceptable project attributes can be identified.
- Accurate predictions of project duration and resource demands are possible once the requirements have been defined.
- Worst–case consequences can be determined in advance.
- The failure of the project was due to lack of skills rather than inappropriate feasibility, suitability, or acceptability of the solution.

This is a normal–science view of project management. In the ERP domain it can be replaced with a post–modern view 1, in which there are:

- Highly uncertain facts about the project attributes.
- Constant disputes about the values and expectations.
- High decision stakes with irreversible consequences.
- Urgently needed decisions in the presence of insufficient information.
- Outcomes that affect broad communities of interest.

Agile methods do not mean that the normal–science model is irrelevant, just that such a model is applicable only when uncertainty and decision stakes are low. The agile methods used to manage an ERP project include:

- *Staged Investments* – capital must be conserved.
- *Managed Risk* – all participants must share the risk.
- *It's the people stupid* – the composition of the participants is "the" critical success factor.

Agility implies a systematic vision of the outcome – an *intelligent* action or *ingenium* that makes it possible to connect separate entities and their outcomes in a rapid and suitable manner.

The set of underlying *values* for an agile project include[2]:

-*Communication* – of information within and outside an agile project is constant.

These communication processes are essential *social* activities for the project participants.

-*Simplicity* – defines the approach of addressing the *critical success factors* of the project in terms of the simplest possible solution.

-*Feedback* – optimism is an occupational hazard of software development, feedback is the cure

-*Courage* – important decisions and changes in the direction of the project must be made with courage. This means having the courage *not* to engage in non–value added activities or artifacts.

-*Humility* – the best project managers acknowledge they don't know everything and must engage the stakeholders to close the gaps.

Using these agile values, the following principles create the foundation for managing ERP projects in an agile manner[4].

-*Assume Simplicity* – as the project evolves it is assumed that the simplest solution is best. Overbuilding the system or any artifact of the project must be avoided.

The project manager should have the courage to not perform a task or produce an artifact that is not needed for the immediate benefit of the stakeholders.

-*Embrace Change* – since requirements evolve over time, the stakeholder's understanding of these requirements evolve as well. Project stakeholders themselves may change as the project makes progress. Project stakeholders may change their point of view, which in turn may change the goals and success criteria of the project. These changes are a natural part of an ERP project.

- *Enabling The Next Effort* – the project can still be considered a failure even when the team delivers a working system to the users. Part of fulfilling the needs of the stakeholders is to ensure the system is robust enough to be extended over time. Using Alistair Cockburn's concept, "when you are playing the software development game your secondary goal is to setup to play the next game" The next phase may be the development of a major release of the system or it may simply be the operation and support of the current system.

Domain	Functions
Product Line Management	Program Management, Product Data Management, Quality Management, Asset Management
Supply Chain Management	Networking, Planning, Coordination, Execution
Customer Relationship Management	Customer Engagement, Business Transactions, Order Fulfillment, Customer Service
Financials	Financial Operations, Accounting, Corporate Services
Human Resources	Administration, Payroll, Organizational Management and Development, Time Management, Legal Reporting, Strategies
Procurement	Indirect Materials Procurement, Direct Materials Procurement, Electronic Tendering, Integrated Analytics

- *Incremental Change* – the pressure to *get it right the first time* can overwhelm the project. Instead of futilely trying to develop an all–encompassing project develop a small portion of the system, or a high–level model of a larger portion of the system.

- *Maximize Stakeholder Value* – the project stakeholders are investing resources-time, money, facilities, and etc.- to create a system to meet their needs. Stakeholders expect their investment will be applied in the best way.

- *Manage With A Purpose* – by creating artifacts that have stakeholder value. Identify who needs the artifact. Identify a purpose for creating the artifact.

- *Multiple Project Views* – considering the complexity of any modern information technology system construction or acquisition process, there is need for a wide range of presentation formats in order to effectively communicate with the stakeholders, participants, and service providers.

- *Rapid Feedback* – the time between an action and the feedback on that action must be minimized. Work closely with the stakeholders, to understand the requirements, to analyze those requirements, and develop an *actionable* plan, which provides numerous opportunities for feedback.

- *Working Software Is The Primary Goal* – not the production of extraneous documentation, software, or management artifacts. Any activity that does not directly contribute to the goal of producing working software should be examined to determine its value.

- *Travel Light* – since every artifact must be maintained over its life cycle. The effort needed to maintain these artifacts must be balanced with their value.

These principles need a context in which to be applied. More importantly they need specific *actionable* outcomes within that context.

There are numerous ERP business domains and functions within those domains. Narrowing the domain from this long list will help focus the case study context. The business domains in which ERP plays a critical role includes:

4. Latest trends in ERP

ERP calls for constant modifications and up gradations. ERP developers are facing tremendous pressure both from vendors and companies.

Romanian IT and software market has had an accelerated development in the past few years, ERP solutions seeing a great increase.

4.1. Web enabled erp services

Web enabled erp services have helped to remove many drawbacks of the earlier applications. This has gained momentum as it has made ERP function more meaningful and dynamic with the latest inclusions.

Some of the facilities offered by WEB ERP are as follows[5]:

-Dependability

Web enabled ERP services help the companies to keep track on what is going on. Since the entire system comes under the purview of internet it is not possible for the employees to engage in any sort of misappropriations funds or otherwise. In addition the errors could be easily deduced and corrected. This system not only helps the personnel in the company but also its stakeholders and well-wishers or anyone who would like to obtain information on the company They can access the details anytime online.

-Convenience in reaching

Formerly when customers had to know the status of their order or any other query he must communicate to the marketing department. They will inurn speak to the concerned department trace the product or get clarifications in the case of technical query or any another information and then get back to them after confirming the required and relevant details. This process could take a few days and few weeks in the case of errors.

With the intervention of WEB erp all that the customer has to do is to speak to the person in charge. He then gets back to the customer within few minutes. On the other hand web enabled ERP has reduced that time to a few seconds. In addition the customer can access the details from his personal computer and need not even depend on the company for trivial information. ERP on the web has done away with all these.

The C.E.O. can know the status of the company's business and problems by sitting anywhere in the world. Similarly any other person can obtain the desired information at the shortest possible span of time. This has thrown lot of issues on confidentiality especially in sensitive subjects like hospital details and financial information.

-Easy to use

Web enabled applications makes the job of the employees easy. They don't have to rely on others before taking a decision for every petty issue. Infact it has helped them to work efficiently and in a relaxed manner. Besides the company the outsiders will be benefited lot as all the clarifications can be made online. Since they tend to be crisp the outsiders will not make mistakes in dealing with the company. The errors if any will be easily filtered in the online tracking system and hence the rectifications will be very quick. This would not have been possible without ERP on the web.

-Integrating technology and manual Data in public domain

Web enabled applications have greatly reduced the limitations of manual data. These manual data became easily accessible after computerization and enterprise resource planning. However the data brought under public domain was still not satisfactory. Web erp applications have helped to improve this feature by offering everything online.

-Future

Web enabled erp have been citied as one of the important reason for ERP's dominance in the days to come. This system needs more development apart from the present changes.

4.2. The advancement of wireless technology in ERP

Wireless technology has helped enterprise operations in many ways .Firstly it has facilitated the stakeholders in getting up-to-date information on enterprise operations as and when required through the use of modern communication devices like mobile phones laptops (all connected to the internet). Some of the criterias in using wireless ERP are as follows:

-Proper coordination with the organizational network

Wireless ERP will give the best results only if it falls in line with proper communication channels. The communication channels should be improved in the organization to make it (Wireless) ERP friendly. The obsolete computers should be replaced with the latest phones. Mobile and telecommunication facilities should also be at par with the industry standards. It happens many a times that companies resort to wireless ERP without improving the communication facilities. This does not serve the purpose no matter

whatsoever the money spent in establishing ERP or the resource persons employed to procure the same. In addition there is another major advantage in improving communication facilities. Apart from dissemination of information and inflating profits and improving productivity it also helps the companies to rise to professional standards in the market. This will also motivate the companies to improve all other facilities that directly or indirectly contribute to the working of ERP and make use of facilities like image Enabled ERP system and ERP data capture.

-Privacy issues

Privacy is a burning issue that occupies significance whenever there is a technological explosion and ERP is no exception to this principle. These calls for more attention due to the (further) improvement namely wireless ERP (from ERP). Privacy always becomes a subject matter of conflict whenever things are brought under public domain.

The company is poised to lose valuable information or prospective businesses when things are exposed unnecessarily .In those cases wireless ERP will be a disaster to the company (and not a boon). Wireless ERP should be provided with maximum security. The scrutiny should prevent third party access without prior permission and approval from the company. This might look impossible practically but it is strongly advocated to have them in force in order to safeguard the interests of the company.

The security system will be successful if a department in the company is able to have a track of the details communicated. The viability of the company is also to be taken into account in this regard. Bigger companies can go for such system whereas the others should restrict depending on their capacity and needs. If they are required unconditionally the companies should resort to alternative arrangements .It should be kept in mind that none of these arrangements should interfere with the functioning of ERP. Image Enabled ERP system and ERP data capture will help to achieve this.

-Message persistency

The frequency of message transfer is referred as message persistency. This rate is important in deciding the success of the communication systems and ERP functions. The organization should ensure that there is no slag in the systems or process or any other procedures that is likely to affect this rate. Companies should constantly monitor and suggest areas for improvement. This will automatically help wireless ERP to succeed.

-Multiple applications and connectivity speed

Wireless ERP should not depend on just one or two devices like laptop or mobile phone but make use of maximum appliances. This will help the companies to gain technological edge .In additions alternatives will be of great help especially in times of emergency and when a particular systems fails.

Conclusions

The market for ERP systems is very competitive. Industry analysts are forecasting steady growth rates for the ERP market. Why are companies replacing their manual or semi-automated systems with ERP systems? Some of the reasons for the increasing popularity of ERP systemsare information integration, improved productivity, improved business agility, reduction in errors, automation, etc. As more and more companies join the ERP bandwagon, the competition is getting keener and ERP vendors are gearing up to meet this challenge by offering more features and better capabilities for their products. Web enabled ERP have been citied as one of the important reason for ERP's dominance in the days to come. This system needs more development apart from the present changes.

Wireless ERP has a huge market potential. This is evident from the fact that big players like SAP and Peoplesoft have penetrated into the segment.

So, the future will see a fierce battle for market share and mergers and acquisitions aimed at gaining strategic and competitive advantage. The ultimate winner in this race will be the customer, who will get better products and better services at affordable prices.

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IMPACT OF HUMAN RESOURCES MANAGEMENT ON COMPANY'S ECONOMIC PERFORMANCE

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Abstract: *This paper aims to demonstrate, with arguments, that human resources management makes a major contribution to the achievement and development of the organization's competitiveness. Also, starting from the impact of human resources management on the company's economic performance we want to emphasize the perspective of internationalizing the practices of human resources management (HRM) due to the need of ensuring convergence, adaptation and integration on the economic markets under the sign of globalization.*

Keywords: *organization's competitiveness, globalization, human resources management, forecasting management, strategic planning.*

1. INTRODUCTION

To be able to achieve their objectives the organizations, regardless of their size and nature, have been and still are bound to face some challenges requiring their ability to secure and maintain successful competition by anticipating contextual developments.

Countless concepts, methods and modern tools, which synthesizes many years of research, are a real support for managerial practice, now that human resources management is becoming a basic factor of the economic results, and the social strategy, one of the main components of the organization's global strategy.

The issue of acknowledging human resources, the ways and means to shape employees to optimize their creative potential, tends to occupy a prior position in today's concerns of science and practice of organizational management.

2. HUMAN RESOURCE MANAGEMENT-GENERAL

The vast majority of specialists in the field believe that human resources management, like any other field of scientific research, is the result of specialized research and is on the already known path of a relatively rapid development and diversification in many fields [1].

Human Resources Management is the science and art of development and implementation of strategy and policy staff, to achieve maximum efficiency of enterprise objectives. Human Resources Management is a science, as it formulates and generalizes concepts, laws, principles, rules, methods, techniques and tools of leadership; it is art as it takes into account each company's specific conditions [2].

The contents of human resource management is also given by the multitude of activities to be carried out, linked and harmonized within the human resources field, activities that are more or less connected among them and have a great impact on the results.

In the attempts to specify as precisely and completely the main areas of activity of HRM there were many opinions expressed, in their great majority, bearing the hallmark of the author's country.

Thus, the American Society for Training and Development (ASTD) identifies nine main areas of activity of human resource management:

- training and development;
- organization and development;
- organization / job design;

- human resource planning;
- selection of personnel;
- personnel research and informational systems;
- rewards / benefits or aid;
- advice on employees' personal problems;
- union / labour relations.

3. STRATEGIES AND POLICIES IN THE FIELD OF HUMAN RESOURCES

Strategies of Human Resources shall appoint all long-term objectives on human resources, the main ways of achieving them and the necessary resources or appropriations, which ensures that the structure, values and culture of the organization and its staff will use to help achieve the general objectives of the organization.

For their elaboration one should start from the organizational objectives and the content of human resource management, and use an appropriate methodology of investigation to ensure a rational targeting of efforts in this area.

Areas where strategies can be established: selection of staff; employees' training; employees' awards; employees' relationships. The wide variety of organizations and specialists' concepts is reflected in the diversity of strategies in human resources.

Thus, an interesting approach to the strategies of human resources is presented by Rolf Buhner [3] who, depending on the degree of dependency on the company's strategy, finds three different types of personnel strategies, namely:

- investment-oriented personnel strategy;
- value-oriented personnel strategy;
- resources-oriented personnel strategy.

For human resources policy to meet the organization's goals is necessary to meet the following requirements:

1. be consistent with the organization's policy and strategy;
2. reflect the organization's value regarding how people should be treated;
3. cover the most important areas of activity of staff's duties;
4. contain provisions to ensure the transmission and understanding of policies at all levels of organization;
5. respect the legal previsions as well as those of the collective work agreement;
6. be very transparent, clearly defined, preferably made in writing, not to permit interpretation.

Stages of drafting a policy for human resources are:

1. analyzing and understanding the existing organizational culture and its accepted value;
2. analyzing the existing personnel policy;
3. analyzing the external influences on the organization;
4. consulting senior management on their opinions;
5. consulting staff and unions on personnel policy;
6. elaborating personnel policy after analyzing the information from the preceding paragraphs.

To implement a personnel policy it must be accepted by managers, become operational by their decision and dissemination at all organization's levels.

4. PROFESSIONAL INTEGRATION AND TRAINING. LEARNING THEORIES

Professional Integration is a stage subsequent to employment; the new employee has contact with the new job, with his new duties, with his new colleagues, in short, with the organization. The main objectives are:

1. familiarization with the new working conditions, achieved by transmitting all necessary information (working programme, duties, relations of subordination and cooperation, presentation of new colleagues, etc.) in a full, transparent way;
2. facilitating the new employee's adaptation to the working team so as to avoid possible initial conflicts;
3. creating an atmosphere of safety, privacy and membership of the new group.

The wide variety of employees' jobs and duties make the establishment of standard rules for professional integration valid in any organization virtually impossible. Professional integration requires a good collaboration among managers, the supervisor of the workplace where the new employee is employed and the personnel department.

In a first phase, professional integration programmes seek that the new employees acquire all the information they need in order to carry out their work and adapt quickly to the job requirements. The integration programmes are done in writing, as the result of collaboration between the human resources department and line managers, under whose control the new employee will be and it shall be given to the new employee, usually within several days after his employment.

The ultimate objective of integration is, however, creating a sense of belonging to the firm, and then identifying them with the mission, objective valid, otherwise, for all employees. Professional integration can be achieved through a large number of processes and methods that differ from one organization to another.

Continuous training has become an essential requirement in all organizations, regardless of the field in which they operate. How the training programs and their objectives are designed arises from the organization's internal needs; they are consistent with the organization's overall objectives. Only in this way, training and development, the two components of professional training can be truly effective, solving the organization's current and future problems.

Further training is aimed at improving the capacity already held by employees (multi-qualification, retraining, and acquisition of new skills on the job or in the same field).

Training can be organized in various forms in the organization, in specialized units or institutions of higher education. In developing a programme of training, the specialist in human resources and other specialists involved in the training-to-be take part.

Modern approaches of learning theory are based on a comprehensive vision of the human being, including elements of traditional theories in an organic way, plus concepts able to designate the contemporary man's complexity. We will further analyze important contributions to the theory of classical learning from the point of view of the application of these theories in the organizational environment.

We would like to mention some of the most important contemporary authors and their contributions to the field of learning, whose works are at the basis of the current process in the most powerful organization in which people learn continuously:

1. Carl Rogers and his "easy learning" concepts;
2. Robert Gagne. Categories of learning;
3. David Kolb and the concept of "learning through experience";
4. Kolb's model.

5. ASSESSMENT OF HUMAN RESOURCES PERFORMANCE

Unlike the job analysis, which refers to the contents and requirements of the job, being an impersonal description of the job goals, tasks and responsibilities, or unlike the job evaluation, which involves determining the relative value of a post, the assessment of performance focuses on meeting the job targets, tasks, responsibilities and requirements by the holder of that job.

The assessment of performance is the activity which determines the degree to which staff of an organization effectively fulfil their duties or responsibilities in relation to their posts.

The result of a training programme is the last step to be taken by the person interested in the assessment of the training courses.

In any training, the assessment of the performance is required. It is distributed throughout a programme. There is usually an assessment at the beginning of the course and at the end; during the course one can also get points after completing a module.

The objectives of the assessment of personnel performance show a great diversity, given the support of many organizational functions and activities of human resource

management. Defining very precisely the objectives of personnel performance and understanding the degree of complexity of these presents a particular importance and their implementation on a legal basis protects both the organization and its employees.

There are several ways of making the assessment: by the managers, by the colleagues who occupy equivalent positions, by self-assessment, by specialist assessors or a combination of those.

6 ROLE OF HRM IN COMPANY'S ECONOMIC GROWTH

The main function of the scientific management is to increase business competitiveness; the science and practice of scientific management is a basic vector of economic growth.

Management helps to increase the company's effectiveness and efficiency as a result of the managers' decisions and actions at the performance level of each job, reflected in increased productivity.

The increased efficiency results from the mix of resources and processes of work, the combination of the results of the work of its individual components, the degree of utilization of material, financial and informational resources at the company's level.

The human factor has an important role in the company's growth. In the whole process of redesigning and rethinking the economic structures it is necessary to know the problems of employment and the effective use of labour.

The human potential is the creative, active and coordinator of economic activities; the recognition of the implications of human resources in economic activities resulted in an amplification of the studies devoted to them in the development of models that contribute to economic growth.

CONCLUSIONS

For an organization to function effectively (to reach its objectives) and efficiently (to obtain a maximum report between the growth of favourable effects and the growth of effort), it is necessary to understand and improve general management and functional management.

An important component of human resource management is forecasting the needs of human resources. The responsible persons for human resources should anticipate, as well as possible, the degree of employment and establish the long-term human resource requirements. They must be able to ensure the efficient use of human resources needs of employees, adapting the number of employees to the needs imposed by the continuous evolution of the business organization.

The need of human resources forecasting management is even more present as the reality shows that many organizations' concerns in this respect are almost nonexistent, resulting in discrepancies: the existence of more employees than needed, the lack of employment for certain skills, imbalances in the structure of employees according to age, etc.

The strategic planning of an organization's human resource requirements is essential for its economic performance; the human resource needs for future periods primarily depend on the volume and structure of work to be done. However, the strategy for estimating human resource requirements should be consistent with the changes in the market, economy, competition and finance.

Human Resources Management must fulfil the role of a catalyst in order to bring performance in line with the employees' individual talents to meet the objectives.

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CREATIVITY OF MANAGERS IN CONDITIONS OF ARMED FORCES OF SLOVAK REPUBLIC

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Abstract: *Author in this article analyze interdisciplinary of creativity solving, which is necessary presume of manager professionalism in Armed Forces in Slovak republic. Practical part of article is oriented on analyze inquiry about students creativity in Academy of Armed Forces in Liptovský Mikuláš. This knowledge has influence to make military professional in Armed Forces of Slovak republic and they are part of whole life education.*

Keywords: *creativity, standards of creativity, methods of creativeness, barriers and prejudice of creativeness, fantasy, psychological particularities of a student of AOS, research of particularity of students.*

Introduction

Creativity is a value by which it is recently put a great emphasis- not only by recruitment and job interviews, but also by an assessment of personal characteristics of a man. It rebounds in all areas of our life. The world around us is full of problems which requires new solutions. A graduate should apply the principles of creative problem-solving in his practice. It means that creativity should have to face teaching. The school is a place where to learn the principles and methods of creative work. Finally, in the schol it is necessary to apply these procedures, because learning in practice can be painful and difficult in conditions of the Armed Forces of the Slovak republic (OS SR) than at universities, which actually has been confirmed by practice.

1.1 Definition of creativity and its criteria

It is well known that everyone have many ideas, but some people have so original ideas which are so exceptional that the law says about them as a creative personalities. Creativity tends to be synonymous also called creativity. The word *creativity* comes from the Greek, which means: to produce, to create,to bear, to four. The concept of creativity is often derived from the Latin word „creatine“, which means production or creation (creare – to form).
In English there the word refers to creativity and creativity as synonyms is often referred to terms originality, divergent thinking, invention, imagination, talent, intuition, thought- courage and so on.
Currently there are about one hundred of definitions of creativity, but none can be considered comprehensive and universally acceptable.

M. Tuma (1991, p. 116) says that "creativity is a process whose product is new, modern, valuable, advanced and better use than creation of previous generations. We get something useful, irregular, more valuable by creative solution, because we used to create completely modern and original approach.“ Creativity is purposefully developed activity that wells up from the internal beliefs and conscious need of man to create something new, original, relevant and important. Creativity also can be seen as: **ability, attitude and process**.

A creative ability is an ability to imagine or invent something new, create thoughts, ideas, ability to perceive problems, the ability to analyze problems and construct its solution. The creative approach is related to willingness to bear risk, operational flexibility, openness to the changes and innovations, the willingness to play with ideas and thoughts.

Creative processes are associated with the methods and techniques that are udes by imaginative approach to the problem, whether consciously or unconsciously. Individual phases of the creative process is influenced by incentives, technical and creative competencies.

Criteria for creativity. Creativity is one of the basic psychological potential of man.

It can be assumed that every healthy individual is born with this potenciality. Rate this ability is given by individual dispositions of the individual, environment, education and so on. Creativity can be developed throughout life and promote personal development of man. Psychologists deemed such creative thinking that meets the following criteria: originality, accuracy, applicability, value - added value.

Originality - uniqueness. It is the ability to create a solution that has been created. The ability to produce unusual, peculiar, and also discover appropriate responses, based on remote associations and have a particularly striking ingenuity. However, no creative product is not absolute new, it is chain of development, which is conditional on the presence of the past.

Correctness means that the resulting artifact must be factually correct and meet the criteria and meet the target.

The applicability and usefulness. Usefulness understand not only the practical exploit-suitability for the use of the resulting artifact, but also meet the criteria for accuracy and novelty.

Value – added value. The creative act is the new act, usable, this means that it has any value or benefit to individuals, or company. The value can be taken at nominal quality (for example: increase of revenue and profits, wobtain new customers) and existential quality (meeting a personal goal, self-awareness, the benefits to society).

1.2 Creative thinking

The basis of creativity is divergent thinking, in which personality is focused on expanding and finding new, affordable options for solving problems and various logical alternatives. Convergence thinking (logical-deductive) applies to more problems with one solution, i.e. thought work goes to one goal arising from the terms of its rules and roles.

1.2.1 Stages of the creative process

Creative people are creative ways of looking around you and the world thought it possible to demarcate the different stages of the creative process, which later expressions in methods of creative work. **Graham Wallas** indicated in his book The Art of Thought fifty years ago (Think Art, 1926) that the creative process consists of four phases: (In: Žák, 2004, p. 103)

a) **Preparation (preparation)** During the preparation we collect all available information about the problem, all the addresses the causes that led to the problem, collect information crucial to the subsequent phases of resolving the problem. We supply the first hypothesis simultaneously, the objective which we want to reach. Preparation phase and the actual feeling of the existence of the problem is that the creative individual's ability to perceive the problem and is willing to solve the problem simultaneously, we call the logical phase. These two skills are the primary characteristics of creative individuals.

b) **Incubation (maturation)** At this stage comes to the word intuition. It is a stage in which creative man does not deal with problems. In the subconscious breaks the old structures and schemes, and generate new connections, which arise suddenly, for example in dreams. It is good that some of the ideas in us slowly mature.

c) **Illumination (Enlightenment**) This stage is also associated with intuition. After deep immersion into the problem and controlled stages of the process there is a stage of enlightenment. A search, which takes place unconsciously in the incubation stage is suddenly resolved by sudden specific idea. This phase is characterized by releasing tension in the calf-survival addresses and it is considered a top of the creative process. A great role play so creative skills such as flexibility and originality. It is very interesting short of this phase but is the most important. As soon as a new idea appears, there is a moment of implementation and verification of the idea.

d) **Verification (check)** This stage is a practical assessment of an idea confirmation (Is a new idea really right answer?) but its actual implementation. An investigator can obtain answer to the question only through this phase, which is the most critical point of the entire system. This is the implementation of solutions and also check back. Each idea is worthless if it is put into practice. Implementation and verification of confirmation are closely connected and one without the other is not possible to be truly creative process.

The levels of creativity have different developmental stages - expressive creativity, productive creativity, innovation, discovery and creativity of the genius level people.

Typical skills for creative individuals shows following: originality, authenticity and flexibility of thinking, high intellectual capacity, autonomy, ability to quickly and easily to form best psychic products, comprehension, perception, memory, imagination and the unconscious, intuitive ability.

The properties that are the most occur: independence from social pressure, diversity of interests, sensitivity, perseverance in work, self, sebavý-rearing, self-development, assertiveness, reflectivity, i.e. creative survival, observe art, immediacy, variability fantasy.

2. Methods of Creativity

The first creative methods are based on the cognition of objective reality, a simple qualitative experience, which was based on observation of treatmention of objects and in fact it was always about some form of experiment. **J. P. Guilford** introduces the most easier creative methods:

- creative methods converged by concurrent-system thinking,
- creative methods of divergent systems of thought. (In: Tuma, 2001, p. 274).

Feature of these methods are convergent thinking (from the Latin word convergere – to move), which used input a problem and thought operations towards some pre-defined goals. The result is the only answer to solve a specific problem. This group includes:

a) heuristics controlled creativity,
b) morphological methods for generating creative ideas,
c) checklist methods,
d) methods of application of abandoned ideas,
e) methods of inventory properties,
f) the Delphi method.

Creative methods of divergent systems of thought. A divergent thinking assumes that the solution of the problem will continue to more directions. Normally we distributed following methods:

a) traditional methods of brainstorming of creative solutions of problems
b) modified brainstorming,
c) synectic simulation methods,
d) modified synectic methods.

A more detailed analysis of the various methods is beyond this article.

Fantasy - a gateway to creativity. Fantasy is the source and basis for creative activity. Fantasy enriches life, it makes it strange, but may also be leakage from reality, such as daily, non-made and impossible dreaming. Fantasy is a part of the visual imagination as fantasy, it's imagination. Creative people in all areas of production had to use fantasy and imagination that invented something new. Fantasy and imagination can train well. The fantasy and imagination kills strict and precise directive, regulation, keeping the hand of man, constant monitoring of its slip of the tongue, trips to the country of dreams and fantasies - unfortunately, in terms of the Armed Forces of the Slovak republic is these people still quite.

Barriers of Creativity

The creative influences range conditions, some positive, others negative. Negativ terms of creativity tend to be labeled as obstacles (barriers) of the creativity. Knowledge of these barriers is essential to remove them, or at least a restriction. Humanity is to be creative man, but mainly under the influence of learning (especially social) creates various obstacles, barriers against creativity. We divided them into four groups: **perception, emotional, cultural and environmental barriers**, **intellectually and expression obstacles**.

Their closer analysis is beyond this article. To overcome these barriers is the best medicine "passionate about thing" ,conscious effort," thinking is the key to all-long treasure."

Psychological peculiarities of students' of the armed Forces Academy.

Mentality of the student

Go into the military environment is a significant psychological watershed.An young man comes into environment characterized by impersonality and rigor, which requires the defense of freedom, independence, sovereignty and territorial integrity of the state.

Human life still vacant individual is converted to uniformed, managed to order overgrowing personal interest. It is going about physical and mental preparation for national defense, the hard-bitten character and passing willingness to self-sacrifice to the deployment of his life. Ideals that were once only dote-spoken, become hard and unrelenting reality.

A young man accustomed to the social routine in the strict family, school, or work environment, enters the society of unfamiliar peers, of which each element is subordinate to a particular unit.

Suddenly awakening, quickly tidying and personal hygiene, breakfast and joint training is a new experience. There are many unpleasant thing as in any new and unusual activities. Sensitive individuals appears that he is one of the crowd that is element while performing the same exercise, the same shape than twenty or thousand other men. An apparently depersonalisation military action only slowly receding, depending on the acquisition of new knowledge, skills and habits.

An incorporation process into conditions of military service is not non conflict and especially military unit is an indicator of the difficulties of their members and effectively help them by overcome. Lack of living experience gives them the number of difficulties, such as effort to understand to series of problems detached from the reality, precipitous and inappropriate generalizations, formulate absolutely verdicts. Students - soldiers have a very strict benchmarks for what is right and wrong. They are particularly sensitive to compliance of words and deeds, they are deeply concerned by the inconsistency, formalism, unconsistency and hypocrisy.

Lack of life experience is often responsible that they can not identify who thinks something really good and who wants to exploit. Only gradually shedding romanticism and the glamorization of looking at the people.

Purpose and objectives of the survey to creativity.

The subject of the survey to creativity were students of the Armed Forces Academy aged from 18 to 23 years. We decided to realize this survey because of decrease of the creativity of our students' educational process, which certainly is related to many factors.

The aim of the survey were: to gather and obtain information and views on the students of the OS SR which has an influence on the formation of a professional military in OS SR; How to find the motives that lead students to the development of the Armed Forces Academy and the realization of creativity and related activities undertaken to gain knowledge on the characteristics of creative man, to find out what prevents students were more creative and to design based on criting barriers to the development creativity of students in certain measures at the Armed Forces Academy.

Method of analysis and interpretation of surveys

Evaluation of the results of the questionnaire was implemented through mathematic - statistical methods. Each of the answer was compare in absolute and relative frequency. The results were processed in tables and graphs.

Research hypotheses.

We anticipated that students of the Armed Forces Academy are interested in developing creativity, which is properly valued, that students are familiar characteristics of creative people and that everyday activities at the Armed Forces Academy feel creative, although none of them does not require that we find obstacles of Creativity development in conditions of the Armed Forces Academy and the survey results help measures for management of the Armed Forces Academy.

Place, time, object exploration and sampling

The survey was conducted at the Armed Forces Academy in different practical fields such as management, transport machinery and electronic systems. The building consisted of 36 students from different grades. The selection was random and survey conducted at the time of personal leave.

Methods and survey techniques

We used the following methods when gathering information: questionnaire, test of Creative attitude, non-standardized interview.

Interpretation of survey results and its treatment:

Questionnaire was attended by 36 students-respondents of the Armed Forces Academy and test of creative we approache to 20 students.

1. Just that thought is creative, that is new and useful.

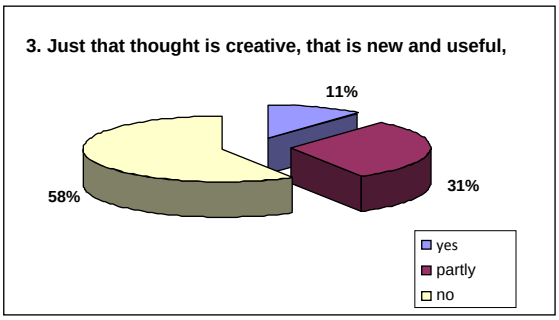

Fig. 1. Consent of the respondents with a given ideas 58% of respondents has opposed with given idea, agreed only 11%. From the findings show that a creative idea may not be fundamentally new and useful.

2. What characteristics should have a creative person?

At first, the respondents offer imagination. Other features that should have creative people are: constancy of purpose, ingenuity, shiftiness, the ability to work independently, self, to invent something new and effectively use.

3. Do you feel in everyday activities at the Armed Forces Academy to be creative?

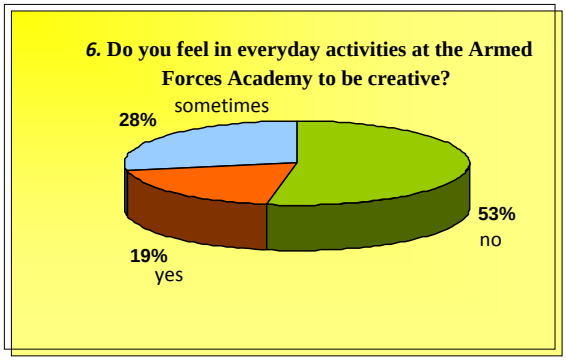

Fig. 2. Creativity in everyday activities of the Armed Forces Academy

Respondents who answered question positively,they given the application of creativity in solving problems in a separate work, on some exercises, to develop notes and projects. In response to "seldom" apply their creativity when they have to on lessons, or when they have an opportunity. In response to "no" were the most frequent reasons for this situation given these facts: strict compliance with regulations, management system, monotonous work, stereotype, unpaid creativity, the pursuit of mediocrity, everything is ordered and there is no place to implement their own ideas and creative thinking.

4. Do you believe that you can apply creativity in at work?

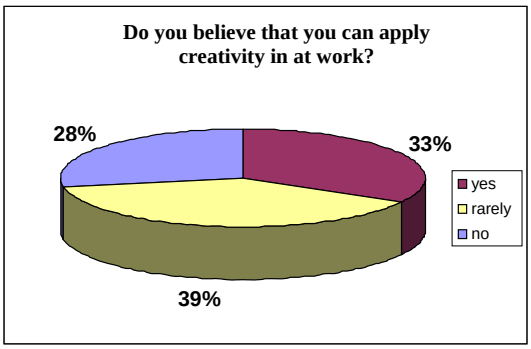

Fig. 3 Application of creativity at work

The respondents' answers that t apply mainly to the creativity of practical exercises and also rarely in the military training.
Those who indicated that they had no opportunity to exercise creativity, said the reason for requiring the exact procedures and activities.

The fact is that the military kills creativity thanks style of management. It could be concluded that in our army is more important an accurate fulfillment of obligations and regulations in comparation with the quality and effectiveness of the goal.

5. What prevents you to be more creative?

Answer	Count
I have no skills	3
I am not very active, rather slothful	16
I have no time	0
I'm tired, exhausted, hardpressed	2
I have no option to show creative work	1
The creative man is usually punished	4
Creativity is not required and also not rewarded	10

44 percent of respondents see the barriers of creativity in itself (I'm not very active, rather lazy). It's certainly self-critical, but this indicates a convenience, laziness of students.

On the other hand **twenty-seven percen**t of respondents believe that creativity is not

required, also not rewarded. Four respondents of total thinks that create man is usually punished. If this is the really- so to remedy this situation would be someone completely different look than the students.
On the subject of which you can take your creativity and self solute the problem situation? Respondents indicated the most frequently articles in the field of management, such as: Project management, strategic management, crisis management, computing management. It is very interesting that seventeen percent of the respondent said physical education, and fourteen percent indicated that the creativity used in any subject.

6. Do you think that a more proactive approach of students of the Armed Forces Academy –and thus better results of them are adequately evaluated?

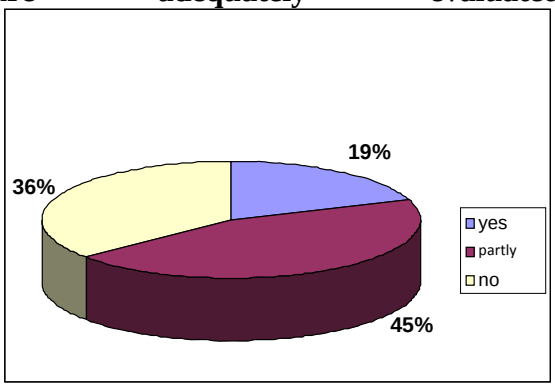

Fig. 4. Assessment of student outcomes, depending on the active approach to work

Respondents in response to this question could their answer supple with own opinion. Most are inclined to believe that the results are adequately assessed only partially, in some cases subjective. Some think it's also about luck.

7. It has no meaning to be creative - an active, devoted more study time than is necessary to achieve an average results?

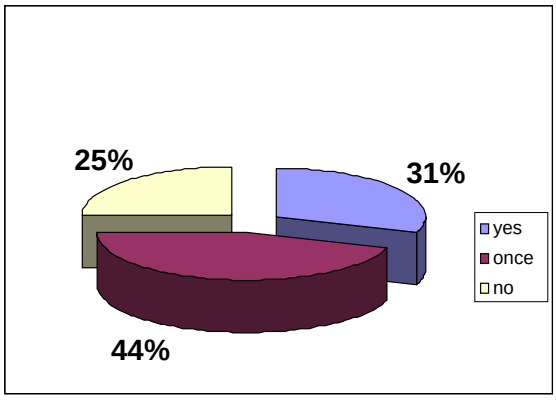

Fig. 5 The significance of creativity

Thirty percent of respondents think that it is important to be creative for its own satisfaction, scholarships, and because the general outline. Sixteen students are in favor of the opinion that it pays to be creative as ever, to develop their own personalities.

Twenty-five percent of respondents thing the opposite view. What are the reasons for this condition? The suggestion that better results does not help me in the future, personality evaluations, waste of time anyway because each passes, poor motivation.

8. Choose three options associated with the terms of creative development caused student´s capability.

Freedom of action 24 persons, Provocative stimulus 6 persons, Information saturated enviroment 10 persons, Invention active environment 9 persons, flexible organization 13 persons, Critical intensity 3 persons, Existential certainty 7 persons, The stability of the envinronment in OS SR 6 persons, Adequate appreciation of the creative power 30 persons. The responses indicate that the most important conditions for creative development of the student are: adequate appreciation of the creative power, freedom to operate and more flexible organization. It is also abundant information environments and the least important condition for students' choice of a critical intensity.

Generalization of the survey results and recommendations for managerial practice

Achievements survey enforced, in terms of the Armed Forces Academy reflect the current situation and look at students' creativity, its importance not only for labor but also of everyday activity. It is clear that students are familiar characteristics of creative people, but on the other hand, students are not sufficiently creative, because creativity is required of them and nobody even rewarded. Obstacles to the development of creativity at the Armed Forces Academy we say in the system, contrary to the study and the military responsibilities of students, the reluctance of senior commander-hunting in the objective evaluation and not least in subjects that are irrelevant in the next practice of proffesional soldier. Major obstacle for creativity we see also in the passivity of students and their satisfaction with that status. Some respondents stated that

they saw no obstacles in the creativity development of students.

Barriers to Creativity can be removed and the level of creativity can be increased as these practical recommendations:

- Alignment of study and military obligations to the student to have more time to study and also creative activities and in their free time.
- Improving the quality of communication between commanders and teachers, allowing them to create a space for creative activities by students.
- Allowing students to demonstrate creativity not only in school but also for training, improving communication between masters and students.
- Rewarded not only the best students but also students who are endeavoring to engage in various extra-curricular activities, a school in various competitions.
- Practical workshops on creating more room for creative solutions of given tasks and challenges show you the various techniques of creativity, improve their managerial skills.

Conclusion

Research of creativity has shown that creative people perceive the world differently. Creative people are receptive and open to the world, to experience. They recorded the facts, they are a source of mental work for them, the source of emotions, creative tireless work. Also they see themselves as subject to improvement and possible improvements. It is necessary to say the fundamental thing:

Creativity as a characteristic personality characteristics- its function can improve, increase. But it should be to train, learn it, practice it. Opposite of creative perception of the world is its stereotyped, schematic vision, enshrined in the clear and unambiguous forms. Through the research, we found that students' creativity of the Armed Forces Academy is not high. The questionnaire and the test of creative attitudes revealed that this feature dwells in the students, only problem is that it not only as free. They are creative if they are profitably rewarded, or if it improves the mark otherwise, so the students are very lazy and satisfied with what they have.

The problem is the motivation and educational programmes, as most students think they use of those objects for its future career minimum of them.

On the other hand, we think that the problem has not only our school but it's a general problem of humanity. A man should think of themselves, does something just for fun, for himself and not just because he will be rewarded for it.

Creativity is now also in the management of these phenomena, which destroy everything old and constantly invents and produces. We see in this a nature of humanity.

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AN ANALYSIS OF OPTIMAL POLICY INTERVENTIONS REGARDING THE REMITTANCES

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Abstract
The processes related to remittances are very complex and is difficult to select optimal policy options. The mix of policy options (from border controls and taxes on remittances to active support of migrants abroad) should work synergic and the design of a policy package should be based on a clear framework. The aim is to identify a set of policy measures compatible with the motivation for remittance flows and to propose easy implemented solutions.
The main objectives of this work are to analyze the impact on growth and the driving factors/ determinants of the variations of remittances in turbulent periods, and to build a decision tree map to assist decision making in policy interventions.

Keywords: migration, remittances, policy interventions, model for remittances

1. INTRODUCTION

A simple model based on bilateral remittance flows that incorporate additional information about migrants' skill level, income inequality and the share of the informal economy in the sending country could offer an adequate design of the mix of policy intervention.

The GDP differential increases remittances, and this an indication that *altruism is important for remitting*. By contrast, *the interest rate differential* is significant only in special situations, and the investment motivation is not strong. Average remittances per migrant increase with the skill level and earning inequality in the host country is more likely to lower average remittances (but this effect may also be the opposite if a narrower measure of low-skilled workers is used). The share of the informal economy tends to lower the average remittances per migrant. Lower remittance costs tend to raise remittance flows.

The mix of policy interventions is based on the analysis of net impact on the welfare of the sending nation. The basic solutions to reinforce the positive effects of remittances and the solutions to reduce the negative effects of remittances are the ingredients in this framework.

2. A SIMPLE ANALYSIS OF THE MOTIVATION FOR REMITTING

The bilateral remittance flows model use information about migrants' skill level, income inequality and the share of the informal economy in the sending country.

The rate of return differential is represented by the real short-term deposit rate differential.

GDP per capita could be a proxy for the income differential between countries. The income differential may account for investment motives, assuming that emerging countries should grow faster and therefore offer higher returns. The effect of income inequality on average remittances depends on the shares of skilled migrants and the strength of the selection bias. *Remittance cost* varies between countries/institutions involved in the transfer. Financial services are more likely to be used for remitting if high travel costs prevent unofficial money transfers.

In the first period, the migrant born in the home country *i*, and working in the host country

j maximizes the utility function by allocating the income between costly transfers, own consumption and savings (financial/non-financial assets). In the first step, earnings are allocated to consumption, savings and transfers to family.

$$\underset{C_1^i, C_2^j, X^{ij}, S\geq 0}{\text{Max}} \dots U_{ij} = \left\{u\left(C_1^i\right) + \beta u\left(C_2^i\right) + \gamma u\left(C_1^j\right)\right\}, \tag{1}$$

where $\beta \in (0,1]$ is the migrant's time discount rate, $\gamma \in (0,1]$ the degree of altruism towards her family; *C*\ migrant's consumption in country *i* at time t (t=1, 2); C_1^j denotes the migrant's family's consumption in country *j* and is defined as:

$$C_1^j = I^j + X^{ij},$$

where I^j is the family income in country *j* and X^{ij} the amount that the migrant working in country *i* sends to his family.

The migrant solves problem (1) subject to the following resource constraints:

$$C_1^i + \tau X^{ij} + S = I^i, \tag{2}$$

$$C_2^i = S \times R \tag{3}$$

where *s* is the amount saved out of the current income I^i that the migrant earns in country *i* and *R* is the overall portfolio return. The constant $\tau > 1$ can be thought of as a transfer cost. The sender pays *T* dollars for each dollar received by the beneficiary.

Assuming logarithmic utility and denoting $I'_d = I' - S$ as the income available for own consumption and family transfers, the optimization problem above can be formulated via the following Lagrangean:

$$L = \ln\left(C_1^i\right) + \beta \ln\left(C_2^i\right) + \gamma \ln\left(I^j + X^{ij}\right) + \\ + \lambda\left(I_d^i - C_1^i - \tau X^{ij}\right) + \mu\left(S \times R - C_2^i\right)$$

$$\left(C_1^i\right)\frac{1}{I_d^i - \tau X^{ij}} - \lambda \leq 0, \cdots C_1^i \geq 0,$$

with complementary slackness,

$$\left(X^{ij}\right)\frac{\gamma}{I^j + X^{ij}} - \tau\lambda \leq 0,\ X^{ij} \geq 0,$$

with complementary slackness

Logarithmic utility assures an interior solution for C_1^i, so

$$\lambda = \frac{1}{I_d^i - \tau X^{ij}}.$$

The solution for X^{ij} is interior if the degree of altruism is sufficiently strong: $\gamma > \frac{\tau I^j}{I_d^i}$.

Assuming family transfers different from zero, we can express C_1' and X' as functions of I_d^i.

$$X^{ij} = \frac{\gamma I_d^i - \tau I^j}{\tau(1+\gamma)} = \frac{\gamma\left(I^i - S\right) - \tau I^j}{\tau(1+\gamma)}, \tag{4}$$

$$C_1^i = I_d^i\left(1 - \frac{\gamma}{\tau(1+\gamma)}\right) + \frac{\tau I^j}{\tau(1+\gamma)} = \\ = \left(I^i - S\right)\left(1 - \frac{\gamma}{\tau(1+\gamma)}\right) + \frac{\tau I^j}{\tau(1+\gamma)} \tag{5}$$

Using (4) and (5) in (1) we get the indirect utility as a function of *S*:

$$\underset{S\geq 0}{\text{Max}}\ U_{ij} = \ln\left\{\left(I^i - S\right)\left[\tau(1+\gamma) - \gamma\right] + \tau I^j\right\} + \\ + \beta \ln(S) + \gamma \ln\left[I^j \tau\gamma + \gamma\left(I^1 - S\right)\right].$$

The optimal savings *S** is the solution of the following first-order condition:

$$\frac{\tau(1+\gamma) - \gamma}{\left(I^i - S\right)\left(\tau(1+\gamma) - \gamma\right) + \tau I^j} + \frac{\gamma}{I^j \tau\gamma + \gamma\left(I^i - S\right)} = \frac{\beta}{S}. \tag{6}$$

The left hand side of (6) is an increasing function of *S* and the right-hand side is decreasing in *S*. Therefore, equation (6) has a unique solution $S^* \in \left(0, I^i\right)$.

The second step of the optimization problem involves the decision regarding the portfolio

allocation by choosing the shares invested in the home and the host country.

That is, given the optimal savings amount S^* and the exogenous rates of return on assets in both countries R^i and R^j, the agent chooses the asset mix A^i and A^j that maximizes the return of her portfolio. Formally,

$$\underset{A^i, A^j \geq 0}{\text{Max}} \left[A^i R^i + A^j R^j \right], \qquad (7)$$

$$\text{subject to } A^i + A^j \left[1 + f\left(A^j\right) \right] = S^*, \qquad (8)$$

where $f(x) = x^{\alpha}$, $\alpha \in (0,1)$ represents the cost of investing in home country assets. This cost is intended to capture not only the monetary costs (fees and charges of the financial institutions in the case of investment in financial assets) but also risks associated with imperfect monitoring or generally idiosyncratic risks not included in the return. For simplicity, the budget constraints above are expressed in terms of consumption goods in the sending country *i*.

The first-order conditions with respect to A^i and A^j are:

$$\left(A^i\right) R^i - \lambda \leq 0, \; A^i \geq 0$$

with complementary slackness;

$$\left(A^j\right) R^j - \lambda \left(1 - (1+\alpha)\left(A^j\right)^{\alpha} \right) \leq 0, A^j \geq 0$$

with complementary slackness.

It can be seen that $A^j = 0$ when $R^i = \lambda > R^j$ and $A^i = 0$ when

$$R^i < \frac{R^j}{1 + (1+\alpha)(S^*)^{\alpha}}.$$

The interior solutions for A^i and A^j are:

$$A^j = \left(\frac{R^j}{R^i (1+\alpha)} \right)^{1/\alpha}$$

$$\text{and } A^i = S^* - \left(\frac{R^j}{R^i (1+\alpha)} \right)^{\frac{1+\alpha}{\alpha}}. \qquad (9)$$

Consequently, the total amount of remittances the representative migrant sends from country *i* to country *j* is:

$$REM_{ij} = X^{ij} + A^j = X^{ij}\left(\overset{+}{I^i}, \overset{-}{I^j}, \overset{-}{\tau} \right) + A^j \left(\overset{+}{R^j}, \overset{-}{R^i} \right).$$

Based on the above equilibrium relationship, we estimate the following remittance function:

$$REM_{ijt} = f\left(I_t^i - I_t^j, R_t^i - R_t^j, \tau\right), \qquad (11)$$

where *REM* are remittances per migrant, subscripts *i.* and *j.* indicate the receiving and sending country respectively and *t* is a time subscript. The first argument denotes the difference between real incomes of the migrant and her family back home, according to equation (4). The second terms denote the rate of return differential for financial and possibly non-financial assets (real-estate) as given by the linearised version of equation (9). The effect of the income differential on the remittance flow will capture the altruistic motive to remit, while the effect of the two rates of return reflects the importance of self-interest behind the decision to remit.

The final term is the cost of sending remittances between two countries.

Since empirical evidence indicates a lot of variation of migrants' skill composition across countries, we augment this framework by accounting for the skill level of migrants and a measure of income inequality in the sending country. Low-skilled migrants tend to make up the bottom of the income distribution in the host country, so a higher income inequality will depress their earnings and thereby, the amount remitted.

3. OPTIMAL POLICY INTERVENTIONS

The complexity of selection the mix of policies is given by the fact that many options attempt to achieve diametrically opposite results, but other options appear to work synergic. The attitude towards migration is based on the answers to the question regarding

the net impact on the welfare (ΔW), decomposed in short-term level effects (ΔW0) and a discounted cumulated effect on future welfare (ΔWt):

$$\Delta W = \Delta W_0 + \sum_{t=1}^{T} \delta^t \Delta W_t$$

At reference time we only observe the short-run effects. The magnitude of the growth effect critically depends on the discount factor $\delta<1$ and the duration T of these growth effects. Migration and remittances have a positive welfare impact on the current generation (reduced poverty and unemployment, increased disposable incomes, multiplier effects of increased aggregate demand on short-term growth).

Remittances are welfare improving for those staying at home, but an active encouragement of migration is not a sustainable, or a politically feasible strategy. There are also important economies of scale associated with public goods, which provide additional rationale against outright promotion of migration.

An active discouragement policy by imposition of barriers will not remove the incentives that motivate migration and intermediaries will likely become increasingly criminalized, while repatriation of remittances will shift completely into the underground economy.

The policies for reducing incentives to migrate are achieved by taxing remittances but these can easily shift into informal channels and the efficiency is very low while the positive effects of remittances are severely decreased. In this case the only effective way for decreasing incentives to migrate is by lowering incentives to migrate by removing financial markets imperfections (this would lower the incentive to migrate in order to accumulate the capital required to finance investments into physical and human capital), by increasing the efficiency of insurance markets and of the social security system (lowering the use of migration as a direct solution for risk diversification) and by increasing economic growth and reduce poverty (this reduce the wage differentials as a main incentive to migrate).

In conclusion the strategies to optimize the short-term welfare effects and tip the balance of welfare consequences towards the positive end represent the only plausible strategic option for the government and can be achieved either by mixing the reinforcing positive effects with the mitigation of the negatives.

4. EMERGING STRATEGIES TO REINFORCE THE NET EFFECTS OF REMITTANCES

The positive impact on investment and savings is the main channel through which remittances affect growth, but fraction saved or invested directly is different. The channels through which this *positive effect can be reinforced* are mobilization of remittances, removal of government distortions, and removal of market failures.

The community channel a larger share of remittances into productive activities by attempting "bank the unbanked", and pooling remittances into community development projects (Johnson, Sedaca, 2004). In this contribution are presented various types of "*remittance and diaspora focused"* programs initiated by private banks, non-banking institutions (microfinance projects, credit unions) and international organizations.

For government authorities, collective remittances represent a vital supplement to their budgets and a simple way to support public services. Governments should be interested in productive activities that can raise income and lower unemployment. In a desire to increase the use and impact of collective remittances some government authorities have implemented different measures: incentives to attract greater flows of collective remittances, special cooperation with *Hometown Associations* (*HTAs*) in the planning and implementation of projects, strategies to match collective remittance inflows with government funds and an actively solicit and encourage investment by emigrants in their hometowns.

Cuc, Lundbăck, Ruggiero (2005) present the *mechanisms of government failures* as the binding constraint in the path of the productive investment of remittances and they conclude that improvements in the investment climate (taxation, labour regulation, infrastructure, corruption, property rights, contract enforcement) is the only way to effectively promote higher investments.

There are different potential *market failures* that policy can address, including *imperfections* in the financial market (Giuliano, Ruiz-Arranz, 2005) and *information asymmetries* between the migrant and recipients (Chami, 2003). Inefficiencies and poor competition in financial system can reduce the impact of remittances. The development of a strong financial system becomes a critical component of an economic strategy that aims at integrating remittances into the development mix.

Because labour outflows and a remittances-caused Dutch disease dramatically reduce export competitiveness, this aspect should be of particular concern to the government of emerging economies. The interest is to design a policy located as close as possible to the cause. There are different solutions to mitigate the negative effects on competitiveness:

a) sterilize the inflow of foreign currency to prevent appreciation of the currency. This could eliminate the remittance-caused Dutch disease, but could not fully compensate the wage increases due to the outflow of labour. On the negative side, monetary policy is an economy-wide lever, which does not only affect the exports.

b) implement an industrial policy, capable to compensate exporters for competitiveness losses due to increased wages and real exchange appreciation (Rodrik, 1994). In the case of commodity-based Dutch diseases, many countries implement stabilization funds (Norway, Russia, Kazakhstan) earmarked to be spent in the event that the export price of a commodity drops or the natural resource is exhausted. It is not evident how such a scheme could be applied to remittances-as it was argued earlier, taxing remittances is not a feasible measure.

5. CONCLUSIONS

The analysis of the determinants of remittances should develop new ways of accommodating variation in a post enlargement migration framework, with a better integration of micro level information (migration projects, potential remitters) and a careful integration of demographic and other non- economic determinants.

The modern literature underlines the fact that the motives of remitting (altruistic or self-interested) are not conditional. It is also possible an investment scenario, in which the pure self interested motivations change the intention to remit (the brain circulation). If altruistic reasons are present the ties with the home country can become less stringent. In the case of the informal contract between migrant and the family left (enlightened self interested motives) the negative relationship holds

Future work and specific remittances policies need reliable data to deal with. The future work should be more focused on country analyses because the change in the cyclical components of GDP, the amount of remittances and other macro variables like financial depth, level of corruption, openness are country specific. Cyclical properties may change in time and the migrant's remitting mechanisms can be also influenced by national migration policies.

The focus will be on the following goals: improving the definition of migrant' remittances so that national central banks and statistical offices should not have any objections; providing banking systems and specific services (fees, minimum balances, exchange rate spreads) on a micro level scale, better adapted to the new capabilities of transfers; estimations for the irregular flows.

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FINANCIAL MANAGEMENT ASPECTS FOR AN EFFICIENT RECOVERY IN THE CASE OF ASSYMETRIC EXTREME RISK EVENTS

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Abstract
The recent cases of crisis management in extreme risk asymmetric events proved an insufficient capacity of the governments for an efficient intervention. Indeed, the new philosophy of terrorism changed and the private insurance markets loss their functionality to cope with the crises. A financial framework of the management in the case of asymmetric extreme risk events capable to respond to the specific aspects of these processes, based on the public-private partnership is proposed. A comparative analysis of different forms of intervention, including governmental intervention and the functionality of this solution is proposed.

Key words*: terrorism, extreme risk events, risk management, governmental intervention, insurance-reinsurance market, extreme risk securities, public-private partnership*

1. INTRODUCTION

Extreme risk is considered a public, shared risk that makes finding individual but also community solutions, difficult (Comfort, 1999, Cardona, 2001). The capacity of a population to respond and recover from an extreme event depends on the losses but also on the global environment of location affected. Prevention measures could prevent large-scale damage but the risk could not be eliminated because in the case of systemic risk problem these events could trigger a spread of secondary effects on other social systems with impact and contributions to the collapse of the entire systems and also new emerging risks that differ completely from what we faced before. The events in the last decade have determined the actors in insurance and reinsurance markets to drastically change their estimates of potential insured property losses from terrorist attacks. In order to analyze the dynamics of the insurance-reinsurance market response it is necessary to discuss the terrorism risk in the context of risks normally handled on the insurance/reinsurance or capital markets, the role of the government in resolving insurance/reinsurance supply problems related to terrorism and the general principles that a government terrorist program should adhere to and provide a critical view on the present inefficiency of the proposals on this market.

The evaluation of alternative forms of governmental intervention implies an analysis of the factors which motivate them. It is important to mix economic instruments with elements from the insurance industry and with the government. Institutions frequently seem to act independently from economic objectives. The present analysis is based on the analysis of the analogy between the insurance markets of terrorism and of natural catastrophes.

The potential loss caused by catastrophes requires a specific capacity of the insurance market that is always insufficient. The alternative risk transfer (ART) is an instrument capable to transfer the catastrophic risk to investors by means of the insurance market (Lewis, Murdock, 1999). The role of the government in managing (reducing/ covering) the terrorism risk has grown after 9/11 but there is a controversy regarding the advantages of the governmental intervention in this case (Priest, 1996).

2. THE ROLE OF GOVERNMENTAL INTERVENTION IN THE CASE OF TERRORISM

The distinctive characteristic of the two forms of extreme risk (natural disasters and terrorism – both

accompanied by considerable losses) refers to the uncertainty caused by the human intervention. The actuarial methods of evaluating the risk of terrorism are not developed enough in the field and represent an objective for subsequent research; the effect created by the interdependence of the terrorism risk will also be analyzed through the general pattern of interdependent security.

The effects of extreme natural disasters such as hurricanes, typhoons, floods and earthquakes represent a serious threat to human life, properties, local communities and the economic growth of the entire nation. The considerable damage have challenged the capacity of the insurance and reinsurance market and underlined the decreasing possibilities of covering the catastrophic risk.

Because of the increasing number of natural disasters which occurred during the last years, the risks triggered by the constant interaction between human activities and the environment are diverse, varied and often catastrophic because of their consequences. The development of a crisis plan, with specific targets as a response to the strategy, needs proactive contributions from the economic national and international players involved: governments, public officials, international organizations, financial institutions and private entities.

The nature of the risk, the probability of loss, and the possible amount of the damage and the capacity of absorbing the consequences of the damage depend on the individual attitude towards risk. Under reasonable circumstances and equal access to information, the economic players can calculate the value of the risk based on the amount of the damage and the possibility of the disaster to happen. The decision must be taken on the basis of this evaluation of the risk.

The traditional mechanism of insurance is not capable to cope with the risk of natural catastrophes, as the predictability of the risk, its space diversification and the financial capacity of the market show serious limitations. The amount of the foreseen losses and the asymmetric information influence the predictability of the risks, and the evaluation needs the conjugated efforts of the groups of insurers and re-insurers. We must underline the fact that the way the information is distributed and the concentration of the market needs a correct and fair approach of the antitrust policies and of the competitive ones.

The considerable losses caused by the natural catastrophes in the last years caused a temporary absence of the reinsurance of catastrophe because of the shortage of supply and the withdrawal from the market of the catastrophic risk (Holzhen and Lechner, 1998). Apart from this, natural disasters can cause even more serious losses.

All these brought about chain reactions which can cause the insolvency of the reinsurance market. Moreover, a significant part of the capacity of the reinsurance market is not available because of liquidity (Cummins, 2002).

Consequently, other solutions are the direct transfer of the risk using the financial market, by means of the famous extreme events securities (ART solution).

The impact of the future major disasters on the market of reinsurance and the impact on the price can bring about a new growth in the volume of the market of the titles of catastrophic risk (known as a technique of private management of risk, combined with a component of the public management of risk). The coverage generated by risk bonds could be an interesting alternative to the solution of the traditional insurance.

Kunreuther (2002) suggests the incorporation of the risk bonds in the approach of the public – private partnership. The involvement of the government usually appears after the catastrophes which cause shock on the level of the industry of insurances and of reinsurances. The growth of the price of reinsurance in the event of a natural catastrophe induces, for a certain period of time, a negotiation and a segmentation of the market of the risk bonds which the re-insurers must reconsider in their own portfolios.

Terrorism risk should be analyzed via the feasibility of financing such a huge losses event through insurance/reinsurance markets. The uncertainty of this risk is another feature of terrorism coverage that initially seems different from other catastrophic risks. This fact makes it difficult for insurers to estimate the probability and severity of loss. Any governmental involvement should not discourage private industry from returning to the market and in this case there is a need for more efficiently instruments for example inspired from capital markets such as catastrophic bonds.

The empirical knowledge on the private markets is very limited, as the governmental interventions dominate these markets in most countries (the public-private system in which a substantial part of the risk is governmentally sustained). The management plans in which the government might

have an insurance role (Kunreuter 2004, OECD, 2004) take into account reinsurance for the high level risks. The most evaluated insurances against terrorism are in France (GAREAT), Germany (EXTREMUS), U.K. (Pool RE), U.S.A. (TRIA).

Robert Merton (2004) shows that the institutional structure must act in the sense of the elimination of the first incorrect effects and of roughness of the market, ignored in most of the economic models. The institutional structures most act so that the economic models to be universally applied even when a simple comparison of the models hypothesizes and of the real institutions suggests something else. This approach could be applied for different institutional structures (prices and traditions) and a unique framework could be valid.

The fundamental impediments regarding the mobilization of large funds are due to: accounting restrictions; provision taxation; taking over risk; re-insurance when confronted with similar capital problems (Frott 2001); the transfer mechanisms failure of the catastrophic risks on the capital market (a standard evaluation procedure doesn't exist), there are no protection mechanisms against hedging risks: the lop-sided risk characteristics; the catastrophic risk liabilities (cat bond) didn't achieve their purpose. It is very difficult to determine the efficiency of the governmental intervention because there is a diminishing effect on private companies' interest. Insurers use *a risk based price setting* especially to co-interest the insured parts to take their own measures to diminish risks but individuals anticipate governmental intervention in case of a catastrophic event and it results a possible *failure of markets.*

3. BASIC ELEMENTS OF EXTREME RISK MANAGEMENT

Extreme risk management (ERM) is a dynamic process that requires continuous adjustments, decision making and interaction at different levels and requires risk identification, risk reduction, and risk transfer. Disaster risk emerges from the interaction between the external risk factor and vulnerability (the internal risk factor), defined by a risk chain and the options for managing risk in terms of loss and it influences the impact on systems. The critical stages of ERM are: preparedness to mitigate extreme risk effects; the response to deal with the physical impacts and the new risk factors created by the extreme events; short term recovery activities to restore vital support systems and long term tasks to bring economical framework back; prevention/ mitigation to reduce the probability and the impact of future extreme risk events (structural and non- structural activities and measures). The use of an integrated risk analysis framework is crucial to understand the priorities of the processes to cope with these events.

First step in management of extreme risk events is to identify the most critical endpoints assessed in terms of the possible impacts on humans, communities and environment. Then, it is necessary to specify the particular nature of each risk that could affect the endpoints in both terms of the likelihood and the degree of damage. The exploration of possible external impacts which might occur is based on the analysis of the risk triplet $R=R(S_i,P_i,D_i)$: the impacts/ damage position outside/ inside our control area; the scale of these impacts and their degree of irreversibility; the trans-boundary characteristics of these impacts; the potential threat to human ethics/ morality.

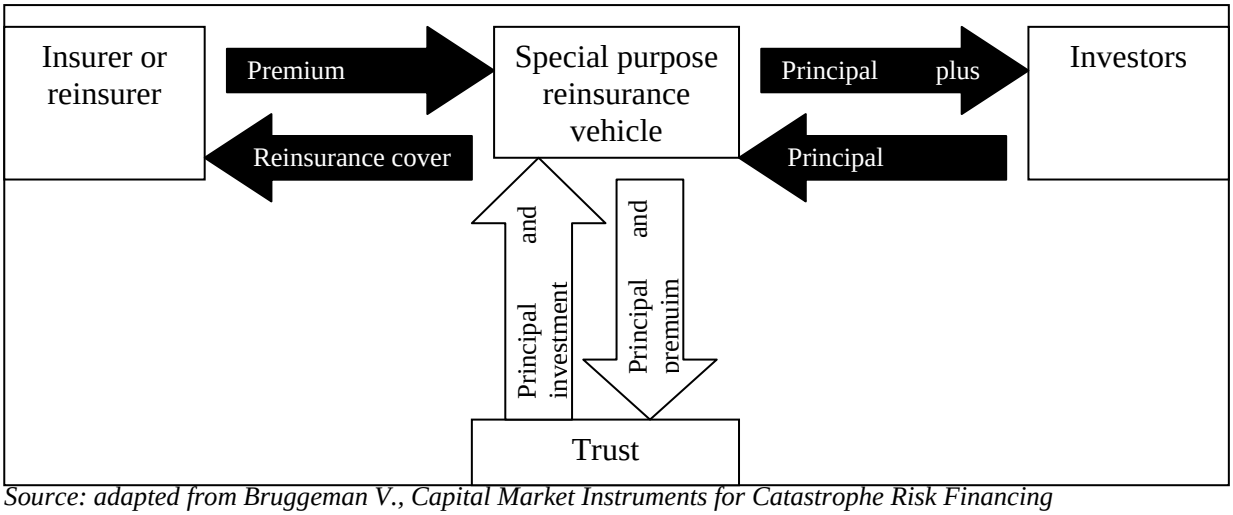
An integrated framework for extreme risk analysis should include the following four steps: scenario formulation- collection and analysis of data related to hazards in terms of their possible origins, pathways, and mitigation; extreme risk assessment – the list of potential extreme events together with their exposure or vulnerability; extreme risk management- with development of mitigation measures and procedures based on the output from the risk characterization; communication by using a dedicated platform to enable a better understanding of the rationale behind the categories of risk assessment.

4. FINANCIAL ASPECTS IN THE CASE OF EXTREME RISK EVENTS

Insurance is a classic way of handling with catastrophe risk, but insurance firms diversify and transfer catastrophe risk through reinsurance. Reinsurance supports insurance firms to underwrite large risks, limit liability on specific risks, increase capacity, and share liability when the specific conditions claim that. If reinsurers don't have enough capital to cover the losses are necessary new solutions from the market (financial innovation; extreme event bonds) and new public policies (governmental reinsurance programs). There are two important implications for insurance companies that operate in catastrophic insurance; the companies cannot limit losses or their variation through *portfolio diversification policies*; the

annual rate of losses (refunds reported on the total of the collected rate) is extremely volatile based on extremely high values. The result is that insurance companies must have remarkable capital and foreign currency reserves to confront such events.

Extreme event bonds appeared due to the insufficient capacity in the catastrophe reinsurance market (Bantwal, Kunreuther, 2000) but this market is relatively small and volatile. Cat risk bonds provide a mechanism for direct transfer of catastrophe risks to capital markets, in contrast to transfer to reinsurance market. But also, there exist a strong possibility of the reinsurers to use cat bonds in order to change the value of cat reinsurance.



Source: adapted from Bruggeman V., Capital Market Instruments for Catastrophe Risk Financing

Figure 1. The structure of catastrophe bonds

5. A MODEL OF PRICING EXTREME RISK SECURITIES

The issuing bonds to finance the losses appeared in the late '80s and that means that some traditional insurance clients replaced insurance with self-insurance programs financed by bonds, which are the turning to the capital market.

The concept of extreme risk bonds (ERB) can be described as a one-period high-yield instrument (Tilley, 1995; Froot, 1995). Let consider a contract where L is a fix amount paid by reinsurers at the end of the period if extreme event occurs, q_{cat} is the probability of an extreme event, *P* is the price of the reinsurance calculated and *r* the default-free interest rate.

In this case, the price of ERB is expressed by:

$$P = \frac{1}{1+r} q_{cat} L \qquad (1)$$

The reinsurer issues enough bonds to raise an amount of cash *C* determined so that:

$$(P + C)(1 + r) = L$$

The price of ERB in terms of discounted cash flow is:

$$\frac{1}{1+r}(1+c)(1-q_b)$$

where $c = R/C$ is the coupon rate and q_b the probability of default of the bonds.

Consider that *c* is determined in order to receive *1+ c* for every *1* paid and the expression is

$$1 = \frac{1}{1+r}(1+c)(1-q_b)$$

By solving for q_b we obtain

$$q_b = \frac{c-r}{1+c}$$

and the implied price for reinsurance is:

$$P_b = \frac{1}{1+r}\frac{c-r}{1+c} L = \frac{1}{1+r} q_b \quad L$$

From the relation R = L-C we obtain

$$(P + C)(1 + r) \geq (P_b + C)(1 + r)$$
$$= \frac{c - r}{1 + c} L + (1 + r)C$$
$$= \frac{R - rC}{C + R} L + (1 + r)C$$
$$= \frac{R - rC}{L} L + (1 + r)C$$
$$= R + C = L$$

In conclusion, if P_b does not exceed *P*, the market of reinsurance will be in an economic frontier by borrowing in the bond market.

$$q_{cat} \geq \frac{c - r}{1 + c}.$$

6. CONCLUSIONS

The experience of last decade interventions requires a serious new thinking about managing terrorism risk. This type of risk is unlikely to occur, even if it can trigger devastating consequences, such as the reluctance on the part of the potential risk transfers to incur the high cost associated with the risk transfer. The paper presented the possibilities to transfer risk to capital markets, the effects of governmental intervention in the market, and the limits of the intervention.

The involvement of the human factor in terrorism makes this risk more difficult to ensure. The main effects introduced by human nature are: the government has better ways of obtaining information than the private markets: if the insurance rates reflect the detailed ratings, then they only count on the information that is directly available to the private insurance firms (a more precise evaluation could only be made by using the governmental information, and this ambiguity concerning the limited access to information leads to higher rates); the governmental disposition to act *as the last instance insurer* influences the credibility of the programs that aim at stopping the terrorist attacks from the beginning; the terrorists will choose the targets strategically and their strategy includes target selection based upon the insurance level (Kunreuther, Michael Kerjan 2004); the action that the individuals and firms take in order to understate the damages that result from a terrorist attack depend on the strategy that the terrorists will choose when they select the targets.

The macroeconomic effects of the terrorists attacks are higher than those caused by natural disasters, as the direct losses can be more considerable and the failure in stopping the attack will be seen like a governmental failure; the terrorists' goal is to maximize the global impact on the economy.

An integrated framework for extreme risk analysis should include the following four steps: scenario formulation- collection and analysis of data related to hazards in terms of their possible origins, pathways, and mitigation; extreme risk assessment - the list of potential extreme events together with their exposure or vulnerability; extreme risk management - with development of mitigation measures and procedures based on the output from the risk characterization; communication by using a dedicated platform to enable a better understanding of the rationale behind the categories of risk assessment.

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VSM, A LEAN MANAGEMENT TOOL, USED FOR HAVE AN COMPETITIVE DIE PRODUCTION SYSTEM

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Abstract: *Currently companies act on a global market. To survive in this market is important to be competitive. The company competitiveness is measured by the levels of performance by making competitiveness products with minimal costs. To control and decrease the costs must make through continuous improvements of the process. A tool who helps the team management of the companies to do that is Value Stream Mapping (VSM). VSM is a tool of lean concept, used by management team, and has an overall product level focus cutting across processes, functions and departments and Trough VSM is analyze and improve how products flow through your process. VSM is a set of tools that analyses overall process flow and presents it in a visual form, allowing the process to be re-designed to eliminate the waste and inefficiency. VSM incorporates lean concepts and tools, such as takt time (cycle time based on customer demand), theory of constraints and pull-based scheduling systems. The companies who use VSM have successfully eliminated the barriers that prevent material and information flowing smoothly throughout the organization. These article present the definition and history of VSM, the objectives and elements for a the necessary steps for making the VSM, an example of VSM for a die production system, advantages and disadvantages of VSM.*

Key words: *Lean concept, Value Stream Mapping, competitiveness, production system, takt time, continuous improve.*

1. INTRODUCTION

To survive on a global market, in continuous economic growing the production systems have to be competitive. A factor which is influencing the competiveness is the production systems management. The Lean Management is a modern management tool, which correlates quality, waste disposal and employees' involvement, and is using a well structured management. The Lean management is using the Lean philosophy at all levels.

A very important tool of Lean is the Value Stream Mapping, which enables the management team to understand and analyze all processes to uncover the waste and inefficiency. It is a powerful, visual Lean tool that graphically identifies every step in a process flow, giving visibility to both the value-adding and non-value-adding steps. Identifying the value-adding and non-value-adding steps is key to implementing Lean. This effort aligns with the key business objectives, defining priorities and resources such that the most pressing issues are addressed first to ensure creation of the annuity effect [1].

Value Stream Mapping is needed for a system production because charts trace the sequence of events for a business, department or process. The most useful VSM charts are quite detailed, this is important because most waste and unnecessary cost is at a micro- level [2].

The fundamental principle of the method is mapping the current state of a process and applying lean techniques to create an improved future state vision of the process. To develop this future state, non-value-added tasks are identified. These are activities deemed to only support the true value-added tasks (Type I waste – often tasks such as set-ups, reviews, etc.), or that are completely unnecessary in

themselves (Type II waste – often "non-tasks" such as waiting in inventory) [3].

2. DEFINITON AND HYSTORY OF VSM

The value stream is analyzed and mapped in order to reduce the waste in processes, enable flow, and move the process towards the ideal of rapid response to customer pull. Most value stream mapping work has been done in the manufacturing context.

Value Stream Mapping (VSM) is the process of visually depicting the details of a business process to evaluate its suitability for meeting customer expectations. While a VSM can be created for a variety of purposes, its initial use is usually for evaluating an existing process with a goal of identifying opportunities for improvement. Business leaders may then want to create a follow-up VSM that represents the intended future state after improvements [4].

VSM charts traces the sequence of events for a business, department or process. The most useful VSM charts are quite detailed, this is important because most waste and unnecessary cost is at a micro- level [h SUP].

Toyota is the pioneer company of lean thinking and used the method since the 1970s. The activities company must be change in product development, manufacturing, company collaboration, distribution and marketing, according to the Toyota production System (Taichi Ohno) [5].

That was possible just if the company created an even flow of varying products that with very short lead times and change over times could pass through all process from door to door. It would also apply to the whole network of cooperating companies throughout the entire value stream. It would create a flow without necessary stops and disturbances and minimum losses and waste.

To be able to see the whole flow activities and to see the waste and non aided value from the activities they created a method to visualize the whole process of material and information's from suppliers to costumers.

3. OBJECTIVES AND ELEMENTS OF VSM

The objective of VSM is that business management and process improvement teams use VSM to evaluate existing processes for providing products and services to customers. By determining which steps are parts of the value stream and which are not, project teams can learn where inefficiencies arise and where improvements are needed. Creating the map also helps business leaders to understand how a process is actually performed, as opposed to how they think it is performed or how it should be performed [4].

A typical VSM consists of five key parts:

- the process activities or tasks;
- the flow of materials;
- the flow of information;
- information about cycle time and queue time;
- and value stream data such as value-added (VA) and non-value added (NVA) determinations: The value stream is the series of tasks that is required to provide the product or service that the customer considers to be of value. Tasks that add value in the eyes of customers are called value-added (VA) activities, whereas other steps are considered non-value added (NVA). In some cases a third category also applies: business-value added (BVA) steps are those activities that are required to meet a business objective (such as documenting work or meeting legal obligations) but that customers would not prefer or pay extra for [4].

All these activities are mapping with standard symbols.

Value Stream Maps capture [6]:

- major process steps and resources involved at each;
- customer demand, overall lead time, and cycle times;
- inventory movement and levels of inventory at each point where it "waits" for work to be
- performed;
- customer and supplier information flows;

- whether parts or information are “pushed” to the next step, or “pulled” by a signal from it;
- how much material or information moves through each process step;
- which activities add value—that is, they change what is moving through the process—and
- which represent wasted effort, motion, time, or other resources.

4. STAPES TO MAKE VSM

The procedure for creating a VSM is not set in stone, and the way it is done is less important than the principles that are followed when doing so. First and foremost, the participants need to understand that the goal is to capture the details of how the process actually works, rather than the way that it should work or the way management thinks it works. To ensure this is the case, individuals who actually perform the process need to be involved in documenting how the process works. Often project team members "walk the process" from beginning to end, capturing data as they go [4].

The success of VSM is utilizing the skills and experience of the area employees and operators. They engage in a powerful discovery process that exposes hidden non-value adding activities. Once these items are known, the stage is set for significant progress toward eliminating them. Going through the VSM process may be quick and relatively easy for simple operations, or it may take much more time with considerable difficulty when examining complex operations.

Using a VSM process requires development of maps: a Current State Map and a Future State Map. In the Current State Map, one would normally start by mapping a large-quantity and high-revenue product family. The material flow will then be mapped using appropriate icons in the VSM template. The (material) flow path of the product will be traced back from the final operation in its routing to the storage location for raw material. Relevant data for each operation, such as the current schedule (push, pull, and order dispatching rules in effect at any process ex. FIFO) and the amount of inventory in various queues, will be recorded. The information flow is also incorporated to provide demand information [7].

After both material and information flows have been mapped, a time-line is displayed at the bottom of the map showing the processing time for each operation and the transfer delays between operations. The time-line is used to identify the value-adding steps, as well as wastes, in the current system. The comparison between the processing times and the takt time (calculated as Available Capacity/Customer Demand) is a preliminary measure of the value and wastes in a stream. This takt time is mostly used as an ideal production rate for each operation to achieve. Ideally, the cycle time for each operation should be less than or equal to the takt time.

5. VSM FOR AN DIE PRODUCTION SYSTEM

First step is to way to create a VSM is to form a cross functional team. The team components are: representatives from departments like sales, customer service, scheduling, purchasing, operations, inventory control, maintenance, quality and information technology. The team members must have some basic training on lean principles to develop a realistic future state map

Once the team is formed, the team members make the schedule (see table 1):

Table 1 The schedule for VSM

Day 1	Day 2	Day 3
• Introduce VSM. • Determine process families. • Walk the flow and gather information.	• Draw the current state map. • Perform lean concepts training.	• Create the future state map. • Develop the draft plan.

Next step is to choose a group of products and services that go through the same or

similar processing steps and create a matrix. After completing this vital step, the team examines the matrix. After that can plotting the Current State.

To create the current state map, they collect the data and information by walking the flow and interviewing the people who perform the task.

From walking the flow, the team collected on a worksheet several types of information, such as: cycle time or processing time, changeover time, reliability of equipment, first pass yield, quantities, number of operators and shifts, hardcopy information, electronic information, inventory levels, queue or waiting times [8].

With the information gathered from walking the flow and the ensuing team discussions, it's now time to sharpen the pencil and put the lead to paper. Any VSM can be drawn using simple symbols or icons, some of which are shown in figure 1.

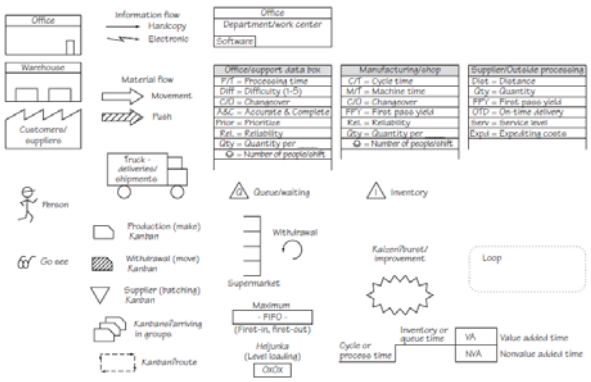

Fig. 1 Common VSM tools [8]

Once the information has been collected, the team drawing the map on paper (landscape) using pencil and a large eraser. Key areas on the map are: the upper right corner for customer information, the upper left corner for supplier information, the top half of the paper for information flow, the bottom half for material (or product) flow, the gutters on top and bottom to calculate value added and non-value added time.

Calculate the cycle time vs. the inventory time (in days) for the material and information flow.

The current state map illustrates how the production system's processes perform in today's work environment. In figure 2 is related the current VSM of the analyzed die production system.

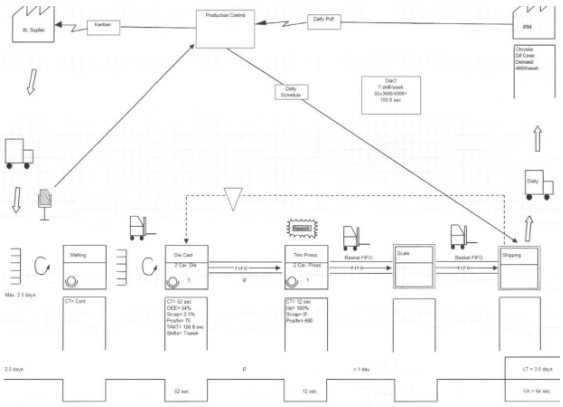

Fig. 2 The current VSM of the analyzed die production system

Once the current state map is complete, the team can set its sights on creating the future state map. The future VSM is created based on the next questions (figure 3):

- What is the takt time?
- Are there bottlenecks or constraints?
- Where can inventory (or queue time) be reduced or supermarkets used?
- Where can you improve flow?
- What other improvements are required?

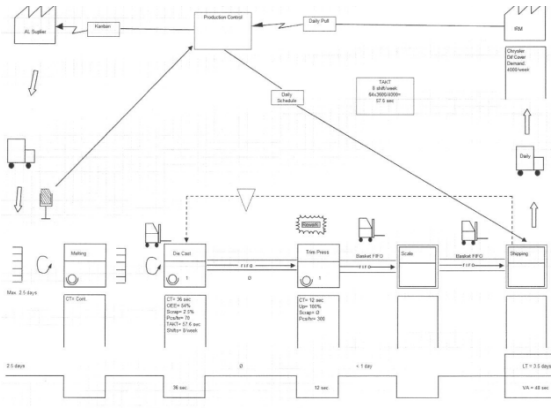

Fig. 3 The future VSM of the analyzed die production system

6. CADVANTEGES AND DISADVANTAGES OF VSM

VSM benefits include:

- helps the company to break down communication barriers [4];
- helps to unify several IE techniques for material flow analysis, such as Production Flow Analysis (PFA), Business Process Reengineering (BPR), and Process Analysis and Improvement (PA&I) that, to date, have been taught and implemented in isolation [7];
- provides a company with a "blueprint" for strategic planning to deploy the principles of Lean Thinking for their transformation into a Lean Enterprise [7];
- provides a company with the basis for an implementation road map [4];
- identifies waste so can eliminate it, contributing to improved customer satisfaction [4];
- reduce inventory and production costs;
- creating a vision of the future by uncovering wastes and opportunities to create flow – and making them visible to all [4];
- enabling broad participation in shaping the future [4];
- relates the manufacturing process to supply chains, distribution channels and information flows [7];
- integrates material and information flows [7];
- reduce lead times;
- forms the basis for implementation of Lean Manufacturing by designing the production system based on the complete dock-to-dock flow time for a product family [7];
- improve quality;
- links Production Control and Scheduling (PCS) functions such as Production Planning and Demand Forecasting to Production Scheduling and Shopfloor Control using operating parameters for the manufacturing system ex. takt time which determines the production rate at which each processing stage in the manufacturing system should operate [7];
- provides important descriptive information for the *Operation* and *Storage* icons that, to date, has not been captured in standard Flow Process Charts used by IE's [7].

Disadvantages of VSM include [7]:

- fails to map multiple products that do not have identical material flow maps;
- fails to relate Transportation and Queuing delays, and changes in transfer batch sizes due to poor plant layout and/or material handling, to operating parameters (ex. machine cycle times) and measures of performance (ex. takt time) of the manufacturing system;
- lacks any worthwhile economic measure for "value" (ex. profit, throughput, operating costs, inventory expenses) that makes it similar to the Flow Process Charting technique used by IE's;
- lacks the spatial structure of the facility layout, and how that impacts inter-operation material handling delays, the sequence in which batches enter the queue formed at each processing step in a stream, container sizes, trip frequencies between operations, etc;
- tends to bias a factory designer to consider only continuous flow, assembly line layouts, kanban-based Pull scheduling, etc. that are suitable mainly for high volume and low variety (HVLV) manufacturing systems.
- fails to consider the allocations and utilization of an important resource – factory floor space – for WIP storage, production support, material handling aisles, etc;
- fails to show the impact on WIP, order throughput and operating expenses of in-efficient material flows in the facility ex. backtracking, criss-cross flows, non-sequential flows, large inter-operation travel distances, etc;
- fails to handle complex product BOM's branched and multi-level Operation Process Charts and Flow Diagrams that result in complex value streams
- fails to factor queuing delays, sequencing rules for multiple orders, capacity constraints, etc. in any map;
- facks the capability, due to the manual mapping method, for rapid development and evaluation of multiple "what if" analyses required to prioritize different alternatives for improving a Current State Map when time and/or budget constraints exist.

7. CONCLUSIONS

VSM is a method who provides optimum value to the customer, through a complete value creation process with minimum waste in: design (concept to customer), build (order to delivery) and sustain (in-use through life cycle to service).

Value Stream Mapping brings visualization and a deep understanding and major breakthroughs in productivity and other performance. It leads to consensus on systemic problems and remedies. While finished charts communicate information about a situation, the real value is the mapping itself. This is where insights grow, paradigms shift and consensus builds.

Value Stream Mapping helps any production system to visualize the product flow, show links between information and material and process, identify sources of waste, establish a clear future vision for the Value Stream, prioritize improvement activities, focus attention on key activities that will improve the Lead Time and reduce the Total Cost of Product.

VSM help the production system to be a competitiveness production system on a global market.

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EXCHANGE RATE STABILIZATION POLICY EFFECTS ON ROMANIAN ECONOMY

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Abstract: Since '70's development economies governments uses exchange rates policies to reduce inflation and to control external deficit. Practically, exchange rates stabilization policies had two effects. First, this generates a boom-recession cycle in economic activity. Into the first stages of exchange stabilization policies consumption and production increases, but at the final stages, recession appears again, even for successful stabilization policies. Second, domestic inflation rate, especially for untradable goods, goes to devaluating rate and also we found real exchange rate appreciations. In our paper we study the inflation persistence in Romania and also the main determinants of inflation evolution.

Key words: inflation, stabilization policy, exchange rate, GDP, consumption

INTRODUCTION

Since 70's in development economies governments use exchange rate policies trying to reduce inflation, especially using a crawling–peg exchange policy. Practically, exchange rates stabilization policies had two effects. First, this generates a boom-recession cycle in economic activity. First stages of exchange stabilization policies, consumption and production increases, but at the final stages, recession appears again, even for successful stabilization policies. Second, domestic inflation rate, especially for untradable goods, goes to devaluating rate and also we found real exchange rate appreciations. Dornbusch (1982) and Rodriguez (1982) show that exchange rate appreciation depend especially on previous domestic untradable goods inflation. Also, Rebelo and Vegh (1995) show that sticky inflation depends on previous inflation rate and also depend on various supply shocks and it is possible to obtain a stabilization policy in term of business cycle. In the presence of sticky inflation and depending on perfect capital mobility, the reduction in the rate of exchange rate depreciation induces a reduction in nominal interest rates so we obtain a boom in economic activity. The excess demand created by the spending boom prevents the domestic inflation rate from declining to the rate of exchange rate depreciation. On the other side, Calvo (1986) and Calvo and Vegh (1993, 1994) shows that in perfectly forward looking price settings and without inflation stickiness, the persistence of domestic inflation and boom – recession cycle can be explained by the lack of credibility on government program. Depending on stabilization policies transmission mechanisms, various models proof different conclusions.

In our paper, starting on Celasun (2003) model, we develop a new inflation dependency model that explain for Romania the determinants of domestic inflation. The influence of exchange rate depreciation on inflation rate was a negative one in Romanian economy. The main determinant of Romanian inflation dynamics was for analyzed period (1990-2009) consumption rate.

1. LITERATURE

Into the models that include dependence between inflation rate and stickiness inflation the suggested policies are even to gradual decrease nominal exchange rate, even to switch from fixed exchange rate mechanism to flexible exchange rate mechanism, followed by exchange rate depreciation (see Dornbusch and Werner (1994)).

If price settings is thought to be completely forward looking and expectation rational and the continued momentum of inflation is explained by the lack of credibility of the exchange rate peg (see Calvo and Vegh (1993)) , then the preferred policy is to enhance advice of corrective devaluations, as such devaluations will further reduce the credibility of the future policies.

Another vision of the literature presents the effects of the stabilization on the supply-side of the economy. Roldos (1995) and Uribe (1997) show that a permanent stabilization increase investment since the transaction costs associated with capital investments falls. As resources that were previously absorbed by high transaction costs are free up, wealth increases, and so does consumption. Lahiri (1996) show in another scenario that nominal interest rates induce a distortion between consumption and leisure, therefore the reduction in inflation and nominal interest rates increase the labour supply, the desired capital stock and investment. While these scenarios explain the initial boom in consumption via wealth effects, they leave the late recession unexplained. Rebelo and Vegh (1995) show that this can be remedied by assuming either sticky wage inflation or sticky inflation in nontradable sector, since the over-appreciation of the real exchange rate due to sticky inflation generates an eventual recession. This scenario can explain the qualitative effects and features of the business-cycles associated with the exchange rate policies.

De Gregorio, Guidotti and Vegh (1998) emphasize the role of durable goods. If the purchases of durable depend on accumulation-consumption rule, a positive wealth effect under exchange rate depreciation causes an initial brunching of durable purchases and a slump thereafter. Their scenario does not explain either the boom-recession cycle in the nontradable sector or the real exchange rate appreciation. Their model explain that if there are nominal rigidities in the nontradable sector, the initial increase in durable consumption will cause a boom also of nontradable consumption since the real exchange rate can not adjust on impact.

3. THE MODEL

We present in this section a simple model based on Calvo's paper (1986) that analyze exchange rate policy stabilization. This model include as distinct problems: representative consumer sector, firms sector, with exportable and untradable goods and government sector.

Consumer Sector

We consider a small open economy with identical consumers that maximize expected utility subject to exportable and non-exportable goods (c_t^*, c_t):

$$\underset{\{c_t, c_t^*, m_t\}_{t=0}^{\infty}}{Max} \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t \left[(1-q)\log c_t^* + q\log c_t\right]. \quad (1)$$

We suppose that discount factor is international interest rate. For exportable goods there price is calculated from PPP law, with E_t nominal exchange rate and where P_t is internal price, P_t^* is external price in foreign units, real exchange rate is $e_t \equiv E_t / P_t$, $\varepsilon_{t+1} \equiv \frac{E_{t+1} - E_t}{E_t}$ is nominal rate of devaluation between t+1 and t periods. If m_t is real money, $s(v_t)$ are transactional costs and v_t is velocity of circulation, then $v_t = \frac{c_t^* + \frac{c_t}{e_t}}{m_t}$.

Consumer budgetary restriction is:

$$b_{t-1}(1+r) + \frac{m_{t-1}}{1+\varepsilon_t} + y^* + \frac{y_t}{e_t} + \tau_t = \\ = b_t + m_t + (1+s(v_t))\left(c_t^* + \frac{c_t}{e_t}\right), \quad (2)$$

where b_t is foreign bonds wealth, y^* respectively y_t is potential output and real output, c^* and c_t is potential consumption and real consumption levels.

If we consider also a Ponzi condition, $\lim_{t\to\infty}\frac{b_t+m_t}{(1+r)^t}\geq 0$, then budgetary restriction became:

$$b_{-1}(1+r)+\frac{m_{-1}}{1+\varepsilon_0}= \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t\left[\frac{i_t m_t}{1+i_t}+(1+s(v_t))\left(c_t^*+\frac{c_t}{e_t}\right)-y^*-\frac{y_t}{e_t}-\tau_t\right]. \quad (3)$$

Equation (3) shows that consumer expected discounted expenses are equals with consumer present wealth.
Consumer problem is to maximize relation (1) subject to budget constraint (3).

First order conditions lead as to:

$$c_t^*=\frac{1-q}{\lambda}\left(1+s(v_t)+v_t s'(v_t)\right)^{-1}, \quad (4)$$

$$\frac{1-q}{q}\frac{c_t}{c_t^*}=e_t, \quad (5)$$

$$\frac{i_t}{1+i_t}=v_t^2 s'(v_t), \quad (6)$$

Untradable goods sector

We suppose that firms change prices only depending on exogenous constrains. If there are an external signal, then a γ proportion of firms do not changing prices (so proportion $1-\gamma$ change there prices). Also a proportion ω of our firms use rational expectation theory to establish prices depending on expected inflation, and a proportion 1-ω establish prices depending on previous period prices. In this case average prices are V_t, a linear combination between the two types of established prices, V_t^b, and V_t^f:

$$V_t=(1-\omega)V_t^b+\omega V_t^f. \quad (7)$$

Starting on this hypothesis, the expected price level will be:

$$\pi_t=(1-\delta^f)\pi_{t-1}+\delta^f\pi_{t+1}+B(\log c_t-\log y^*), \quad (8)$$

where δ is discount factor, π_t is inflation rate, c_t is consumption level and y^* is output potential level, $\delta^f=\frac{\gamma}{\omega+\gamma}$ and $B=\frac{\beta(1-\omega)(1-\gamma)^2}{\omega+\gamma}$.

Government sector

We suppose that government subsidize consumers and support a part of transactional costs. Government budget constraint is:

$$d_t=d_{t-1}(1+r)+m_t-\frac{m_{t-1}}{1+\varepsilon_t}-\tau_t-\left(c_t^*+\frac{c_t}{e_t}\right)s(v_t), \quad (9)$$

where d_t is external bonds stock.

With Ponzi condition: $\lim_{t\to\infty}\frac{d_t-m_t}{(1+r)^t}\geq 0$, budget constraint can be rewrited:

$$d_{-1}(1+r)-\frac{m_{-1}}{1+\varepsilon_0}= \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t\left[\tau_t+\left(c_t^*+\frac{c_t}{e_t}\right)s(v_t)+\frac{i_t m_t}{1+i_t}\right] \quad (10)$$

This equation shows that government discounted expenses and segniorage revenue must be equal with initial value of government actives.

Equilibrium

In our model nonexportable production equals domestic consumption:

$$c_t=y_t,\forall t. \quad (11)$$

From consumer and government budgetary constrain we obtain general budgetary constraint:

$$f_{-1}(1+r)+\frac{(1+r)}{r}y^*=\sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t c_t^*, \quad (12)$$

Given (11) and (12), we find the Lagrange multiplier λ:

$$\lambda=\frac{1}{f_{-1}(1+r)+\frac{(1+r)}{r}y^*}\sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^t\frac{1-q}{q+s(v_t)+v_t s'(v_t)}. \quad (13)$$

The consumption and inflation trajectories are:

$$\begin{aligned}\pi_t &= (1-\delta^f)\pi_{t-1} + \delta^f \pi_{t+1} + B(\log c_t - \log y^*) \\ \log c_t &= \log c_{t-1} + \log(1+\varepsilon_t) - \pi_t + \log c_t^* - \log c_{t-1}^*\end{aligned} \quad (14)$$

If devalorization rate is constant, ε^H, then the consumption of exportable goods is constant and we obtain consumption equilibrium, inflation equilibrium and exchange rate equilibrium.

$$c^* = y^* + rf_{-1} \quad (15)$$

$$c = \bar{y}, \quad (16)$$

$$\pi = \varepsilon^H. \quad (17)$$

$$e = \frac{1-q}{q}\frac{\bar{y}}{(y^* + rf_{-1})}. \quad (18)$$

In our model inflation, consumption and exports depend essentially on discount factor δ^f.

4. STUDY CASE: INFLATION PERSISTANCE IN ROMANIA AND HIS DETERMINANTS

To analyze inflation persistence in Romania we use monthly data from 1990 to 2009.

We consider the central bank utility function:

$$Z = -0.5\pi^2 - 0.5b(y - Y - k)^2, b, k > 0,$$

where b>0 is the importance of targeting output.

Output evolution is described by a Phillips curve:

$$y = Y + a(\pi - \pi^e) + \varepsilon \qquad a > 0 \qquad (19)$$

Where ε represent a supply shock that follow a Gaussian law:

$$\varepsilon_t = c\varepsilon_{t-1} + \eta \qquad \eta \sim N(0, (1-c^2)\sigma^2 I) \quad (20)$$

If c > 0 will be a parameter that indicates supply shocks autocorrelation coefficient, then inflation persistence is done by the correlation coefficient:

$$corr(\pi_t, \pi_{t-1}) = c / \left[c^2 + (1 + a^2 b)^{-2}(1 - c^2)\right] \quad (21)$$

If the correlation coefficient is positive and closer to 1, then there is strong inflation persistence in economy. If this value is closer to 0 or small negative we don't found a persistence of inflation in analyzed economy.

In Romanian economy analysis we consider as supply shock the real wage increasing in considered periods.

Estimating function estimators a and c we obtained: a = 0,347 and c = -0,258. For different values of parameter b the correlation coefficient is negative and relatively closer to 0.

That indicates for Romanian economy there is not a strong persistence in inflation for analyzed periods.

Inflation determinants in Romania

In this section we estimate inflation rate starting on inflation rate structural equation (8) that describe nonexportable goods price rate, and we introduce also in this equation the exchange rate and consumption influence on inflation rate.

So, inflation rate equation (in logarithmic expression) is:

$$\pi_t = \alpha_0 + (1-\delta^f)\pi_{t-1} + \delta^f \pi_{t+1} + \alpha_1 \cdot e_t + \alpha_2 \cdot c_t \quad (19)$$

were: e_t represents real exchange rate and c_t represents consumption rate (in logarithmic expression).

Our dataset is represented by time series for inflation rate, expected inflation rate, exchange rate (LEU/ USD and LEU/EUR), and consumption rate for 1990-2009 periods, monthly data.

We have two different equations that estimate inflation rate equation: first one without expected inflation influence and the second one that include expected inflation influence.

So, if we consider the equation without expected inflation influence, we obtained:

$$\pi_t = 0{,}707 + 0{,}964\pi_{t-1} - 0{,}105E_t - 0{,}72C_t \quad (20)$$

for LEU/EUR exchange rate influence

and

$$\pi_t = 0{,}68 + 0{,}977\pi_{t-1} + 0{,}133E_t - 0{,}655C_t \quad (21)$$

for LEU/USD exchange rate influence.

The most important influence on inflation rate dynamics were previous inflation in both variants. Since consumption contributes negatively on inflation persistence, exchange rate influences positively inflation in LEU/USD case and negatively in LEU/EUR case (that depend on EUR/USD variation in analyzed period). The result varies if we include in our model also expected inflation, based on National Bank estimations for every study year.

The model which includes expected inflation is:

$$\pi_t = \alpha_0 + (1-\delta^f)\pi_{t-1} + \delta^f \pi_{t+1} + \alpha_1 E_t + \alpha_2 C_t \quad (22)$$

Estimating equation (22) parameters we obtained:

$$\pi_t = -0{,}231 + 0{,}329\pi_{t-1} + 0{,}671\pi_{t+1} + 0{,}835E_t - 1{,}7 \cdot C_t$$

for LEU/USD exchange rate influence,

and

$$\pi_t = 0{,}112 + 0{,}387\pi_{t-1} + 0{,}673\pi_{t+1} + 1{,}023E_t - 1{,}961C_t$$

for LEU/EUR exchange rate influence.

In this case we can observe that consumption still remain with a negative contribution on inflation dynamics (due especially on particular Romanian situation, where inflation rate decrease and consumption increase on studied period) but into the both equation exchange rate influence positively inflation rate, as we expected.

The main contribution on inflation dynamics are from by expected inflation not from sticky inflation. As we can observe, the exchange rate influence positively inflation rate, so in Romania the decreasing inflationary processes was strongly sustained by exchange rate appreciation in studied period.

5. CONCLUSIONS

Our main goals in this paper were to analyze in inflationary process was a persistent one in Romania and also to observe the main determinants on inflation in Romania in 1990-2009 period. To achieve first objective we use a model that determine inflation persistence by intermediary on a correlation coefficient. This correlation coefficient depends essentially on autocorrelation of supply shocks. For Romania, this coefficient is a small and negative one, so the main conclusion is that in Romania inflation process was not a persistent one, between current inflation and previous one there are a negative and week relationship.

Secondly, we use an econometric model to found the main determinants of inflation in Romania for the same period.

We use two types of econometric models that include only sticky inflation into the first one and the sticky inflation and expected inflation into the second one.

Also, as main determinants for inflation rate we considered exchange rate and consumption dynamics.

First model indicates that a negative relationship between inflation rate and consumption (unexpected relationship, but in Romania the consumption level increase last years and inflation rate decrease on studied period). Also, the main influence on current inflation rate was form previous inflation rate and a relatively small influence from exchange rate (positively for LEU/USD exchange rate and negatively for LEU/EUR exchange rate).

The second model that includes the expected inflation shows a different influence.

In this case the exchange rate was a determinant influence on inflation dynamics, but also the expected inflation are positively and strong correlated with current inflation rate. From the both models, consumption was negatively correlated with inflation rate that are not in concordance with theoretical approach.

So, we can consider as main determinants in Romanian inflation evolution: inflation expectations and exchange rate evolution. Regarding consumption, this variable influence negatively inflation rate, but this depend especially on particular condition of Romanian economy.

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NEW CONCEPT OF MILITARY LEADERS' EDUCATION

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Abstract: *The paper deals with the proposal of a new concept of professional competencies which military leaders need to successfully face new challenges of military service at the beginning of the 21st century. Competent and motivated military leaders will represent the most valuable part of the armed forces in the future. These demands on their university education and professional training will keep rising following the trends in the military field. This envisaged new concept of competencies, introduced by military experts and teachers of the University of Defence of the Czech Republic, is to correspond with the new trends in the emerging European educational area.*

Keywords: *military leader, professional competencies, university education, professional training, European educational area*

INTRODUCTION

The authors of this article would like to specify and determine the important attributes of graduates of military tertiary education. They would like to simply answer the question: What would the graduate of a military tertiary school be like? In a more detailed view, the authors have researched the basic job requirements of these graduates as newcomers to a military organization. The next question is what the possible ways to meet the quality requirements on these military professionals are. The authors have no ambition to cover all aspects of military tertiary education, and the complex preparation of newcomers for military profession, in this article.

1. ESSENTIAL REQUIREMENTS

The Essential requirements express the complexity of the military commander's personality. One's personality can be perceived as a set of qualities that make a person distinct from another one. The individual complex of biological, psychological and social traits of every individual must be taken in account. The personality is built via relations with the environment and society. Within such a framework we can perceive a professional as a personality with certain pronounced traits. In common sense we perceive a professional as an individual who does for money what others do for their enjoyment. From a more detailed point of view a professional is an individual who is qualified for a certain profession thanks to appropriate education, professional training and who, if possible, is equipped with some expert experience. If we want to deal with the term of a military professional we shouldn't expect generally anything else than we do when dealing with the terms of other professions.

We can be in dispute as far as the term "Military professional" is concerned. From a certain point of view, every serviceman of the fully professional armed forces, like the Army of the Czech Republic and the other armies worldwide certainly are, could be considered a military professional.

But we shouldn't rate everybody who is paid for his service as a military professional. The signature on a professional contract does not automatically make anybody a military

professional. We are looking for something more, we are looking for some higher quality and deeper understanding of what the term military professional means. We need to find something like an inward mission, a conscious process through which the individual must unceasingly follow the contemporary trends in the branch in an effort to cope with them and at the same time he must possess a strong ambition to influence them.

2. COMPLEX VIEW OF THE MILITARY SERVICEMAN PERSONALITY

One's personality is to be perceived always as an organic whole with all its strengths and weaknesses. The military professional should always be a balanced personality which must possess all of the following traits:

- Professional knowledge - appropriate to the service position, function and particular assignments;
- Skills, proficiency, special habits and experience - needed for performing the assigned function;
- Mental endurance - sufficient to combat and operational stressors;
- Physical fitness and readiness - needed for participation in combat activities;
- Moral and ethical traits - necessary to respect international law, rules of engagement and the other rules of conducting armed conflicts.

All the mentioned attributes of the military serviceman affect each other. It is evident that the physically capable soldier is usually in good mental shape and resilient because he/she is aware of his/her fitness which is a necessary condition for his/her success on the battlefield. The rule is valid vice versa as well.

A very important requirement on the education of the military professional is a high level of moral qualities which is needed not only for the reasons introduced above but for every single military professional – a graduate of the military tertiary education must meet requirements of a military leader.

3. MILITARY EDUCATION IN THE CZECH REPUBLIC

According to the Czech Act on Higher Education Institutions**,** the University of Defence as a higher education institution represents the highest level of the military educational system. As a higher educational institution it represents the highest level of the educational system in the field of responsibility of the Ministry of Defence. The University with its faculties and institutes is regarded as the top centre of education, independent research and creative activities in the field of security and defence. As a higher educational institution it plays the key role in scholastic, cultural, social and economic development of the Czech armed forces.

Among the other activities the University of Defence provides university education in the following accredited degree programmes:

- Bachelor's degrees programme;
- Follow-up Master's degrees programmes;
- PhD (doctoral) degrees programmes.

The bachelor study programme is aimed at providing the student with the necessary qualification to enter a profession making use of all contemporary knowledge and methods; this programme also includes the essential theoretical background.

The master study programmes are aimed at familiarizing the student with the latest theoretical findings based on current scientific knowledge, research and development. It is required to master the application of these findings and develop abilities for creative activity.

The doctoral study programmes are aimed at scientific research and independent creative activity in the field of research and development, or independent theoretical and creative activity.

The fact, that the level of preparedness of military personnel is the basic prerequisite for combat readiness needs to be taken into account during the whole course of the accredited study at the military higher

educational institution, is obvious.

Furthermore in this process we cannot ignore the fact that the Army of the Czech Republic must by ready to fulfil the new tasks resulting from the membership in the Alliance and other political commitments. From the inside point of view the educational processes must work according to the new rules of military educational system transformation. These new rules come with a new vision of the Czech Army transformation anchored in new conceptual documents of transformation of the Army of the Czech Republic.

The Faculty of Economy and Management plays the main role in providing university education to new military commanders and other military professionals at the University of Defence The primary mission of the faculty is to provide university education to military professionals as qualified experts, educated in military science and specially trained for military service.

In accordance with legislative in force and considering the anticipated time limitations of the military service, the students are also prepared for a „second career“after finishing their military service.

The accredited programmes provide students with standard education. Graduation from the Faculty guarantees the university education comparable with those provided by military and civilian universities abroad.

4. FACULTY OF ECONOMY AND MANAGEMENT OF THE UNIVERSITY OF DEFENCE

The Faculty of Economy and Management is a holder and guarantor of accredited academic programme in which the military professionals – future military officers are educated. Within the course of studies at the faculty the military training is provided to military students. This complex preparation is focused on building the complex graduate capabilities to practice all the commander, manager and economic positions at the organizational structures of the Army of the Czech Republic. The basic part of this training is conducted at the Military Training and Doctrine HQ, Vyškov, and takes two months in the summer before the academic lessons start. At the end of the first and second grades of the academic programme the application courses are organized. Namely those are the Basic Sergeant Course (the level of squad commander) after the first grade and the Warrant Officer Course (the level of platoon commander) after the second academic grade. After graduating from the bachelor programme the graduates pass the Specialist Application Course where they are prepared for practice in the tangible planned service position.

The system of military officers preparation is based on the idea of two-cycle approach to the university education, namely pre-graduate and graduate The first cycle is connected with bachelor level and the second cycle is open for successful graduates usually after passing two or three years of military practice at military units. The graduate of the bachelor programme can apply for the same or similar master programme

5. FACULTY ACADEMIC PROGRAMME

The Academic programme of Economics and Management is a generally recognized and accepted university programme of a broad academic scope and focus. The bachelor’s degree programme qualifies students to cope with the managerial processes on the knowledge platform especially in branches such as management, economics, law, mathematics, statistics and informatics. The wide scope of social sciences contributes to the necessary basis of the students’ personality development reaching from creative approaches to the application of theoretical and practical knowledge learnt from research. This part of the study programme forms the baseline for students to qualify them for further masters or doctoral degrees which the graduates may utilize for their professional careers within the military structures as well as in the civilian sector.

The programme structure consists of study branches that are projected mainly according to the requirements of the MoD into specific modules.

The programme syllabi simultaneously develop adequate studies oriented on military branches which form conditions for mastering the wide scale of significant knowledge necessary for a contemporary military professional and career officer in the Czech Army. Studies of such a focus respond to the request of career permeability within the dynamically developing military structures.

With regards to the requirements on the professional army the faculty guarantees standardized language training in two world languages and at the same time the students achieve the necessary physical condition in the above mentioned study programmes.

In the Military Management study branch, the bachelor's study programme focuses on management as a whole paying specific attention to its special partial issues that reflect the requirements of the military department and wider security community. Along with learning theoretical knowledge of the military system, management students develop their knowledge and skills in the procedural management.

In the main features, the students' basic skills are formed together with acquiring theoretical knowledge necessary for military command or other positions in army units and while fulfilling the goals of the Czech Republic commitments resulting from our membership in the EU and NATO.

The study of military management is divided into the following study modules:

- Mechanised and Tank Units Commander,
- Reconnaissance Units Commander,
- Artillery Units Commander,
- Engineer Units Commander.

The bachelor's degree study in the State Defence Economics branch focuses on the fields of economics and resource management as a whole, but also on their parts as requested by the Ministry of Defence and other entities active in the sphere of defence and security. Within the study programme the goal is to handle all the economic, financial, material, personnel, organisational, information and management factors of the processes occurring in the units and departmental organizations as well as their inter-relations with the public administration.

Together with gaining theoretical knowledge from the area of creating, allocating and utilising resources to meet the needs of the Army of the Czech Republic within peace and combat operations, the study concentrates on developing skills that are necessary for both managers and executives.

The state defence economy topics are taught in general and at the application level in study modules:

- Logistics,
- Military Transport Economics,
- Logistic Services,
- Human Resources Management
- Quality Management,
- Population Protection.

The Faculty carries out and develops the education of experts in the Economics and Management follow-up master's degree programme. In this programme the graduate receives the general academic and military-oriented education being thus qualified for middle management positions within the defence department, possibly in organizations involved in ensuring state security. Upon conclusion of the study they graduate in the branch of Military Management or National Defence Economics and they are awarded the academic title Engineer (Ing.)

The branches of study continue and enhance the knowledge learnt at the bachelor's level in study modules that are equal to bachelor's degree programme modules. In the Military Management branch in the follow-up master's degree programme the study module Management of Information Sources appears as an addition. The sequence of the Mechanized and Tank Units Commander bachelor's study module is guaranteed in the master's degree by the Combined-Arms Commander module.

Doctoral degree programmes are considered the natural baseline of independent creative research activities. The doctoral degree studies development is based on the

utilisation of all research sources and capacities outside the faculty as well, mainly in military research institutes and partnership educational and research institutions.

New researchers are trained in the Military Management and State Defence Economics study branches of the accredited Economics and Management doctoral degree programme. The answer to the question of what the graduate of the Faculty should be like is to be defined by the so called Graduate Profile. This is the tangible platform for planning the future traits of the faculty graduates. The Profile itself has undergone a gradual development based on the expert discussions among the scholars and the „employers"- the potential supervising commanders of the faculty graduates. The gradual changes in both the content and structure have been incorporated into the profile.

The original profile had determined generally academic and military oriented education requirements focused on abilities needed for practicing positions on the middle level of management all over the area of responsibility of the Ministry of Defence. The tangible requirements were structured into Groups, namely what the graduate is supposed to know, be able to and be informed about.

6. Dublin Descriptors

Within the framework of Bologna process many initiatives have appeared bringing experts to cooperate on creating the compatible tertiary education accepted all over the Europe. The *Joint Quality Initiative* (*JQI*) could be presented as one remarkable initiative among them. Members of this initiative represent agencies for quality assessment from 12 European countries and their ambition is to ensure the high quality of tertiary education within the spirit of Bologna Declaration. At the beginning it was clear that the international comparability of national systems of tertiary education would require generally shared standards. At one of the first meetings of JQI in Dublin (Ireland) generally accepted standards for bachelors and masters cycles of education have been introduced.

These attributes have been structured into five categories of education achievements in individual educational cycles:

- knowledge and understanding,
- applying knowledge and understanding,
- making judgments,
- communication,
- learning skills.

There has been an eligible definition of differences in the individual cycles of education. It is obvious that the Descriptors give a true picture of general differences between bachelor and master level of education. Keeping the intention of achieving the compatibility of national educational systems, many countries introduced the descriptors into the course of quality assessment of tertiary education.

At the two meetings of JQI, in March and October 2004, the descriptors have been extended to those of doctoral level of education.

As a result, the general descriptions are the same in all five cycles but the requirements differ according to respective levels and they are going up.

Next follows an example of one of the profile contents used at the faculty for graduates of Military management programme branch at the bachelors' level.

6.1. General Traits

The graduates of the bachelor study programme, studying theoretical subjects of the Programme of Economics and management and special subjects will be provided with rudimentary knowledge of social sciences professionally oriented on management in the field of military practice and state administration. The final knowledge and skills enable them successful practice on the basic and middle management level. Apart from that they will be able of successful transition into the second civilian career after finishing their military service. Passing the study branch of Military Management the

graduates gain following professional knowledge, skills and competencies.

6.2. Professional knowledge

The graduates of the study branch of Military Management will gain the knowledge enabling them understanding the theories, concepts and methods of modern management efficient in the specific military service environment. They will be able to practically apply the gathered knowledge in the state administration with a focus on special management of the armed forces The professional knowledge will enable their assignment at the basic and middle level of commanding and specialized professional positions all over the department competencies of the Ministry of Defence.

6.3. Professional Skills

The graduates will be able to make use of their specialized professional knowledge and skills in conducting managerial assignments at the level of basic and middle management. Apart from that they will be able to utilize supporting tools of managerial decision making, make use of innovative methods and approaches to solving difficult and unpredictable problems connected with conducting duties of their commander or specialized professional functions.

6.4. General eligibility

The graduates will be able to make use of their professional knowledge and skills and apply them properly in every single managerial function. They will be able to independently and initiatively act at commanding positions of the basic and middle level. They will be competent to plan and organize various activities of their subordinate servicemen and to show creativity at fulfilling commanding and controlling tasks. . They will have the capabilities to asses the outcomes of military training and general preparation of their units for fulfilling the operational tasks. They will be able to independently access achievement of their own and their subordinate servicemen training. Apart from that they will be able to identify further educational and training needs of forthcomings demands. They will be able to utilize a variety of modern information and communication devices and procedures and other tools supporting commander's and managerial decision making.

CONCLUSION

No school at any level can prepare its students and graduates for real life in a total scale. Different admonition and reservation from military headquarters addressed to imperfect preparedness of the graduates of the University of Defence are logical consequences of the above statement. Varieties of real life are so extensive that the period spent at school must be considered just as a mere beginning of the lifelong process of learning. The graduates of University of Defence cannot match the experienced servicemen who passed several missions abroad. At the same time the awareness of these conditions has to be a motivational factor for everybody involved in the educational and training processes.

Nowadays the University of Defence finds itself at a crucial point in decision making about the future of military educational and training systems.

Currently at the Faculty of Economics and Management we undergo the process of re-accreditation which should come to power in 2011. This is the opportunity both to make use of everything good from the past and to launch all the above described innovative changes and novel methods and procedures introduced by the emerging European educational area. This is the chance to reflect the novel methods and procedures applied in the armed forces, changing role of the military in democratic societies and increasing technological intensity.

That is the reason why we would like to build a space for sharing experience among academic staff of military schools in the European educational area. We believe that together we will be able to support our

students on their way to solid preparedness for real military life.

The prevailing trend of downsizing military personnel in most European countries is a good reason for sharing information and experience concerned with system of preparation of new military officers. These days there is an opportunity to prepare the military officer who will - as an educated military professional - be able to make impression on his/her subordinates, to have solid capability to cope with military information processes and to make use of this in orientation in difficult situations and while solving problems. There is no dispute that we have to prepare the competent commander who is able to bring the reasoned standpoint and enforce his/her own decision; to fulfil assigned task with the committed unit. Thus we are looking for ways how to prepare a self-confident, mentally resilient, versatile and communicative military professional.

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THE PROXIMAL POINT ALGORITHM

ON HADAMARD MANIFOLDS

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Abstract: *In this paper we extend the maximal monotonicity notion in Banach space to Hadamard manifolds.We consider the problem of finding a singularity of a multivalued vector field in a Hadamard manifold and present a general proximal point algorithm to solve that problem, which extends the known proximal point algorithm in Euclidean spaces.We used a result which prove that the sequence generated by this method is well defined and converges to a singularity of a maximal monotone vector fields, to prove that the sequence converges to a solution of a variational inequality.*

Keywords: Hadamard manifold, proximal point algorithm, maximal monotone operator, monotone vector fields.

MSC2010 : 47J20; 47J25; 58C30.

1. INTRODUCTION

The theory of variational inequalities is used in many fields of mathematics and physics.Among these we point out the optimization problems, the boundary value problems of PDEs, etc.The restrictions which appear in physical phenomena lead to many Boundary Value Problems on manifolds.These problems are solved by using variational inequalities on Riemannian manifolds. Section 2 contain some basic facts on Hadamard manifolds. We follow the iteration scheme of Rockafellar on Hilbert spaces to define the following proximal point algorithm.Given $x_0 \in M$ a Hadamard manifold and $\{\lambda_n\} \subset (0, 1)$, define x_{n+1} such that

$$0 \in A(x_{n+1}) - \lambda_n \exp_{x_{n+1}}^{-1} x_n, \quad n=0, 1,2,\ldots, \qquad (1)$$

Where A is a maximal monotone vector field and exp is the exponential map. In Section 3, we shall introduce the variational inequalities on Hadamard manifolds.

2. PRELIMINARIES

In this section, we introduce some fundamental definitions, properties and notation that are essential for our study.

Let M be a complete and connected m-dimensional manifold. Let $p \in M$. The tangent space of *M* at p is denoted by $T_p M$ and the tangent bundle of M by $TM = \bigcup_{p \in M} T_p M$, which is a manifold. Given a piecewise smooth curve $\gamma:[a, b] \to M$ such that , $\gamma(a)=p$ and $\gamma(b) = q$. A vector field X is said to be *parallel along* γ if $\nabla_{\gamma'} X = 0$. If γ' itself is parallel along γ, then we say that γ is a *geodesic.*

Assuming that M is complete, the *exponential map* $\exp_p : T_p M \to M$ at $p \in M$ is defined by $\exp_p v = \gamma_v(1, x)$, where $\gamma(.) = \gamma_v(., p)$ is the geodesic starting at p with velocity v. A complete, simply connected Riemannian manifold of nonpositive sectional curvature is called a *Hadamard manifold.*

In this paper, we will always assume that M is an m-dimensional Hadamard manifold.

Let X(M) denote the set of all multivalued vector fields $A:M\to 2^{TM}$ such that $A(x)\subseteq T_x M$ for each $x\in M$ and the domain D(A) of A is closed and convex, where the domain D(A) of A is defined by

$$D(A) = \{x\in M : A(x)\neq \emptyset\}.$$

Definition 1. Let $A\in X(M)$. Then A is said to be *monotone* if the following condition holds for any $x, y\in D(A)$

$$\langle\ u,\ \exp_x^{-1} y\ \rangle \le \langle\ v,\ -\ \exp_y^{-1} x\ \rangle \quad \forall\, x\in A(u)$$

and $\forall\, y\in A(v)$.

Definition 2. Let $A\in X(M)$ and $x_0\in D(A)$. Then A is said to be *upper Kuratowski semicontinuous* at x_0 if, for any sequences $\{x_k\}\subseteq D(A)$ and $\{u_k\}\subset TM$ with each $u_k\in A(x_k)$, the relations $\lim_{k\to\infty} x_k = x_0$ and $\lim_{k\to\infty} u_k = u_0$ imply that $u_0\in A(x_0)$.

Let $A\in X(M)$ a multivalued vector field with closed and convex domain D(A). We say that $x\in D(A)$ is a *singularity* of A if $0\in A(x)$. The set of all singularities of A is denoted by $A^{-1}(0)$, that is,

$$A^{-1}(0) = \{x\in D(A) : 0\in A(x)\}.$$

Proposition 3 ([2]). *Let X be a finite-dimensional space and $T:X\to 2^X$ be an upper semicontinuous multivalued operator. Suppose that $D(T) = X$ and that T satisfies the following coercivity condition:*

$$\lim_{\|z\|\to\infty} \frac{\langle w, z\rangle}{\|z\|} = +\infty \quad \forall\ w\in T(z)$$

Then there exists $x\in X$ such that $0\in T(x)$.

Theorem 4 ([4]). *Let $A\in X(M)$ be a maximal, strongly monotone vector field with the domain $D(A)=M$. Then there exists a unique singularity of A.*

Theorem 5 ([4]). *Let $A\in X(M)$ be such that $A^{-1}(0)\neq\emptyset$. Suppose that A is monotone and upper Kuratowski semicontinuous. Let $\{\lambda_n\}\subset (0, 1)$ satisfy*

$$\sup\{\lambda_n : n\ge 0\} < \infty. \qquad (2)$$

Let $x_0\in D(A)$ and suppose that the sequence $\{x_n\}$ generated by the algorithm (1) is well defined. Then $\{x_n\}$ converges to a singularity of A.

3. VARIATIONAL INEQUALITIES

Let K be a convex subset of M and $V:K\to TM$ a univalued vector field, that is, $V(x)\in T_x M$ for each $x\in K$.Following [2], the problem of finding $x\in K$ such that

$$\langle\ V(x), \exp_x^{-1} y\ \rangle \ge 0 \quad \forall\, y\in K \qquad (3)$$

is called a *variational inequality* on K.A point $x\in K$ satisfying (3) is called a solution of the variational inequality (3).We deduce that a point $x\in K$ is a solution of the variational inequality (3) if and only if x satisfies

$$0\in V(x)+N_K(x),$$

that is, the point x is a singularity of the multivalued vector field $A=V+N_K$ Applying the algorithm (1) to A, we obtain the following proximal point algorithm with initial point x_0 for finding solutions of the variational inequality (3)

$$0\in V(x_{n+1})+N_K(x_{n+1})-\lambda_n \exp_{x_{n+1}}^{-1} x_n \quad \forall\, n\ge 0. \qquad (4)$$

We study the convergence of the algorithm above. To apply Theorem 5, one needs to prove that the algorithm is well defined.For this purpose and for the sake of completeness, we first include some lemmas.

Proposition 6 ([4]). *Let K be a convex compact subset of M. Then there exists a totally geodesic submanifold $N\subseteq K$ such that $K = N$, the closure of N, and the following condition holds: for any $q\in K\backslash N$ and $p\in N$, we have $\exp_p t(\exp_p^{-1} q)\in N$ for all $t\in(0, 1)$ and $\exp_p t(\exp_p^{-1} q)\notin K$ for any $t\in (1,+\infty)$.*

Lemma 7 ([2]). *Let K be a convex compact subset of M and let $p_0\in \mathrm{int}K$. Then*

$$\exp_{p_0}^{-1}(\mathrm{bd}K) = \mathrm{bd}(\exp_{p_0}^{-1} K) \text{ and}$$

$\exp_{p_0}^{-1}(\text{intK})=\text{int}(\exp_{p_0}^{-1}\text{K})$

where intK is called the interior of K and bdK the boundary of K.

Lemma 8 ([4]). *Let K be a compact convex subset of M. Let $F : K \to K$ be a continuous map. Then F has a fixed point in K.*

Theorem 9. *Let K be a closed convex subset of M and $V : K \to TM$ a univalued continuous monotone vector field. Let $x_0 \in K$ and $\{\lambda_n\} \in (0, 1)$ satisfy* (2). *Suppose that the variational inequality* (3) *has a solution. Then the sequence $\{x_n\}$ generated by the algorithm* (4) *is well defined and converges to a solution of the variational inequality* (3).

Proof. By Theorem 5, we only need to prove that the sequence $\{x_n\}$ generated by the algorithm (4) is well defined. Let $\lambda > 0$ and $y_0 \in K$. Consider the following variational inequality:

$$\left\langle V(x)-\lambda\exp_x^{-1} y_0, \exp_x^{-1} y \right\rangle \geq 0 \quad \forall y \in K. \quad (5)$$

For fixed n, note that x_{n+1} satisfies (4) if and only if x_{n+1} is a solution of the variational inequality (5) with $\lambda = \lambda_n$ and $y_0 = x_n$. Thus, it suffices to prove that the variational inequality (5) has a solution. Let $R > 0$ be such that $\|V(y_0)\| - 2R\lambda < 0$ and set

$$K_R = \{x \in K : d(x, y_0) \leq R\}.$$

Then K_R is a compact convex subset of *M*. Let $P_{K_R} : M \to K_R$ be the projection to K_R. Then, by [5], the projection P_{K_R} is Lipschitz continuous and characterized by

$$\left\langle \exp_{P_{K_R}x}^{-1} x, \exp_{P_{K_R}x}^{-1} y \right\rangle \leq 0 \quad \forall\ x \in M, y \in K_R.$$

Consider the continuous map $F: K_R \to K_R$ defined by

$$F(x)=P_{K_R}(\exp_x(-V(x) + \lambda\exp_x^{-1} y_0) \quad \forall\ x \in K_R$$

By Lemma 8, the map *F* has a fixed point x_R. This implies that

$$\left\langle V(x_R)-\lambda\exp_{x_R}^{-1} y_0, \exp_{x_R}^{-1} y \right\rangle \geq 0 \qquad (6)$$

holds for any $y \in K_R$. Since

$$\left\langle V(x), \exp_x^{-1} y_0 \right\rangle \leq \left\langle V(y_0), \exp_{y_0}^{-1} x \right\rangle$$

by monotonicity and

$$\left\langle \exp_x^{-1} y_0, \exp_x^{-1} y_0 \right\rangle = \left\langle \exp_{y_0}^{-1} x, \exp_{y_0}^{-1} x \right\rangle = d(x, y_0)^2$$

, it follows that, if $d(x, y_0) = R$, then

$$\left\langle V(x)-\lambda\exp_x^{-1} y_0, \exp_x^{-1} y_0 \right\rangle \leq$$
$$\leq \left\langle V(y_0)-\lambda\exp_{y_0}^{-1} x \right\rangle - 2\lambda d(x, y_0)^2$$
$$\leq (\|V(y_0)\| - 2R\lambda)R < 0.$$

This means that $d(x_R, y_0) < R$. We shall now show that (6) holds for any $y \in K$ and this will complete the proof. Indeed, given $y \in K$ and $y_t = \exp_{x_R} t(\exp_{x_R}^{-1} y) \in K_R$ for $t>0$ sufficiently small. Consequently,

$$t\left\langle V(x_R)-\lambda\exp_{x_R}^{-1} y_0, \exp_{x_R}^{-1} y \right\rangle =$$
$$= \left\langle V(x_R)-\lambda\exp_{x_R}^{-1} y_0, \exp_{x_R}^{-1} y_t \right\rangle \geq 0.$$

Thus, we conclude that (6) holds for $y \in K$.

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A PROBABILISTIC INTERPRETATION OF A MIXED SEQUENCE OF SUMMATION- INTEGRAL TYPE OPERATORS

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Abstract. *In this paper we presented a probabilistic interpretation of a mixed sequence of summation – integral type operators, namely Szasz – Inverse Beta operators.*

Key words. *Durrmeyer-Szasz operators, Inverse – Beta operators, Szasz-Inverse Beta operators Poisson process, Gamma process.*

MSC2000. 41A35, 41A36

1. INTRODUCTION

It is know that, the classical Szasz-Mirakjan's operators which are defined as :

$$S_t(f;x)=\sum_{k=0}^{\infty}s_{t,k}(x)f\left(\frac{k}{t}\right) \tag{1}$$

with

$$s_{t,k}(x)=e^{-tk}\frac{(tx)^k}{k!},\quad t>0,x\geq 0,k\in N\cup\{0\} \tag{2}$$

can be represented as the mathematical expectation or the mean value of the random variable $f\left(\frac{Y_{t\,x}}{t}\right)$, $t>0$, $x\geq 0$, where the random variable $Y_{t\,x}$ has the Poisson distribution and take the value k with probability $s_{t,k}(x)$ defined with (2). So,

$$S_t(f;x)=E\left[f\left(\frac{X_{tx}}{t}\right)\right],t>0,x\geq 0 \tag{3}$$

are well defined , if f is a real measurable function on $[0,+\infty)$ such that $E\left[\left|f\left(\frac{X_{t\,x}}{t}\right)\right|\right]<\infty$, for each $t>0$.

These operators preserving the affine functions because

$$\begin{aligned}&S_t(e_0;x)=e_0(x)=1,\\&S_t(e_1;x)=e_1(x)=x,\text{and}\\&S_t(e_2;x)=x^2+\frac{x}{t},\ x\geq 0,\ t>0\end{aligned} \tag{4}$$

Other well know operators are the Inverse - Beta operators or the Stancu's operators of second kind [11] defined as

$$\begin{cases}T_t(f;x)=\dfrac{1}{B(tx,t+1)}\displaystyle\int_0^{\infty}\frac{u^{tx-1}}{(1+u)^{tx+t+1}}f(u)du\\ T_t(f;0)=f(0),\end{cases}$$

$$\begin{cases}T_t(f;x)=\displaystyle\int_0^{\infty}f(u)b_{tx,t+1}(u)du,\ t>0,x>0\\ T_t(f;0)=f(0),\end{cases} \tag{5}$$

with

$$B(tx,t+1)=\int_0^{\infty}\frac{u^{tx-1}}{(1+u)^{tx+t+1}}f(u)du \tag{6}$$

the Inverse – Beta function.

This operator can be also probabilistic represented, as the mean value of the random variable $f\left(W_{t\,x,\,t+1}\right)$, where $W_{t\,x,\,t+1}$ has the Inverse – Beta distribution with density probability function

$$b_{tx,t+1}(u)=\frac{1}{B(tx,t+1)}\cdot\frac{u^{tx-1}}{(1+u)^{tx+t+1}},\quad t>0,\ x>0,\ u>0 \tag{7}$$

So,

$$\begin{cases}T_t(f;x)=E\left[f\left(W_{tx,t+1}\right)\right],\ t>0,\ x>0\\ T_t(f;0)=f(0)\end{cases} \tag{8}$$

under the condition that, f is a measurable function on $[0,+\infty)$ such that $E\left[\left|f\left(W_{t\,x,\,t+1}\right)\right|\right]<\infty,$ for $t>0,\ x>0.$

But from [9.IV.10.(3)] if, we consider two independent random variables $U_{t\,x}$, V_{t+1} having Gamma distribution with density

$$d_{\alpha}(u)=\begin{cases}\dfrac{u^{\alpha-1}e^{-u}}{\Gamma(\alpha)}, & \alpha>0,\ u>0\\ 0, & u\le 0\end{cases} \qquad (9)$$

for $\alpha=tx$ respectively $\alpha=t+1$, then the density probability function of the ratio $\dfrac{U_{t\,x}}{V_{t+1}}$ is $b_{t\,x,t+1}(u)=\int y\,d_{U_{tx}}(uy)d_{V_{t+1}}(y)dy$ defined as (7).

So,

$$\begin{cases}T_t(f;x)=E\left[f\left(W_{t\,x,t+1}\right)\right]=E\left[f\left(\dfrac{U_{t\,x}}{V_{t+1}}\right)\right], \\ \qquad\qquad t>0,\ x>0\\ T_t(f;0)=f(0)\end{cases} \qquad (10)$$

The Inverse- Beta operators (5) preserve the affine functions on $[0,+\infty)$

$$\begin{cases}T_t(e_0;x)=e_0(x)=1,\\ T_t(e_1;x)=e_1(x)=x,\ \text{and}\\ T_t(e_2;x)=x^2+\dfrac{x(x+1)}{t-1},\ t>1\end{cases} \qquad (11)$$

A variant of these operators which not preserve the affine functions was investigated with the monotonic convergence under convexity and with the preservation of Lipschitz constants by Adell J. A., De la Cal J., Miguel S. M., [1].

Recently, Gupta V., Noor M. A., [5] considered the following operators:

$$L_t(f;x)=$$

$$=e^{-t\,x}f(0)+\sum_{k=1}^{\infty}s_{t,k}(x)\int_0^{\infty}b_{t,k}(u)f(u)du= \qquad (12)$$

$$=\int_0^{\infty}J_t(u;x)f(u)du,\ x\ge 0$$

with $s_{t,k}(x)$ as (2) and

$$b_{t,k}(u)=\frac{1}{B(k,t+1)}\cdot\frac{u^{k-1}}{(1+u)^{t+k+1}}, \qquad (13)$$

$$u>0,\ t>0$$

$B(k,t+1)$ beaing Inverse – Beta function as (6),

$$J_t(u;x)=e^{-t\,x}\delta(u)+\sum_{k=1}^{\infty}s_{t,k}(x)b_{t,k}(u) \qquad (14)$$

$\delta(u)$ being the Dirac's delta function, for which $\int_0^{\infty}\delta(u)f(u)de=f(0)$.

The iterative constructions of these operators were studied recently by Finta Z., Govil N. K., Gupta V. [3].

Also, starting from the Szasz-Mirakjan's operators, in a similar way with the construction of the Goodman and Sharma operators [4] starting from the Bernstein operators, Phillips R.S. [8] obtain modified of Szasz-Mirakjan operators and these were extended by Păltănea R. [7] using two continuous parameters.

As a matter of fact, all of these operators was defined for *t=n* positive integers but they remain valid when *t* is a continuous positive number but in the domain of these operators.

In the next section, we propose a probabilistic representation of the Szasz – Inverse Beta operators (12)-(14).

2. A PROBABILISTIC REPRESENTATION OF THE SZASZ – INVERSE BETA OPERATORS.

Using same ideea as Adell J. A., De la Cal J., [2], which gave an interesting probabilistic representation for the Durrmeyer – Szasz 's operators , which were defined by Mazhar S. M., Totik V. [6] as :

$$M_t(f'x)=\int_0^{\infty}H_t(u;x)f(u)du,\ x\ge 0,\ t>0$$

$$H_t(u;x)=t\sum_{k=1}^{\infty}s_{t,k}(x)s_{t,k}(u)$$

with $s_{t,k}(x)$ as in (2), in the sense that

$$M_t(f;x)=E\left[f\left(\frac{U_{N(tx)+1}}{t}\right)\right],\ t>0,\ x\geq 0,$$

is a mean value of a random variable , with $\{N(t):t\geq 0\}$ a standard Poisson process and $\{U_t:t\geq 0\}$ a Gamma standard process independent of the former, we have the following probabilistic representation for Szasz- Inverse Beta operators' .

Let $\{N(t):t\geq 0\}$ be a standard Poisson process and let $\{U_t:t\geq 0\}$, $\{V_t:t\geq 0\}$ be two mutually independent Gamma processes defined all on the same probability space.

Note that, the Poisson process is a stochastic process starting at the origin, having stationary independent increments with probability

$$P(N(t)=k)=\frac{e^{-t}t^k}{k!},\ t\geq 0,\ k\in N\cup\{0\}$$

and the Gamma process is a stochastic process starting at the origin $(U_0=0)$, having stationary independent increments and such that for $t>0$, U_t has the Gamma density probability function $d_t(u)$ as (9) and without loss of generality [10] it can assumed that $\{U_t:t\geq 0\}$, $\{V_t:t\geq 0\}$ for each $t>0$ has a.s. no decreasing right- continuous paths.

The Szasz – Inverse Beta operators (12) – (14) can be represented as the mean value :

$$L_t(f;x)=E\left[f(Z_{tx})\right]=$$

$$=E\left[f\left(\frac{U_{N(tx)}}{V_{t+1}}\right)\right],\ t>0,\ x\geq 0 \qquad (15)$$

where the random variable $\frac{U_{N(tx)}}{V_{t+1}}$ has the probability density function $J_t(\cdot\,;x)$ defined as (14).

Indeed,

$$E\left[f\left(\frac{U_{N(tx)}}{V_{t+1}}\right)\right]=\int_0^{+\infty}\left(f(u)\int_0^{+\infty}y\,d_{U_{N(tx)}}(y)\,d_{V_{t+1}}(y)dy\right)du=$$

$$=\int_0^{+\infty}f(u)\left(\int_0^{+\infty}y\sum_{k=0}^{+\infty}\frac{e^{-tx}(tx)^k}{k!}\,d_{U_k}(yu)\,d_{V_{t+1}}(y)dy\right)du=$$

$$=e^{-tx}f(0)+\sum_{k=1}^{\infty}s_{t,k}(x)\int_0^{\infty}f(u)\left(\int_0^{+\infty}\frac{y^{k+t}}{\Gamma(k)}\cdot\frac{u^{k-1}}{\Gamma(t+1)}e^{-y(u+t)}dy\right)du\underset{y(u+t)=v}{=}$$

$$=e^{-tx}f(0)+\sum_{k=1}^{\infty}s_{t,k}(x)\int_0^{\infty}f(u)\left(\int_0^{+\infty}\frac{\left(\frac{v}{u+1}\right)^{k+t}}{\Gamma(k)}\cdot\frac{u^{k-1}}{\Gamma(t+1)}e^{-v}\frac{dv}{u+1}\right)du=$$

$$=e^{-tx}f(0)+\sum_{k=1}^{\infty}s_{t,k}(x)\int_0^{\infty}f(u)\frac{b_{t,k}(u)}{\Gamma(k+t+1)}\left(\int_0^{+\infty}v^{k+1}e^{-t}dv\right)du=$$

$$=e^{-tx}f(0)+\sum_{k=1}^{\infty}s_{t,k}(x)\int_0^{\infty}f(u)b_{t,k}(u)du=L_t(f;x).$$

On the other hand, the Szasz- Inverse Beta operators can be represented as the composition of Szasz operators (1) – (2) and Inverse Beta operators (5) :

$$L_t(f;x) = (S_t \circ T_t)(f;x) = S_t(T_t)(f;x), \quad t > 0,\ x \geq 0 \tag{16}$$

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A SPECIAL CASE OF ROBBINS-MONROE ALGORITHM

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Abstract: *In the present paper, we show a particular case of the Robbins-Monroe algorithm, the case in which we not know all of the values of the random variable, which represent the values of a function perturbed by the noises.*

Key words: *Robins-Monroe algorithm, stochastic approximation.*
MSC2010: 62L20

It is known the problem of finding the unique root of function f:R→R, when, for any $x \in R$, it is unknown the exact value of f(x), but it is known one of the f(x) values with errors, that means instead of exact value of f(x) we have the value of a random variable $W(x) = f(x) + \varepsilon(x)$, where f(x) is the exact value of f(.) in x and $\varepsilon(x)$ is a random variable with average 0, that means $E[\varepsilon(x)] = 0$ ([1],[2],[3]). In this context, $\varepsilon(x)$ represents the noise or perturbation from the exact value of f in x. This phenomenon takes place in every x point from R, where f(.) function is defined. In this context, the Robbins-Monroe algorithm finds out the root of f(x)=0, which is supposed to be unique, noted with x^0, so we have $f(x^0)=0$. The difficulty of solving this problem is that the values of f(x) for every x are unknown. For finding the value of x^0 root, Robbins and Monroe supposed the next algorithm:

$$x_{n+1} = x_n + a_n * W(x_n) \qquad (1)$$

with the initial value x_0, which can be any real number, and $(a_n)_n$ is a string with real numbers and has the following properties:

$$a_n > 0, \sum_{n=1}^{\infty} a_n = +\infty, and \sum_{n=1}^{\infty} a_n^2 \neq +\infty \qquad (2)$$

the values of a_n numbers can be any just to fulfill the (2) conditions.

If f(.) function, the random variables W(x) and $(a_n)_n$ numbers fulfill certain conditions, then sequence with x_n give by (1), is convergent to x^0. Certainly, the Robbins-Monroe theorem([4]) has the next form:

Theorem 1. Let it be $f:R^m \to R^m$, so that exists an unique value of $x^0 \in R^m$, so that $f(x^0)=0$.
It is supposed that are taking place the following conditions:

(a) There exist the real sequences $(a_n)_n$ with the following conditions:

$a_n > 0$,

$\sum_{n=1}^{\infty} a_n = +\infty$, and $\sum_{n=1}^{\infty} a_n^2 \neq +\infty$

(b) There exists a continuously twice differentiable Lyapunov function v: $R^m \to R$ satisfying the following conditions:

(b1) Its second derivative is bounded

(b2) $v(x) \geq 0$,$\forall\ x \neq x^0$, $v(x^0)=0$, and $v(x) \to +\infty$, as $\|x\| \to +\infty$

(b3) For any $\varepsilon \geq 0$ there is a $\beta_\varepsilon \geq 0$ such that

(b4) $\text{Supp}\{ v_x^T(x)f(x) / \|x-x^0\| \geq 0 \} = -\beta_\varepsilon \leq 0$, where $v_x^T(x)$ is the gradient of v(.) .

(c) For any $x \in R^m$ we have $W(x)=f(x)+\varepsilon(x)$, and $E[\varepsilon(x)]=0$, and for any sequences

of the form:

$x_{n+1}=x_n+a_n \cdot W(x_n)$ exist a sequences $(F_k)_k$ where (x_k , F_k) is a adapted sequence (x_k is F_k – measurable for any k), and $W(x_n)=f(x_n)+ \varepsilon(x_n)$ and we have the property: $(\varepsilon(x_n),F_n)_n$ is a martingale difference sequence with

$E[\varepsilon(x_n) / F_{n-1}]=0$, and $E[\|x_n\|^2] \neq +\infty$, for any $n \in N$

(d) The function f(.) and the conditional second moment of the $\varepsilon(x_n)$ have the following upper bound:

$\|f(x_n)\|^2 + E[\varepsilon(x_n) / F_{n-1}] \leq c(1+v(x_n))$, where c is a positive constant, for any $k \in N$.

Then $x_n \to x^0$ a.s., as $n \to +\infty$, for any initial value x_0 of x.

But the last problem can be solved with the algorithm given by Theorem 1 only if we can calculate the values W(x) random variable for any x from R. If we have a case in which we need to work with f(.) function, for that we have certain x values for that f(.) can not be calculated (or their calculation involves to much time waste or any other resources) we have the next problem, like the one solved with Theorem 1, but much more generally:

Let a real function f(.) and let the set $A=\{a_1, a_2, \dots ,a_p\}$ which gives the values of the random variables $W(a_i)$ for any i=1,…,p, and in out of the set A, we do not have values for W(.). In this case, the missing values for f(.), which give the values for W(.), will be obtained using another function which interpolate in a certain way the $W(a_1)$, $W(a_2)$, … ,$W(a_p)$ values.

This problem can be solved better using the case of a function f:R→R, because in R we have an order relation. Before that we have to define what does it mean Lyapunov function, for a given f:R→R function.

Definition 1. If we have a given function f:R→R, it is called Lyapunov function, one function v:R→R with the following properties:

(1)It is a continuously twice differentiable

(2)Its second derivative is bounded

(3) Exist a unique x^0 such that $v(x) \geq 0$,$\forall\ x \neq x^0$, $v(x^0)=0$, and $v(x) \to +\infty$, as $|x| \to +\infty$

(4) For any $\varepsilon \geq 0$ there is a $\beta_\varepsilon \geq 0$ such that

$\text{supp}\{ v_x(x)f(x) / |x-x^0| \geq \epsilon \} = -\beta_\varepsilon \leq 0$, where $v_x(x)$ is the derivative of v(.)

If f:R→R has a Lyapunov function, then exists the following properties:

Lemma.1. f>0 on $(-\infty, x^0)$, and f<0 on $(x^0, +\infty)$.

Proof: Supposing that takes place inverted, f<0 pe $(-\infty, x^0)$, and f>0 pe $(x^0, +\infty)$. From the hypothesis it is known that we have $\text{supp}\{ v_x(x)f(x) / |x-x^0| \geq \epsilon \} = -\beta_\varepsilon \leq 0$, so, for any x with $|x-x^0| \geq \epsilon$, we have:

$v_x(x)f(x) < -\beta_\varepsilon \leq 0$ (3)

Because relation (3) is true for any x with $|x-x^0| \geq \epsilon$,for any $\epsilon > 0$ results that on $(-\infty, x^0)$ we have f<0. So, from (3) results that on $v_x(x)>0$ which means that function v(.) is increasing on $(-\infty, x^0)$ and because the second derivate of v(.) is continuous, results that v(.) is continuous on $(-\infty, x^0)$. Also, from hypothesis, exists an unique x^0 such that $v(x) \geq 0$,$\forall\ x \neq x^0$, $v(x^0)=0$. So, on $(-\infty, x^0)$ we

have that v(.)<0, which is impossible because from hypothesis we have that v(x) ≥ 0 ,$\forall$ $x \neq x^0$.(q.e.d.)

Lemma 2. If for f:R→R, function v(.) is a Lyapunov function, then we have v(.) decreasing on $(-\infty, x^0)$ and v(.) increasing on $(x^0, +\infty)$.

Proof: The same like we have proved Lemma 1 we have also here that on $(-\infty, x^0)$ $v_x(x)<0$, so v(.) is decreasing and on $(x^0, +\infty)$ $v_x(x)>0$, so v(.) is decreasing (q.e.d).

In the next, from f(.) function it is made a new interpolation function using given points $A=\{a_1,a_2,\ldots,a_m\}$. With this one are calculated the string values, string that appears in the Robbins-Monroe algorithm, in points that are not from A set.

So, we know only the values of the stochastic variables which are calculated only in points from set A, so we have:

for the string $x_{n+1}=x_n+a_nW(x_n)$, with any initial value, x_0 from R and with $W(x_n)$ stochastic variable which has like values the ones affected by the f(.) noises, calculated in x_n, with x_n stochastic variable, if for any value of x_0 we calculate the first terms of the string presented before, we have:

$x_1=x_0+a_1W(x_0)$, and if it is selected any value of $W(x_0)$ stochastic variable, noted by z_0 we have $x_1=x_0+a_1z_0$. If x_0 is part of set A, then the stochastic variables $W(x_0)$ let to be calculated a selection of a value, noted by z_0, which can be used for calculating x_1. If the value of x_0 would not have been in set A, then we cannot calculate a selection that we can use for finding x_1. The same, if we know x_1, than can be calculated x_2 using the same formula $x_2=x_1+a_2W(x_1)$, which means that we use a selection of the stochastic variable $W(x_1)$, noted z_1 and we calculate x_2.

But if x_1 is not part of set A, than we do not have on $W(x_1)$, so we do not have from where to select a value of this stochastic variable, value that can be used to calculate x_2. This situation we can find when we want to calculate any x_n.

For that we use an interpolation of function f(.) in those points that are not from set A.

So, let it be g(.) linear interpolation of g(.), given by the next formula $g(x)=[(a_{i+1}--x)/(a_{i+1}-a_i)]f(a_i)+[(x-a_i)/(a_{i+1}-a_i)]f(a_{i+1})$, if x is part of set $[a_i,a_{i+1}]$, for any i=1,2,...,m.

After that, we form a Robbins-Monroe string for function g(.) because, for any i=1,2,...,m we have $W_g(y)=g(y)+e_y$ where e_y is the noise produced by calculation of g(y) with $E[e_y]=0$, the expectation of e_y. Said in a different way, $W_g(y)=[(a_{i+1}--y)/(a_{i+1}-a_i)]W_{ai}+)+[(y-a_i)/(a_{i+1}-a_i)]W_{ai+1}$, where $W_{ai}=f(a_i)+e_{ai}$ is the stochastic variable which gives values to $f(a_{i+1})$ affected by e_{ai+1} noise, so we have $W_g(y)=)=[(a_{i+1}--y)/(a_{i+1}-a_i)]W_{ai}+[(y-a_i)/(a_{i+1}-a_i)]W_{ai+1}=[(a_{i+1}--y)/(a_{i+1}-a_i)](f(a_i)+e_{ai})+ +[(y-a_i)/(a_{i+1}-a_i)](f(a_{i+1})+e_{ai+1}) =g(y)+Wy$, where $W_y= =[(a_{i+1}--y)/(a_{i+1}-a_i)]e_{ai}+[(y-a_i)/(a_{i+1}-a_i)]e_{ai+1}$, for any y and any i=1,2,….Actually g(.) is an approximation of f(.) and if has been supposed that f(.) has an unique root x^0 on R, than g(.) has also an unique root on R (noted by y^0), this if g(.) approximate good enough on f(.). But for obtaining the Robbins-Monroe string for function f(.) is necessary that g(.) to have a Lyapunov function. We offer, without proof the following theorem:

Theorem 2. If function f:R→R is continuous on R with a unique root,x^0, and if f(.) admits a Lyapunov function on R, then, for $a_1,a_2,\ldots,a_m,\ldots$ points, chosen on R, such that we can calculate all of values W_{ai}, than it's linear interpolation function noted by:

$g(x)=[(a_{i+1}-x)/(a_{i+1}-a_i)]f(a_i)+[(x-a_i)/(a_{i+1}-a_i)]f(a_{i+1})$ if x is from $[a_i,a_{i+1}]$

admits also a Lyapunov function on R.

So, with this theorem, can be created a Robbins-Monroe string for function g(.), string like: $g_{n+1}=g_n+a_nW(g_n)$,, for any n and for any initial value of g, like g_0. Then, this string $(g_n)_n$ is almost sure convergent to a g^* value which approximates x^0, which was the unique solution of f(x)=0.

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SOME THEORETICALLY ASPECTS OF THE INVERSE PROBLEM FROM SEISMOLOGY

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Abstract: *The case of a wave propagation generated by a boundary source into a heterogeneous medium occupying a half-space is one of the important actually seismic problems. In this paper we study the problem of the reconstruction of the velocity inside the half-space from the knowledge of the medium response measured at z=0. In the zero-order approximation we derive a system of non linear Volterra integral equations for the refractive index. The first-order approximation is determined as a solution of a coupled linear system of Volterra type integral equations. Next, we obtain the inverse problem in the second-order approximation.*

Key-Words: *Inverse problem, Seismology, Spectral analysis, Fourier transform, Integral equations.*

1. INTRODUCTION

Seismic wave propagation in the upper layers of the earth's crust is a complex physical process. In addition to the primary downgoing pulse, there is always upgoing energy from the source that reflects off of the earth's free surface to produce a so-called source ghost. In fact, there will be an entire series of similar ghosts that are produced when either the primary or a particular ghost reflects off the base of the near surface and travels up again to reflect off the free surface. Thus, it must always be expected that the downgoing pulse that serves to illuminate the subsurface consists of a complex reverberatory series.

The subsurface is commonly idealized as a stacked sequence of nearly homogeneous layers, called formations, whose geometry may be simple or complex. The contacts between the formations are called horizons and are assumed to be in welded contact. In the case of a sedimentary basin, the formations are assumed to be horizontal and hence their material description depends only on the vertical coordinate. More complex settings are found near mountain belts, along passive continental margins, and near the boundaries of sedimentary basins. Here, formations can be greatly distorted from the horizontal due to tectonic compressional or extensional forces.

Common jargon for such settings is to say that they are $n(\vec{x},z)=\dfrac{1}{c(\vec{x},z)}$, with $\vec{x}=(x_1,x_2)$, environments which means that seismic wave speed or refractive index can depend arbitrarily upon position.

Let us adopt the usualy convention of a righthanded Cartesian coordinate system with the z coordinate oriented in the vertical and increasing downward and thus it is to describe the sedimentary basin environment as a $c(\vec{x},z)$ setting by which it is meant that the propagation speed of seismic waves depends only upon the formation depth.

The direct geo-exploration problem consist to find in

$$\Omega=\left\{(\vec{x},z)\middle|(x_1,x_2)\in\square^2, z\in(-\infty,0)\right\},$$

the solution of the of the wave equations

$$n^2(z,\vec{x})\frac{\partial^2 u}{\partial t^2}-\frac{\partial^2 u}{\partial x_1^2}-\frac{\partial^2 u}{\partial x_2^2}-\frac{\partial^2 u}{\partial z^2}=0, \qquad (1)$$

with $t\in(0,+\infty)$, where $u=u(\vec{x},z,t)$ means the wave function and must obey to the Dirichlet's boundary condition

$$u(\vec{x},z,t)\big|_{z=0} = v(\vec{x},t),$$

or Neumann's boundary condition

$$\frac{\partial u}{\partial z}(\vec{x},z,t)\big|_{z=0} = w(\vec{x},t)$$

and to the homogenous initial conditions

$$\begin{cases} u(\vec{x},z,t)\big|_{t=0} = 0, \\ \dfrac{\partial u}{\partial t}(\vec{x},z,t)\big|_{t=0} = 0. \end{cases} \qquad (2)$$

In the direct problem it is assumed that all the data, i.e. $c(\vec{x},z)$, $v(\vec{x},t)$, $w(\vec{x},t)$, are known functions which satisfied sufficient and/or necessary conditions of regularity for ensure existence and uniqueness of its solution.

By the ather hand, seismic waves excited by an artificial way or arising to earthquakes are the basic source of the information about an internal structure of the Earth, beginning from deposition of sediments up to an internal core. Seismic data have allowed finding distribution of elastic parameters and density in a radial direction, to study peculiarities of a structure of earth, crust and upper mantle in continental and oceanic zones.

Thus, the inverse problem of geo-exploration imply investigation of domains inside the earth crust which contain gas, oil or anther minerals, but a large part of it may be approximated by a layered structure, that is, may be represented as a stack of layers separated with interfaces. Within every layer the properties like velocity of the wave propagation, density, pressure etc. depend smoothly on z and slightly vary along the horizontal coordinates and have jumps discontinuities while crossing an interface.

The main goal of the solution of inverse problem is reconstruction of an internal structure of the earth by using seismic data measured on a surface of the Earth and in wells.

In mathematical terms, this is the determination of velocity of wave propagation of the wave field generated by an excitation is known on the earth's surface at baseline.

2. PROBLEM FORMULATION

So, we study this problem assuming that the velocity of wave propagation depends weakly on the horizontal coordinates $\vec{x}$ comparing to the strong dependence on the vertical coordinate z, i.e. we deal with a weakly lateral heterogeneous medium (WLHM). This means that we must considered a small parameter ε characterizing the ratio of the horizontal and vertical gradients of $c(\vec{x},z)$. Thus, we assume that in (1) the refractive index has the following asymptotical behavior

$$n^2(z,\varepsilon\vec{x}) \sim \sum_{m:=(m_1,m_2)\in \square^2} \varepsilon^{|m|} p_{m_1,m_2}(z)\, x_1^{m_1} x_1^{m_1} . \qquad (3)$$

If the direct problem consists to find in Ω the solution of the equation

$$n^2(z,\varepsilon\vec{x})\frac{\partial^2 u}{\partial t^2} - \frac{\partial^2 u}{\partial x_1^2} - \frac{\partial^2 u}{\partial x_2^2} - \frac{\partial^2 u}{\partial z^2} = 0 \qquad (4)$$

under known initial and boundary conditions, the inverse problem consists in velocity reconstruction inside the half-space from the knowledge of the medium response measured at $z=0$. Thus, instead of the boundary conditions we assume a boundary point source at the ground surface $z=0$ and we analyze a response of the medium at $z=0$ which provides the data for this inverse problem. This means that we have to impose the boundary condition

$$u\big|_{z=0} = \frac{\delta(\vec{x})\, f(t)}{\sqrt{n_0(0)}}, \qquad (5)$$

with $f(t)=\delta(t)$ or $f(t)=\theta(t)$, where we used classical symbols for Dirac and Heaviside functions.

Now, for the problems (4), (5) and (2) we seek the solution in its inverse Fourier transform

$$u(\vec{x},z,t) = \frac{1}{4\pi^2}\int_{\square^2} e^{i\langle\vec{\xi},\vec{x}\rangle} U(z,\vec{\xi},t)\, d\vec{\xi}$$

with

$$U\left(z,\vec{\xi},t\right)\square \sum_{m:=(m_1,m_2)\in\square^2} \varepsilon^{|m|} i^{|m|} U^m\left(z,\vec{\xi},t\right),$$

$\forall\vec{\xi}=\left(\xi_1,\xi_2\right)\in\square^2$, and we assume that (3) can be rewriting in the form

$$n^2\left(z,\vec{x}\right)\square n_0^2\left(z\right)+\varepsilon\left\langle\vec{x},\vec{n}\left(z\right)\right\rangle+ +\frac{\varepsilon^2}{2}\left\langle\vec{x},\vec{\vec{P}}\cdot\vec{x}\right\rangle+O\left(\varepsilon^3\right),$$

where we adopted the following notations:

$$\vec{n}\left(z\right)=\left(n_1\left(z\right),n_2\left(z\right)\right),$$

$$\vec{\vec{P}}\left(z\right)=\begin{pmatrix} p_{2,0}\left(z\right) & \frac{1}{2}p_{11}\left(z\right)\\ \frac{1}{2}p_{11}\left(z\right) & p_{0,2}\left(z\right)\end{pmatrix}.$$

Through directly calculus, we obtain the following approximate equation in the Fourier transformations space, respective, for the zero order

$$n_0^2\left(z\right)\frac{\partial^2U^{(0)}}{\partial t^2}\left(z,\vec{\xi},t\right)-\frac{\partial^2U^{(0)}}{\partial z^2}\left(z,\vec{\xi},t\right)+ +\left|\vec{\xi}\right|^2U^{(0)}\left(z,\vec{\xi},t\right)=0, \quad (6)$$

with $\left|\vec{\xi}\right|^2=\xi_1^2+\xi_2^2$, for the first order

$$n_0^2\left(z\right)\frac{\partial^2U^{(1)}}{\partial t^2}-\frac{\partial^2U^{(1)}}{\partial z^2}+\left|\vec{\xi}\right|^2U^{(1)}= =\left\langle\vec{n}\left(z\right),\nabla_{\vec{\xi}}\frac{\partial^2U^{(0)}}{\partial t^2}\right\rangle, \quad (7)$$

where

$$\left\langle\vec{n}\left(z\right),\nabla_{\vec{\xi}}\frac{\partial^2U^{(0)}}{\partial t^2}\left(z,\vec{\xi},t\right)\right\rangle= =\sum_{j=1}^{2}n_j\left(z\right)\frac{\partial^3U^{(0)}}{\partial\xi_j\partial t^2}\left(z,\vec{\xi},t\right),$$

and, at last,for the second order

$$n_0^2\left(z\right)\frac{\partial^2U^{(2)}}{\partial t^2}\left(z,\vec{\xi},t\right)-\frac{\partial^2U^{(2)}}{\partial z^2}\left(z,\vec{\xi},t\right)+ +\left|\vec{\xi}\right|^2U^{(2)}\left(z,\vec{\xi},t\right)= =p\left(z,\vec{\xi}\right)\frac{\partial^2U^{(0)}}{\partial z^2}\left(z,\vec{\xi},t\right)+ +\left\langle\vec{n}\left(z\right),\nabla_{\vec{\xi}}\frac{\partial^2U^{(1)}}{\partial t^2}\left(z,\vec{\xi},t\right)\right\rangle. \quad (8)$$

2.1. THE ZERO-ORDER APPROXIMATION

The inverse problem is from the equation (6) together with boundary condition

$$U^{(0)}\big|_{z=0}=r_0\left(t,\vec{\xi}\right),\ \text{where}$$

$$r_0\left(t,\vec{\xi}\right)=\int_{\square^2}\cos\left(\left\langle\vec{\xi},\vec{x}\right\rangle\right)R_0\left(z,\vec{x},t\right)d\vec{x}$$

which was obtained in spirit of our goal to reconstruct the refractive index, namely, the functions $n_0\left(z\right)$, $\vec{n}\left(z\right)$ and $\vec{\vec{P}}\left(z\right)$, from the knowledge of the leading terms of

$$\frac{\partial u}{\partial z}\big|_{z=0}=R\left(\vec{x},t,\varepsilon\right),\ \text{with}$$

$$R\left(\vec{x},t,\varepsilon\right)\square\sum_{m\in\square}\varepsilon^mR_m\left(\vec{x},t\right),\quad 0<t<2T,$$

$R_{(m)}\left(\vec{x},t\right)$ being even, with respect to $\vec{x}$, for even m, and odd for odd m.

Let y be the travel time variable definite by $y=\int_0^z n_0\left(z\right)dz$ (9)

so that equation (6) is rewritten in the new independent variables like

$$\frac{\partial^2U^{(0)}}{\partial t^2}\left(y,t,\vec{\xi}\right)- -\frac{1}{n_0\left(z\right)}\frac{\partial}{\partial y}\left(n_0\left(z\right)\frac{\partial U^{(0)}}{\partial y}\left(y,t,\vec{\xi}\right)\right)=0 \quad (6')$$

Further, we introduce two new unknowns by

$$\begin{cases}\psi_1\left(y,t,\vec{\xi}\right):=\sqrt{n_0\left(z\right)}U^{(0)}\left(y,t,\vec{\xi}\right)\\ \psi_2\left(y,t,\vec{\xi}\right):=\frac{\partial\psi_1}{\partial t}\left(y,t,\vec{\xi}\right)+\frac{\partial\psi_1}{\partial t}\left(y,t,\vec{\xi}\right)\end{cases}'$$

which reduce the second order partial differential equation (6)' to a system of two first order partial differential equations

$$\begin{cases} \dfrac{\partial \psi_1}{\partial t} + \dfrac{\partial \psi_1}{\partial y} = \psi_2 \\ \dfrac{\partial \psi_2}{\partial t} - \dfrac{\partial \psi_2}{\partial y} = q(y)\psi_1 \end{cases} \quad (10)$$

with $\psi_1 = \psi_1\left(y,t,\vec{\xi}\right)$, $\psi_2 = \psi_2\left(y,t,\vec{\xi}\right)$, where

$$q\left(y,\vec{\xi}\right) = -\frac{1}{\sqrt{n_0}}\frac{d^2\sqrt{n_0}}{dz^2} - \frac{\left|\vec{\xi}\right|^2}{n_0^2}, \quad (11)$$

So, integrating the equations (11) along characteristics $\begin{cases} \tau = \eta + t - y \\ \tau = t + y - \eta \end{cases}$ for $t > y$, we obtain

$$\psi_1\left(y,t,\vec{\xi}\right) = \int_0^y \psi_2\left(\eta, t+\eta-y, \vec{\xi}\right) d\eta \quad (12)_1$$

and

$$\psi_2\left(y,t,\vec{\xi}\right) = -\int_0^y q\left(\eta,\vec{\xi}\right)\psi_1\left(\eta, t-\eta+y, \vec{\xi}\right) d\eta + \quad (12)_2$$
$$+ g\left(t+y,\vec{\xi}\right),$$

where

$$g\left(t,\vec{\xi}\right) = \delta'(t) + \frac{1}{2n_0(0)}\delta(t) + \frac{r_0\left(t,\vec{\xi}\right)}{\sqrt{n_0(0)}}$$

is bounded as $t \to +\infty$ due the cancellation of $\delta'(t)$ and $\delta(t)$ singularities.

In fact, the system $(12)_1$-$(12)_2$ is not complete to solve the corresponding inverse problem because it has three unknown functions $\psi_1\left(y,t,\vec{\xi}\right)$, $\psi_2\left(y,t,\vec{\xi}\right)$, $q\left(y,\vec{\xi}\right)$ and just two equations. The third equation is obtained in the hypothesis of the acoustic theory, i.e. based on the singularity analysis for $U^{(0)}$, using the propagative wave expansion

$$U^{(0)}\left(y,t,\vec{\xi}\right) \sim \sum_{m\in\Gamma} f_m(t-y)U_m^{(0)}\left(y,\vec{\xi}\right)$$

with here Γ is Euler' second kind function. Thus, we obtain

$$U^{(0)}\left(y,t,\vec{\xi}\right) =$$
$$= \frac{\delta(t-y)}{\sqrt{n_0(0)}} + \frac{\theta(t-y)}{2n_0(0)}\int_0^y q\left(\eta,\vec{\xi}\right)d\eta + \cdots \text{ i.e.}$$
$$\psi_2\left(y,t,\vec{\xi}\right) = \frac{1}{2}\theta(t-y)q\left(\eta,\vec{\xi}\right) + \cdots,$$

which implies, due the second in (12), that

$$q\left(\eta,\vec{\xi}\right) =$$
$$= -2\int_0^y q\left(\eta,\vec{\xi}\right)\psi_1\left(\eta, t-\eta+y, \vec{\xi}\right)d\eta +$$
$$+ 2g(2y).$$

Finally, we have a closed system of coupled Volterra-type integral equations (12) and (13) to determine unknown function $q\left(\eta,\vec{\xi}\right)$, for $0 < y < T$, from $g\left(t,\vec{\xi}\right)$, for $0 < t < 2T$. Once, we know $q\left(\eta,\vec{\xi}\right)$, than we calculate $q(\eta,\xi_1)$, $q(\eta,\xi_2)$, and we recover

$$n_0(y) = \sqrt{\frac{\xi_1^2 + \xi_2^2}{q(\eta,\xi_1) - q(\eta,\xi_2)}},$$

making use of (9), at last, we obtain $n_0(z)$.

2.2 . THE FIRST-ORDER APPROXIMATION

The first-order-approximation problem is formatted by the equation (7), which is rewriting in the travel time coordinates like

$$\frac{\partial^2 U^{(1)}}{\partial t^2}\left(y,t,\vec{\xi}\right) -$$
$$- \frac{1}{n_0(z)}\frac{\partial}{\partial y}\left(n_0(z)\frac{\partial U^{(1)}}{\partial y}\left(y,t,\vec{\xi}\right)\right) +$$
$$+ \frac{\left|\vec{\xi}\right|^2}{n_0^2(z)}U^{(1)}\left(y,t,\vec{\xi}\right) =$$
$$= \left\langle \vec{n}(z), \nabla_{\vec{\xi}}\frac{\partial^2 U^{(0)}}{\partial t^2}\left(z,\vec{\xi},t\right)\right\rangle \quad (7)'$$

and Cauchy conditions

$$\begin{cases} U^{(1)}\left(y,t,\vec{\xi}\right)\big|_{y=0}=0, \\ \dfrac{\partial U^{(1)}}{\partial y}\left(y,t,\vec{\xi}\right)\big|_{y=0}=\dfrac{\hat{r}_1\left(t,\vec{\xi}\right)}{n_0(0)}, \end{cases}$$

where $\hat{r}_1\left(t,\vec{\xi}\right)=\int_0^t r_1\left(t,\vec{\xi}\right)dt$.

The goal of this order of approximation is to a reconstruction algorithm to find $\vec{n}(z)$. First, we take $f(t)=\theta(t)$ in (5), and, secondly, we use the wave expansion

$$U^{(1)}\left(y,t,\vec{\xi}\right)=\theta(t-y)\,A_0\left(y,\vec{\xi}\right)+\cdots, \quad (14)$$

where

$$A_0\left(y,\vec{\xi}\right)=\frac{1}{\sqrt{n_0(y)}}\int_0^y\left\langle\vec{n}(\eta),\vec{\xi}\right\rangle p(\eta)d\eta,$$

$$p(y)=\frac{1}{2n_0^2(y)}\int_0^y\frac{d\eta}{n_0^2(\eta)}.$$

Now, we consider the Green's function "causal" with respect to travel variable y, denote by $G(y,\eta,t)$ and satisfying

$$\begin{aligned} &\frac{\partial^2 G}{\partial t^2}\left(y,\eta,t,\vec{\xi}\right)- \\ &-\frac{1}{n_0(z)}\frac{\partial}{\partial y}\left(n_0(z)\frac{\partial G}{\partial y}\left(y,\eta,t,\vec{\xi}\right)\right)+ \\ &+\frac{\left|\vec{\xi}\right|^2}{n_0^2(z)}G\left(y,\eta,t,\vec{\xi}\right)= \\ &=\delta(t)\delta(y-\eta),\ \text{if}\quad y>\eta, \end{aligned} \quad (15)_1$$

$$G\left(y,\eta,t,\vec{\xi}\right)=0,\ \text{if}\quad y<\eta,\ \forall t,\ \forall\vec{\xi}\,. \quad (15)_2$$

Because we recover $n_0(z)$, $G\left(y,t,\vec{\xi}\right)$ is obtained through (15) and, then we have

$$\begin{aligned} &U^{(1)}\left(y,y+0,\vec{\xi}\right)= \\ &=\int_0^y d\eta\int_\eta^{2y-\eta}\tilde{G}\frac{\left\langle\vec{n}(\eta),\nabla_{\vec{\xi}}\dfrac{\partial^2U^{(0)}}{\partial\tau^2}\right\rangle}{n_0^2(\eta)}d\tau- \\ &-\frac{1}{n_0(0)}\int_0^{2y}\tilde{G}\hat{r}_1\left(\tau,\vec{\xi}\right)d\tau,\ \text{where} \\ &\tilde{G}=G\left(y,0,y-\tau,\vec{\xi}\right). \end{aligned}$$

Introducing $\vec{\varphi}(y)=\left(\varphi_1(y),\varphi_2(y)\right)$ i.e. $\vec{\varphi}(y)=\vec{n}(y)\cdot p(y)$ and employing the expansion (14), we obtain the following equation

$$\begin{aligned} &\left\langle\vec{\varphi}(y),\vec{\xi}\right\rangle= \\ &=2\int_0^y G_1\left(y,\eta,\eta-y,\vec{\xi}\right)\frac{\left\langle\vec{\varphi}(\eta),\nabla_{\vec{\xi}}\dfrac{\partial^2U^{(0)}}{\partial\tau^2}\right\rangle}{n_0^2(\eta)\,p(\tau)}d\tau- \\ &-\frac{2}{n_0(0)}G_1\left(y,0,-y,\vec{\xi}\right)\hat{r}_1\left(2y,\vec{\xi}\right)+ \\ &+\int_0^y d\eta\int_\eta^{2y-\eta}G_2\left(y,\eta,y-\tau,\vec{\xi}\right)\frac{\left\langle\vec{\varphi}(\eta),\nabla_{\vec{\xi}}\dfrac{\partial^2U^{(0)}}{\partial\tau^2}\right\rangle}{n_0^2(\eta)\,p(\tau)}d\tau \\ &-\frac{1}{n_0(0)}\int_0^{2y}G_2\left(y,0,y-\tau,\vec{\xi}\right)\hat{r}_1\left(\tau,\vec{\xi}\right)d\tau, \end{aligned}$$

where

$$\begin{cases} G_1\left(y,\eta,t,\vec{\xi}\right)=\sqrt{n_0(y)}G\left(y,\eta,t,\vec{\xi}\right), \\ G_2\left(y,\eta,t,\vec{\xi}\right)=\dfrac{\partial G_1}{\partial t}\left(y,\eta,t,\vec{\xi}\right)+\dfrac{\partial G_1}{\partial y}\left(y,\eta,t,\vec{\xi}\right). \end{cases}$$

Taking $\vec{\xi}_1=(a,0)$ and $\vec{\xi}_2=(0,a)$, with $a\in\mathbb{R}\setminus\{0\}$, we obtain a paire of Volterra-type integral equation for $\varphi_1(y)$ and $\varphi_2(y)$.

2.3 THE SECOND-ORDER APPROXIMATION

In this case the equation of the second order approximation is given in (8) and it can be rewritten like

$$\frac{\partial^2 U^{(2)}}{\partial t^2}\left(y,t,\vec{\xi}\right)-$$
$$-\frac{1}{n_0(z)}\frac{\partial}{\partial y}\left(n_0(z)\frac{\partial U^{(2)}}{\partial y}\left(y,t,\vec{\xi}\right)\right)+$$
$$+\frac{\left|\vec{\xi}\right|^2}{n_0(z)}U^{(2)}\left(y,t,\vec{\xi}\right)=\frac{\tilde{p}(z,\tilde{x})}{n_0^{\,2}(z)}\frac{\partial^2 U^{(0)}}{\partial z^2}+$$
$$+\left\langle\vec{n}(z),\nabla_{\vec{\xi}}\frac{\partial^2 U^{(1)}}{\partial t^2}\left(z,\vec{\xi},t\right)\right\rangle, \qquad (8)'$$

where

$$\tilde{p}(z,\vec{x})=$$
$$=p_{2,0}(z)x_1^2+p_{1,1}(z)x_1x_2+p_{0,2}(z)x_2^2.$$

So, we have

$$\frac{\partial^2 U^{(2)}}{\partial t^2}-\frac{1}{n_0(z)}\frac{\partial}{\partial y}\left(n_0(z)\frac{\partial U^{(2)}}{\partial y}\right)+\frac{\left|\vec{\xi}\right|^2}{n_0(z)}U^{(1)}$$
$$=\frac{1}{n_0^{\,2}(z)}\left[p_{2,0}(z)\frac{\partial^4 U^{(0)}}{\partial^2\xi_1^2\partial z^2}+p_{1,1}(z)\frac{\partial^4 U^{(0)}}{\partial\xi_1\partial\xi_2\partial z^2}\right.$$
$$\left.+p_{0,2}(z)\frac{\partial^4 U^{(0)}}{\partial^2\xi_2^2\partial z^2}\right]+\left\langle\vec{n}(z),\nabla_{\vec{\xi}}\frac{\partial^2 U^{1)}}{\partial t^2}\right\rangle,$$

with the conditions

$$\begin{cases}U^2\left(y,t,\vec{\xi}\right)\Big|_{y=0}=0,\\ \dfrac{\partial^2 U}{\partial y}\left(y,t,\vec{\xi}\right)\Big|_{y=0}=\dfrac{\hat{r}_2\left(t,\vec{\xi}\right)}{n_o(0)},\end{cases}$$

and $f(t)=\delta(t)$.

This case follows the same way like the zero and first-order approximations. But, as further we known, this case is not yet approached numerical point of view.

3. CONCLUSION

The problem (10) is a particularly case of the following inverse problem: find a pair of the functions $\psi_1,\psi_2\in C^1\left([0,L]\times[0,+\infty]\right)$ and a pair of the functions $v_1,v_2\in C\left([0,L]\right)$, satisfying for $\forall(y,t)\in[0,L]\times[0,+\infty]$ the system of equations

$$\begin{cases}\dfrac{\partial\psi_1}{\partial t}+\dfrac{\partial\psi_1}{\partial y}=\psi_2+v_1(y)\\ \dfrac{\partial\psi_2}{\partial t}-\dfrac{\partial\psi_2}{\partial y}=q(y)\psi_1+v_1(y)\end{cases} \qquad (16)$$

with the following initial conditions

$$\begin{cases}\psi_1(y,0)=\varphi_1(y)\\ \psi_2(y,0)=\varphi_2(y)\end{cases} \qquad (17)$$

and the boundary conditions

$$\begin{cases}\psi_1(L,t)=\zeta_1(t)\\ \psi_2(0,t)=\zeta_2(t)\end{cases} \qquad (18)$$

where the functions are the data of the problem; $q\in C\left([0,L]\right)$, $\varphi_1,\varphi_2\in C^1\left([0,L]\right)$ and $\zeta_1,\zeta_2\in C^1\left([0,+\infty]\right)$.

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PREDICTING SEASONALITY AFFECTED PHENOMENA

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***Abstract*:** *The process followed by the economic agents in order to make a decision, presumes knowing the effects of each variable and of each variants used for making a decision in the future. The evolution during a period of time of certain factors that determin the process that we are interested in the future of represents the basis for the fundamentation of some prognosis methods using different models.*

This article presents different methods of conducting forecasts for phenomena with a seasonal character.

***Key words*:** *seasonal, real data, adjusted values, mobile averages, trimestrial averages, deviations from trend, seasonal indexes, prognosis values*.

1. INTRODUCTION

The economic processes develop in time, the economic growth and developpment are interpretabile in time, therefore the projection of the economic variables on the time axis leads to time series or chronological series.

If we are given all the chronological series data up to the moment if the analisys, then we are able to make a longitudinal investigation of the movement, dinamics, progress or regress in time. Considerring the time horizon, there can be short term analisys or long term analisys, calculated using the speciffic statistical and econometric methods.

The coomponents of a chronological series can be:

- long term component;
- seasonal component;
- cyclic component;
- residual component.

It is extremely important to know the systematic influence, under the shape of certain waves that appear during short time periods. This is the influence on the evolution of a certain phenomenon, in order to effect the predictions as accurate as possible.

Considerring that the components of a chronological series can be determined and characterized, than a correct prediction of the evolution of the phenomenon can be done. The necessary information needed in order to predict and forecast the evolution of a statistical variable can be:

- quantitative, reprezented by the past empirical series, split in components using the speciffic statistical methods;
- qualitative, due to which the analised variable follows the same trend in the projected future.

The predictions econometric mthods are built based on certain experiments and tests of a real phenomenon, followed by th creation of an experimental model that identically matches the natural one.

It is generally adminted that the decision is also the solution to the problem. The decision process involves th knowledge of the effects of each future variable or solution, and this knowledge is based on prediction. The prediction gives a certain level of accuracy for a certain time interval, it binds the connection between the companies and the external environment, and creates the best conditions for the integration of the company. The following evlution of certain factors that determine the process of the study, is the actual base for the understanding of some prognosis methods using different models

2.THE CALCULUS OF THE SEASONAL VARIATION, USIND THE REAL DATA

The exemplification of the statistical methods for the seasonal study is done using the data that reffers to the gross profit (mil. Lei) of a company between 2007 – 2009.

Table 2.1. Gross profit (thousand lei) between 2007-2009

Year	Annual profit	Trimestrial profit (y_{ij})				Annual average ($\bar{y}_i$)
		I	II	III	IV	
0	1	2	3	4	5	6
2007	92,04	20,50	23,605	28,185	18,75	23,01
2008	109,62	24,325	29,88	30,265	25,15	27,405
2009	84,60	19,06	20,885	24,225	20,43	21,15
Trimestrial average ($\bar{y}_j$)	$\sum_i\sum_j y_{ij}$ = =286,26	63,88:3= = 21,295	74,37:3= = 24,79	83,67:3= = 27,558	64,33:3= = 21,443	$\bar{y}_0$ = =23,855

For the calculus of the seasonal variation, using the real data, one must calculate the seasonal coeffcients for each year and the synthetic coefficient for all teh considered years, as follows:

- The trimestrial seasonal period coefficients 2007 - 2009

$$\begin{cases} K_{ij}\% = \dfrac{y_{ij}}{\bar{y}_i}100, \\ \bar{y}_i = \dfrac{\sum_j y_{ij}}{4} \end{cases} \quad \begin{matrix} i \in \{2007,\ 2008,\ 2009\} \\ j \in \{\mathrm{I,II,III,IV}\} \end{matrix} \qquad (1)$$

Table 2.2. The trimestrial seasonal period coefficients 2007-2009

Year	$K_{ij}\%$			
	I	II	III	IV
2007	89,09	102,59	122,49	81,49
2008	88,76	109,03	110,44	91,77
2009	90,12	98,75	114,54	96,60

- The seasonal synthetic coefficients or indexes

$$\begin{cases} K_j\% = \dfrac{\bar{y}_j}{\bar{y}_0}\cdot 100, \\ \bar{y}_j = \dfrac{\sum_i y_{ij}}{3} \\ \bar{y}_0 = \dfrac{\sum_j \bar{y}_j}{4} \end{cases} \quad \begin{matrix} j \in \{\mathrm{I,II,III,IV}\} \\ i \in \{2007,\ 2008,\ 2009\} \end{matrix} \qquad (2)$$

$$K_{\mathrm{I}/0}\% = \frac{21{,}295}{23{,}855}\cdot 100 = 89{,}27\%$$

$$K_{\mathrm{II}/0}\% = \frac{24{,}79}{23{,}855}\cdot 100 = 103{,}92\%$$

$$K_{\mathrm{III}/0}\% = \frac{27{,}558}{23{,}855}\cdot 100 = 115{,}52\%$$

$$K_{\mathrm{IV}/0}\% = \frac{21{,}443}{23{,}855}\cdot 100 = 89{,}89\%$$

The stability degree of these coefficients can be checked by using adjusted values for their determination, values that have been adjusted using different statistical methods

3. THE CALCULUS OF THE SEASONAL VARIABLE USING ADJUSTED VALUES

➢ Because it is trimestrial, the periodicity of the terms is used as mechanical model for adjusting the mobile averages in two steps, first by determining the temporary mobile averages $\tilde{y}_{ij}$ and afterwards by determining the final mobile averages $\overline{\overline{y}}_{ij}$, $i \in \{2007,2008,2009\}$ and $j \in \{\mathrm{I,II,III,IV}\}$. The results of this calculus are presented in table 3.1.

Table 3.1 The calculus of the seasonal coefficients using the additive model

Year	Trim.	Trimestrial profit y_{ij}	$\tilde{y}_{ij}$	$\overline{\overline{y}}_{ij}$
A	B	1	2	3
2007	I	20,50	–	–
	II	23,605	23,010	–
	III	28,185	23,966	23,488125
	IV	19,75	25,535	24,750625
2008	I	24,325	26,055	25,795
	II	29,88	27,405	26,73

	III	30,265	26,089	26,746875
	IV	25,15	23,084	27,586375
2009	I	19,06	22,330	22,707
	II	20,885	21,150	21,74
	III	24,225		–
	IV	20,43	–	–
Total	–	286,26	–	–

Deviations from trend $y_{ij} - \hat{y}_{ij}$	The arithmetic means of the deviations from the trend	Seasonal indexes $S_j^* = S_j - \bar{S}$
4	5	6
–	$S_I = -2,5585$	-2,678
–	$S_{II} = 1,1475$	1,028
4,696875	$S_{III} = 4,1075$	3,988
-5,000625	$S_{IV} = -2,2185$	-2,338
-1,47	$\sum_j S_j$	-2,678
3,15	$\bar{S} = \frac{j}{4} =$	1,028
3,518125	$= \frac{0,478}{4} =$	3,988
0,563625	$= 0,1195$	-2,338
-3,647		-2,678
-0,855		1,028
–		3,988
–		-2,338
–	–	0

Table 3.2 The calculus of the seasonal coefficients using the multiplicative model

Year	Trim	Trimestrial profit y_{ij}	$= y_{ij}$	Deviations from trend $= y_{ij} : y_{ij}$	The geometric means of the deviations from the trend	Seasonal indexes $S_j^{**} = S_j' : \bar{S}$
A	B	1	2	3	4	5
2007	I	20,50	–	–	$S_I' = 0,88969$	0,89633
	II	23,60	–	–		1,04408
	III	28,18	23,488	1,19997	$S_{II}' = 1,03634$	1,17395
	IV	19,75	24,750	0,79796		0,91021
2008	I	24,32	25,795	0,94301	$S_{III}' = 1,16525$	0,89633
	II	29,88	26,73	1,11785		1,04408
	III	30,26	26,746	1,13153	$S_{IV}' = 0,90347$	1,17395
	IV	25,15	24,586	1,02292		0,91021
2009	I	19,06	22,707	0,83939	$\bar{S} = \sqrt[4]{\Pi S_j'} =$	0,89633
	II	20,88	21,74	0,96077		1,04408
	III	24,22	–	–	$= 0,99259$	1,17395
	IV	20,43	–	–		0,91021
Total	–	286,26	–	–	–	$\prod_j S_j^{**} = 1$

The seasonal indexes that correspond to the multiplicative model and to the mobile averages adjustment, in percentes, are:

$$S_{\text{I}}^{**}\% = 89,633\% \quad S_{\text{II}}^{**}\% = 104,408\%$$

$$S_{\text{III}}^{**}\% = 117,395\% \quad S_{\text{IV}}^{**}\% = 91,021\%.$$

➢ Taking into account the proffit general evolution trend, it is better to use a parabolic analitical adjustment model, that has the following ecuation:

$$\hat{y}_{ij}^{P} = a + b \cdot t_{ij} + c \cdot t_{ij}^2 \quad j \in \{\text{I,II,III,IV}\} \quad i \in \{2007,\ 2008,\ 2009\} \tag{3}$$

for which the system of normal equations resulted after the application of the method of least squares is:

$$\begin{aligned} &12a + b\sum_i\sum_j t_{ij} + c\sum_i\sum_j t_{ij}^2 = \sum_i\sum_j y_{ij} \\ &a\sum_i\sum_j t_{ij} + b\sum_i\sum_j t_{ij}^2 + c\sum_i\sum_j t_{ij}^3 = \sum_i\sum_j t_{ij} y_{ij} \\ &a\sum_i\sum_j t_{ij}^2 + b\sum_i\sum_j t_{ij}^3 + c\sum_i\sum_j t_{ij}^4 = \sum_i\sum_j t_{ij}^2 y_{ij} \end{aligned} \tag{4}$$

$$j \in \{\text{I,II,III,IV}\} \quad i \in \{2007, 2008, 2009\}$$

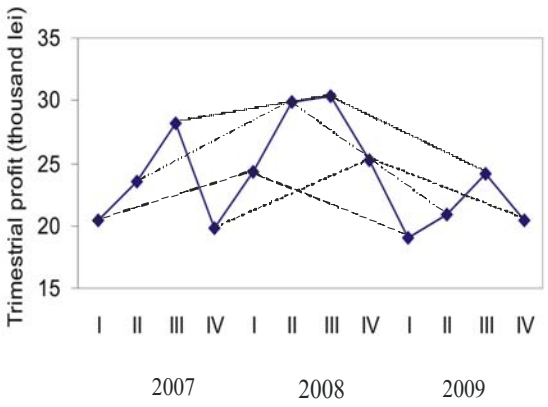

Fig. 3.1 The trimestrial distribution of the profit graphic

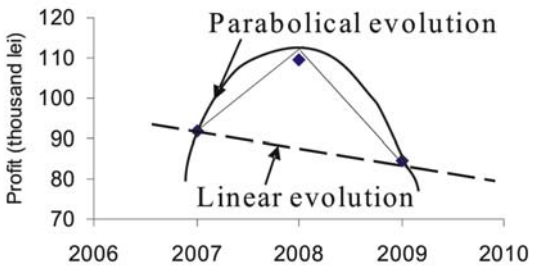

Fig.3.2 The annual profit variation graphic

Table 3.3 Processed data for the choosing of the adjustment analitical model

Year	Trim	y_{ij}	t_{ij}	t_{ij}^2	$t_{ij}y_{ij}$	$t_{ij}^2 y_{ij}$	t_{ij}^4
A	B	1	2	3	4	5	6
2007	I	20,5	-11	121	-225,5	2480,5	14641
	II	23,605	-9	81	-212,44	1912,00	6561
	III	28,185	-7	49	-197,29	1381,06	2401
	IV	19,75	-5	25	-98,75	493,75	625
2008	I	24,325	-3	9	-72,975	218,92	81
	II	29,88	-1	1	-29,88	29,88	1
	III	30,265	1	1	30,265	30,265	1
	IV	25,15	3	9	75,45	226,35	81
2010	I	19,06	5	25	95,3	476,5	625
	II	20,885	7	49	146,19	1023,36	2401
	III	24,225	9	81	218,02	1962,22	6561
	IV	20,43	11	121	224,73	2472,03	14641
Total	–	286,26	0	572	-46,88	12706,8	48620

$\hat{y}_{ij}^P$	$\hat{y}_{ij}^L$	$y_{ij}-\hat{y}_{ij}^P$	$\left(y_{ij}-\hat{y}_{ij}^P\right)^2$	$y_{ij}-\hat{y}_{ij}^L$	$\left(y_{ij}-\hat{y}_{ij}^L\right)^2$
7	8	9	10	11	12
21,527	24,757	-1,027	1,054729	-4,257	18,12204
23,123	24,593	0,482	0,232324	-0,988	0,976144
24,367	24,429	3,818	14,577124	3,756	14,10753
25,259	24,265	-5,509	30,349081	-4,515	20,38522
25,799	24,101	-1,474	2,172676	0,224	0,050176
25,987	23,937	3,893	15,155449	5,943	35,31924
25,823	23,773	4,442	19,731364	6,492	42,14606
25,307	23,609	-0,157	0,02469	1,541	2,374681
24,439	23,445	-5,379	28,933641	-4,385	19,22822
23,219	23,281	-2,334	5,447556	-2,396	5,740816
21,647	23,117	2,578	6,646084	1,108	1,227664
19,723	22,953	0,707	0,499849	-2,523	6,365529
286,22	286.26	0,04	124,824526	0	166,0433

The solutions of the system (4) are:

$a = 25{,}949$, $b = -0{,}082$, $c = -0{,}044$

and the ecuation for the adjusting model is:

$$\hat{y}_{ij}^P = 25{,}949 - 0{,}082t_{ij} - 0{,}044t_{ij}^2$$
$$i \in \{2007,\ 2008,\ 2009\} \qquad (5)$$
$$j \in \{\mathrm{I}, \mathrm{II}, \mathrm{III}, \mathrm{IV}\}$$

➢ Considerring that the gross profit has a linear evolution, the ecuation for the adjustment model is:

$$\hat{y}_{ij}^L = a_1 + b \cdot t_{ij},$$
$$i \in \{2007,\ 2008,\ 2009\} \qquad (6)$$
$$j \in \{\mathrm{I}, \mathrm{II}, \mathrm{III}, \mathrm{IV}\}$$

the system of the normal ecuations is:

$$\begin{cases} 12a_1 + b \cdot \sum_i \sum_j t_{ij} = \sum_i \sum_j y_{ij} \\ a_1 \sum_i \sum_j t_{ij} + b \sum_i \sum_j t_{ij}^2 = \sum_i \sum_j t_{ij} y_{ij} \end{cases} \qquad (7)$$

with the following solution $a_1 = 23{,}855$, $b = -0{,}082$.

Calculating the summ of the square errors for the two adjusting models, the foloowing result is obtained:

$$\sum_i \sum_j \left(y_{ij} - \hat{y}_{ij}^P\right)^2 = 124{,}824526$$
$$\sum_i \sum_j \left(y_{ij} - \hat{y}_{ij}^L\right)^2 = 166{,}043358 \qquad (8)$$

Therefore, the right analitical model is the parabolic one.

➢ The seasonal coefficients calculated using the analitical adjustment of the parabolic model by the additive and multiplying method are written in table 3.4.

Tabelul 3.4 The values of the seasonal coefficients calculated using the analitical adjustment of the parabolic model by the additive and multiplying method:

Year	Trim	Trimestrial profit y_{ij}	$\hat{y}_{ij}^P$	$y_{ij}-\hat{y}_{ij}^P$	The arithmetic means of the trimestrial deviations
A	B	1	2	3	4
2007	I	20,50	21,527	-1,027	$S_{\mathrm{I}} = -2{,}627$
	II	23,605	23,123	0,482	
	III	28,185	24,367	3,818	$S_{\mathrm{II}} = 0{,}680$
	IV	19,75	25,259	-5,509	
2008	I	24,325	25,799	-1,474	$S_{\mathrm{III}} = 10{,}838$
	II	29,88	25,987	3,893	
	III	30,265	25,823	4,442	$S_{\mathrm{IV}} = -1{,}653$
	IV	25,15	23,307	-0,157	
2009	I	19,06	24,439	-5,379	$\bar{S} 1{,}8095$
	II	20,885	23,219	-2,334	
	III	24,225	21,647	2,578	
	IV	20,43	19,723	0,707	
Total	–	286,26	286,22	0,04	–

Seasonal indexes $S_j^* = S_j - \bar{S}$	$y_{ij} : \hat{y}_{ij}^P$	The arithmetic means of the trimestrial deviations	Seasonal indexes $S_j^{**} = S_j' : \bar{S}$
5	6	7	8
-4,4365	0,952	$S_{\mathrm{I}}' = 0{,}23341$	0,70370
-1,1295	1,021		1,06079
9,0285	1,157		1,52488
-3,4625	0,782	$S_{\mathrm{II}}' = 0{,}35185$	0,87849
-4,4365	0,943		0,70370

-1,1295	1,150	$S'_{III} = 0,50579$	1,06079
9,0285	1,172		1,52488
-3,4625	1,079	$S'_{IV} = 0,29138$	0,87849
-4,4365	0,780		0,70370
-1,1295	0,899		1,06079
9,0285	1,119	$\overline{\overline{S}} = \sqrt[4]{\prod_j S'_j} =$	1,52488
-3,4625	1,036	$= 0,33169$	0,87849
0	-		$\prod_j S^{**}_j = 1$

Therefore

$$S^{**}_{I}\% = 70,37\%,\ S^{**}_{II}\% = 106,079\%,$$

$$S^{**}_{III}\% = 152,488\%,\ S^{**}_{IV}\% = 87,849\%$$

The use of the additive model leads to teh conclusion that the seasonal factor does influence the gross profit like this:
- For the first, second and fourth trimester the average gross profit is situated 4,436 thousand lei under the trend, respectively 1,1295 thousand lei and 3,4625 thousand lei.
- For the third trimester the average gross profit is situated 9,0285 thousand lei over the trend

The influence of the seasonal factor on the gross profit calculated using the multiplying model led to the conclusion that:
- For the first and the fourth trimester, the gross profitis situated 29,63% below the trend, respectively 12,151% below the trend;
- For the second and the third trimester, there is an average exceeding of the gross profit trend level of 6,079%, respectively 52,488%.

The predicted values for 2010 are:

$$\hat{y}^{P}_{2010,I} = 25,949 - 0,082 \cdot 13 - 0,044 \cdot 13^2$$
$$= 17,447 \text{ thousand lei}$$

$$\hat{y}^{P}_{2010,II} = 25,949 - 0,082 \cdot 15 - 0,044 \cdot 15^2 =$$
$$= 14,819 \text{ thousand lei}$$

$$\hat{y}^{P}_{2010,III} = 25,949 - 0,082 \cdot 17 - 0,044 \cdot 17^2 =$$
$$= 11,839 \text{ thousand lei}$$

$$\hat{y}^{P}_{2010,IV} = 25,949 - 0,082 \cdot 19 - 0,044 \cdot 19^2 =$$
$$= 8,507 \text{ thousand lei}$$

$$\hat{y}^{P}_{2010} = \sum_j \hat{y}^{P}_{2009,j} = 52,612 \text{ thousand lei.}$$

The prdicted values for 2010, not taking into account the seasonal influence are calculated this way:

– For the S^{*}_{j} indexes it will be obtained:

$$\hat{y}^{P\,*}_{2010,I} = \hat{y}^{P}_{2010,I} - S^{*}_{I} = 17,447 - (-4,4365) =$$
$$= 21,8835 \text{ thousand lei}$$

$$\hat{y}^{P\,*}_{2010,II} = \hat{y}^{P}_{2010,II} - S^{*}_{II} = 14,819 - (-1,1295) =$$
$$= 15,9485 \text{ thousandlei}$$

$$\hat{y}^{P\,*}_{2010,III} = \hat{y}^{P}_{2010,III} - S^{*}_{III} = 11,839 - 9,0285 =$$
$$= 2,8105 \text{ thousand lei}$$

$$\hat{y}^{P\,*}_{2010,IV} = \hat{y}^{P}_{2010,IV} - S^{*}_{IV} = 8,507 - (-3,4625) =$$
$$= 11,9695 \text{ thousandlei}$$

– For the S^{**}_{j} indexes it will be obtained:

$$\hat{y}^{P\,**}_{2010,I} = \hat{y}^{P}_{2010,I} : S^{**}_{I} = 17,447 : 0,70370$$
$$= 21,8835 \text{ thousand lei}$$

$$\hat{y}^{P\,**}_{2010,II} = \hat{y}^{P}_{2010,II} : S^{**}_{II} = 14,819 : 1,06079 =$$
$$= 13,9698 \text{ thousand lei}$$

$$\hat{y}^{P\,**}_{2010,III} = \hat{y}^{P}_{2010,III} : S^{**}_{III} = 11,839 : 1,52488$$
$$= 7,7639 \text{ thousand lei}$$

$$\hat{y}^{P\,**}_{2010,IV} = \hat{y}^{P}_{2010,IV} : S^{**}_{IV} = 8,507 : 0,87849 =$$
$$= 9,6837 \text{ thousand lei}$$

4. CONCLUSIONS

By comparring the seasonal indexes, $K_j\%$, S^{**}_{j}, $j \in \{I, II, III, IV\}$ determined using the real data and also using the mobile averages method and the multiplying model parabolic method, it can be stated that the differences between them are not significant. It can be easily seen that the trimestrial gross profit is barely affected by the seasonal wave. Therefore, the second and the third semesters show that the seasonal wave did exist and positively influenced the gross profit, while for the first and the fourth trimesters it negatively influenced the evolution of the gross profit.

Table 4.1 Seasonal indexes (%)

Term	I	II	III	IV
Real data	89,27	103,92	115,52	89,89
Adjusted data with mobile averages method	89,633	104,408	117,395	91,021
Adjusted data with parabolic model	70,37	106,079	152,488	87,849

The same conclusion can be reached by analysing the seasonal coefficients that resulted after using the additiv model method.

Following the statistic analisys accomplished using the seasonal indexes, the company board must regardfully plann the incomes and the expenses, and meand for increasing the efficiency and the rentability must also be found for the first and the fourth trimesters.

As a conclusion, the main factor that caused the decrease of the annual gross profit in certain trimesters is the commercial profitableness rate.

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SOME CONSIDERATIONS ON THE CRACK-INCLUSION INTERACTION

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***Abstract*:** *In metallic materials, even in single crystals, the microstructure is influenced by heterogeneities as inclusions, micro-cracks, grain boundaries and dislocations. The theoretical treatment of such homogeneities in materials deal to a new concept of the driving forces* (*configurational forces, material forces*)*, developed on the virtual displacements or velocities of the defects. M. E. Gurtin show that the balance of configurational forces is an autonomous law of nature, in contrast to the original works of Eshelby which say that the constitutive assumptions of the bulk material yields to the expression of the configurational forces. We deduce the tractional forces developed on the crack tip and we indicate a manner of calculation of configurational forces.*

Key words: *configurational forces, stress concentrator, linear shape functions.*
MSC 2010: *74A15, 65D30.*

1. INTRODUCTION

In metals, during deformation, the microstructure is influenced by the heterogeneities such as inclusions, micro-cracks, grain boundaries and dislocations. The local constitutive behavior is closely influenced by the common micro-structural arrangement and particularly from evolution of such defects. In the case of deformation the treatment of heterogeneities is given in context of thermodynamics, introducing the new concept of driving forces acting on the virtual displacements, or on velocities of the defects. In spite of similarity between configurational forces and material forces, which are synonym for the driving forces, in *Gurtin* [8], [9] the balance of configurational forces is considered as an autonomous law of nature, fundamental as *Newton*'s law of motion. Configutational forces can be used in treatment of mechanisms which change the structure in the material and
are determined by the kinematics of these defects: migration of dislocations, shape evolution of inclusions, the growth of the micro-cracks. The interaction of defects, influencing each other is a great significance during the deformation, arising the stress concentrators. Following S. *Kolling* and others [13], we derive the configurational forces acting on a crack tip and on the interface of an inclusion in context of a dilatation eigenstrain of the matrix.

The crack will be represented by an unknown distribution of dislocations to be computed from the resulting singular integral equations, see [3]. Otherwise, it is developed a micro-mechanically based cohesive zone that is based on the assumptions that the inter-granular material can be characterized roughly as an

assemblage of parallel fibrils bridging across grains, see [10].

We analyse an interaction between two small defects: a single crack and an inclusion, we deduce the configurational forces acting on the head of the crack or on the inclusion interface. Some consequences are derived: in spite of anisotropy, the hard inclusion move towards the crack tip and an agglomeration of inclusions take place near the crack tip. Solution include the case of a concentrated force as well, it is sought in connection with the complex potential of *Mushelishvili*'s type, 1955, [13].

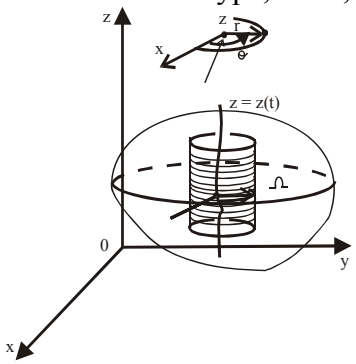

Figure 1. Polar coordinate system connected to the dislocation

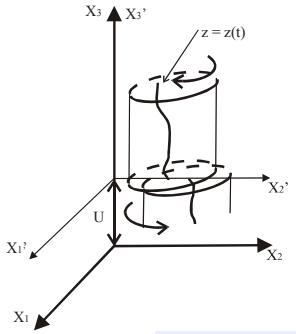

Figure 2. Anti-plane shear to form a screw dislocation

In practical case of fracture mechanics, using *J*-integral method, it is calculated the *energy release rate* on the crack, see also [5], [6], giving an expression like $J = \frac{K^2\left(1-\upsilon^2\right)}{E} + \eta_p \frac{U_p}{\pi b^2}$, with $U_p = \int_0^{u_p} P du$, where K is the stress intensity factor, E is the *Young*'s modulus, υ is the *Poisson*'s ratio, U_p is the plastic strain work, u_p is the plastic part of the displacement, η_p is a factor dependent on u_p, for material with hardening, P is the applied load on the material, see [10].

The structure of this paper is organized as follows: in Section 2 is defined the state parameters on a crack tip, in the Section 3 it is formulated the nonlinear problem of the quasi-static equilibrium of pseudo-momentum and are given the conditions for the general state function. The hypothesis of a polynomial asymptotic behavior permit us the fruitful considerations. The fourth section cover the calculation of the configurational forces, concerning a quasi-linear behavior of the state function. Some technological consequences are deduced.

2. SOME CONSIDERATIONS ON THE CONFIGURATIONAL FORCES

Let $R(t)$ be a *migrating control volume* (*mcv*) into material, having a infinite cylindrical shape, including a screw dislocation $z = Z(t)$, $t \in \mathcal{T}$, $\mathcal{T}$ being an finite time interval. We consider a transversal section $\Omega(t) \subset R(t)$, lying in the plane $\{e_1, e_2\}$, the unit normal vector to $\Omega(t)$ is e_3. The state of deformation in this section is characterized by the following tensors: the vector of deformation γ, the scalar velocity v of the migrating domain $R(t)$, which satisfy the compatibility conditions: $rot\gamma = 0$, $\dot{\gamma} = \nabla v$. The material presents a single dislocation $z = Z(t) \subset R(t)$, $t \in \mathcal{T}$, characterized by the modulus of *Burger* b, $b = \left\|\vec{b}\right\|$, $\vec{b} = be_3$ is the *Burger* vector of non-enclosure, given by

$$b = \oint_l \gamma d\vec{r}\,, \qquad (2.1)$$

where $(l) \subset R(t)$ is a closed, regular curve, surrounding the dislocation.

The equilibrium equation of the torsional stress τ is given by $div\,\tau = 0$ in $\Omega(t) - Z(t)$, so that

$$\oint_{disl} \tau.n d\Gamma = 0\,, \text{ on } z = Z(t). \qquad (2.2)$$

The structural lattice of the material is endowed with an internal field of cohesional forces, denoted by *C*, connected on the free energy density ψ, compatible with the second law of thermodynamics for a weakly continuous medium. The tensor field C satisfies the *Eshelby* relation

$$C = \psi.I_2 - \gamma \otimes \tau\,, \qquad (2.3)$$

here $\otimes$ denote the tensorial product of two vectors, $(\vec{a} \otimes \vec{b})(\vec{c}) = (\vec{a}.\vec{c})\vec{b}$, for all $\vec{a}, \vec{b}, \vec{c} \in \mathcal{V}_3$. During deformation, the cohesional forces concentrate on the crack tip, satisfying the equilibrium equation

$$j = \oint_{disl} C n d\Gamma = -g\,, \qquad (2.4)$$

where j is the traction forces on the dislocation, g being the density of configurational forces on the crack tip.

We decompose the parameters of deformational state of the material:

$$\gamma = \gamma^* + \nabla u\,,\ \gamma^* = b\frac{f(\theta)}{r}e_\theta\,, \qquad (2.5)$$

where u is the displacement and γ^* is the singular strain vector on the crack tip, $\int_0^{2\pi} f(\theta)d\theta = 1$;

$$v = v^* + \dot{u}\,,\ v^* = -b\frac{f(\theta)}{r}e_\theta.\dot{Z}(t), \qquad (2.6)$$

v^* being the singular scalar function of velocity on the crack tip, the state parameters $\{\gamma^*, v^*, b\}$ satisfy the compatibility conditions: $\dot{\gamma}^* = \nabla v^*$, $b = \oint_l \gamma d\vec{r}$, that permit us to calculate the scalar displacement function $u : \Omega(t) \to R$, given by expression:

$$u(x_1, x_2, t) = \int_{C_{x_0 x}} \left(\gamma(\xi, t) - b\bar{d}(\xi, t)\right)d\xi\,,$$

$$+ \int_{t_0}^{t} \{v(x_0, \tau) - bd(x_0, \tau)\}d\tau + b_0\,, \qquad (2.7)$$

the constant being chosen as scaled parameter, such that b will characterize the jump of function u along the slide surface in e_3 – direction, here $\bar{d} = f(\theta)d\theta$, $d = -f(\theta)\nabla\theta.\dot{Z}(t)$ have singularities on the crack tip.

We add at these equations an inequality of dissipation on crack tip

$$g.\dot{Z}(t) \le 0\,, \text{ for all } t \in \mathcal{T}, \qquad (2.8)$$

which connects the cohesional forces g and the velocity of the movement of the dislocation. Certainly, the state parameters $\{u, \gamma, v, b, \psi\}$ for a material with a single screw dislocation, submitted to deformation satisfies the second law of the thermodynamics,

$$\frac{d}{dt}\int_{R(t)} \psi dV \le \mathcal{P}(R(t)), \qquad (2.9)$$

where $\mathcal{P}(R(t))$ is the power of external forces and configurational forces,

$$\mathcal{P}(R(t)) = \int_{\partial R(t)} \{v_q.(\tau.n) + Cnq\}d\Gamma\,, \qquad (2.10)$$

here $v_q = v + \gamma.q$ is the migration velocity of crack tip.

We will analyse some elastic behavior of weakly continuous materials. We return to the cylinder submitted to twisting forces. Suppose that the free energy density ψ and internal shear stress τ are dependent of the deformation γ:

$$\psi = \hat{\psi}(\gamma)\,,\ \tau = \hat{\tau}(\gamma), \qquad (2.11)$$

where $\hat{\psi}$, $\hat{\tau}$ are real functions with sufficient regularity in $\Omega(t) - Z(t)$ and satisfy the compatibility condition

$$\hat{\tau}(\gamma) = \frac{\partial\hat{\psi}}{\partial\gamma}(\gamma), \qquad (2.12)$$

In this way we may show that they satisfy the equality in dissipative relation $g.\dot{Z}(t) \le 0$. Indeed, we have $\hat{\tau}(\gamma) = \frac{\partial \hat{\psi}}{\partial \gamma}(\gamma) = \frac{\partial \hat{\psi}}{\partial t}(\gamma).\ \frac{1}{\frac{\partial \gamma}{\partial t}} = \frac{\partial \hat{\psi}}{\partial t}(\gamma).\frac{1}{\dot{\gamma}(t)} \Leftrightarrow$

$$\dot{\hat{\psi}}(\gamma) = \hat{\tau}(\gamma).\dot{\gamma}(t) \qquad (2.13)$$

Definition 2.1. A weakly continuous material is anisotropic linear elastic material, endowed with bi-dimensional tensor L, symmetric and positive definite if and only if

$$\hat{\psi}(\gamma) = \frac{1}{2}\gamma.L\gamma,\ \ \hat{\tau}(\gamma) = L\gamma,\ \text{for all vector } \gamma. \qquad (2.14)$$

Definition 2.2. A weakly continuous material is isotropic linear elastic material, with a positive torsion modulus μ, if and only if $L = \mu I_2$ and

$$\hat{\psi}(\gamma) = \frac{1}{2}\mu|\gamma|^2,\ \ \hat{\tau}(\gamma) = \mu\gamma,\ \text{for all vector } \gamma. \qquad (2.15)$$

Definition 2.3. A weakly continuous material is isotropic non-linear elastic material, endowed with non-linear shearing modulus, iff there exists $\mu(\gamma) = \hat{\psi}'(|\gamma|)\frac{1}{|\gamma|}$, and the free energy density and shearing stress are given by $\hat{\psi}(\gamma) = \tilde{\psi}(|\gamma|),\ \ \hat{\tau}(\gamma) = \mu(\gamma)\gamma\ \ = \tilde{\psi}'(|\gamma|)\frac{\gamma}{|\gamma|}$, for all vector γ. (2.16)

In order to show the finiteness of the total free energy we introduce a similar result like lemma of *Calculus of Variations*.

Lemma 2.1. Let v be a smooth vector field in $\Omega(t) - Z(t)$, such that $\int_{\partial D_\varepsilon} |v.n| d\Gamma < +\infty$ and $\oint_{disl} v.n d\Gamma = 0$, if $\phi = \phi(x_1, x_2, t)$ is a continuous scalar field on $\Omega(t)$ (even in $Z(t)$), then $\oint_{disl}(v.n)\phi\ d\Gamma = 0$.

Proof. The integral $\oint_{\partial D_\varepsilon}(vn)\phi d\Gamma$ defined on the boundary of the small domain D_ε can be rewritten as $\oint_{\partial D_\varepsilon}(vn)\phi d\Gamma = \phi(Z(t))\int_{\partial D_\varepsilon}(v.n)d\Gamma + \int_{\partial D_\varepsilon}\{\phi - \phi(Z(t))\}v.n d\Gamma$. Applying the continuity of the map ϕ, we have

$$\oint(v.n)\phi d\Gamma = \lim_{\varepsilon\to 0}\int_{\partial D_\varepsilon}(v.n)\phi d\Gamma =$$

$$\lim_{\varepsilon\to 0}\phi(Z(t))\int_{\partial D_\varepsilon} v.n d\Gamma +$$

$$\lim_{\varepsilon\to 0}\int_{\partial D_\varepsilon}\{\phi - \phi(Z(t))\}\beta.n d\Gamma =$$

$$\phi(Z(t))\lim_{\varepsilon\to 0}\int_{\partial D}\beta.n d\Gamma = 0, \qquad (2.17)$$

which proves the result.

The linear elastic materials have a great importance because any *mcv* $R(t)$, with $z = Z(t) \in R(t)$ has a free energy density ψ, which determine a total energy differentiable with respect to $t \in \mathbb{T}$. More precisely, we have

Theorem 2.1. Let $R(t)$ be an *mcv* containing a screw dislocation of a linear elastic material, then (in spite of infiniteness of $\int_{R(t)}\psi dV$ on crack tip $Z(t)$), there exists $\frac{d}{dt}\int_{R(t)}\psi dV$ and it is finite.

Proof. Take a material derivative of the free energy density, $\overset{\circ}{\psi} = \frac{D}{dt}\hat{\psi}(\gamma) = \partial_\gamma\hat{\psi}(\gamma).\dot{\gamma}$ (the link between free energy density and tangential stress) $= \hat{\tau}(\gamma).\overset{\circ}{\gamma}$, but in the vicinity of the point $Z(t)$, $\overset{\circ}{\gamma} = \dot{\gamma} + \nabla\gamma.\dot{Z}(t)$ and $\dot{\gamma} = \nabla v$, therefore $\overset{\circ}{\psi} = \hat{\tau}(\gamma)(\nabla v + \nabla\gamma.\dot{Z}(t))$ (using the symmetry of $\nabla\gamma$) $= \hat{\tau}(\gamma)(\nabla v + (\nabla\gamma)^t.\dot{Z}(t))$, $\dot{Z}(t)$ is

independent of spatial variable. We integrate over a *mcv* $R(t)$, which contains $z = Z(t)$. Consider $R_\varepsilon(t) = R(t) - D_\varepsilon(t)$, we have the integrability of $\overset{\circ}{\psi}$ in the sense of *Cauchy principal value*, $\int_{R_\varepsilon(t)} \overset{\circ}{\psi}\, dV = \int_{R_\varepsilon(t)} \tau(\gamma)\nabla\left(v + \gamma.\dot{Z}(t)\right)d\Gamma$ (since $\dot{Z}(t)$ is independent of spatial variable, using *Stokes-Ampere* Theorem) $= \int_{\partial R(t)} \tau.n\left(v + \gamma.\dot{Z}(t)\right)d\Gamma -$ $\int_{R_\varepsilon(t)} (div\tau)v_{\dot{Z}(t)}dV$ (but $div\,\tau = 0$) $= \int_{\partial R_\varepsilon(t)} (\tau.n)v_{\dot{Z}(t)}d\Gamma$. Decompose now $\partial R_\varepsilon(t) = \partial R(t) \cup \partial D_\varepsilon(t)$, we continue $\int_{R_\varepsilon(t)} \overset{\circ}{\psi}\, dV = \int_{\partial R(t)} (\tau.n)v_{\dot{Z}(t)}d\Gamma -$ $\int_{\partial D_\varepsilon} (\tau.n_{\partial D_\varepsilon})v_{\dot{Z}(t)}d\Gamma$. Following the conditions of *Lemma* 2.1, the continuity of $v_{\dot{Z}(t)}$, since $\int_{\partial D_\varepsilon} |\tau.n_{\partial D_\varepsilon}|d\Gamma < +\infty$ and $\oint_{disl} \tau.nd\Gamma = 0$, results $\int_{\partial D_\varepsilon} (\tau.n_{\partial D_\varepsilon})v_{\dot{Z}(t)}d\Gamma = 0$), thus $\int_{R_\varepsilon(t)} \overset{\circ}{\psi}\, dV = \int_{\partial R(t)} (\tau.n)v_{\dot{Z}(t)}d\Gamma$. In this way we deduce

$$\int_{R(t)} \overset{\circ}{\psi}\, dV = \lim_{\varepsilon\to 0} \int_{R_\varepsilon(t)} \overset{\circ}{\psi}\, dV = \lim_{\varepsilon\to 0} \int_{\partial R(t)} (\tau.n)v_{\dot{Z}(t)}d\Gamma = \int_{\partial R(t)} (\tau.n)v_{\dot{Z}(t)}d\Gamma, \quad (2.18)$$

therefore it is finite.

Example 2.1. Deformation of anisotropic elastic material with dislocation. Assume that

$$f(\theta) = \frac{1}{1-e^{-2\pi}}e^{-\theta},\ \theta \in [0,2\pi]. \quad (2.19)$$

Clear, we have $\int_0^{2\pi} f(\theta)d\theta = 1$, we can calculate $u_{\sin g}$ from the relation $\gamma^* = bf(\theta)d\theta = \nabla u_{\sin g} := u^*$, $u_{\sin g}(\theta) = \int_0^\theta bf(u)du = \frac{b(1-e^{-\theta})}{1-e^{-2\pi}}$, which is smooth on $z = Z(t)$, and $\gamma^* = \frac{be^{-\theta}}{1-e^{-2\pi}}\frac{1}{r}e_\theta$ which has a singularity on the curve $z = Z(t)$.

Turning back to the expressions of configurational tensor C from (2.3) and tractional forces j developed on the crack tip from (2.4), we perform the following calculus: $\int_{\partial D_\varepsilon} Cnd\Gamma = -\int \{\gamma^*\tau_{reg}.n + \gamma_{reg}\tau^*.n\}d\Gamma =$ (but $\gamma^* = b\frac{f(\theta)}{r}e_\theta$ and $d\Gamma = \varepsilon d\theta$, then) $= \int_{[0,2\pi]} f(\theta)\tau_{reg}(\hat{x}(\varepsilon,\theta,t),t)d\theta + O(\varepsilon)$, where $\hat{x}(\varepsilon,\theta,t) = Z(t) + \varepsilon\cos\theta.e_1 + \varepsilon\sin\theta.e_2 \to Z(t)$, as $\varepsilon \to 0$, thus we have the traction forces on the crack tip:

$$j = \oint_{disl} Cnd\Gamma := \lim_{\varepsilon\to 0}\int_{\partial D_\varepsilon} C.nd\Gamma = -b\,\tau_{reg}(Z(t))\times e_3 = \tau_{reg}(Z(t))\times\vec{b}, \quad (2.20)$$

named the traction force of *Peach-Koehler* type, here $\vec{b} = -be_3$. Particularly, the expression $j = \mu b\nabla u \times e_3$ is the *Peach-Koehler* forces for an isotropic linear elastic material and $j = b(L\nabla u)\times e_3$ is the Peach-*Koehler* forces for an isotropic linear elastic material acting on the crack tip.

3. NONLINEAR BALANCE OF PSEUDO-MOMENTUM AND CONFIGURATIONAL FORCES

Consider an inhomogeneous elastic-plastic material, governed by the small deformation hypothesis, characterized by the strain energy density $\psi =: \tilde{\psi}(x,\varepsilon)$, depending on the linearized strain tensor $\varepsilon = \frac{1}{2}(\nabla u + \nabla u^t)$ and explicitly on the position x in a Eulerian current reference $R(t)$. We investigate the energy change of the body, following some

ideas of *Eshelby*, see *Kolling* and others [12],

$$\nabla\psi = \frac{\partial\tilde{\psi}}{\partial\varepsilon} : \nabla\nabla u + \frac{\partial\tilde{\psi}}{\partial x}$$

$$:= \sigma : \nabla\nabla u + \frac{\partial\tilde{\psi}}{\partial x}, \qquad (3.1)$$

here the tensor product $\sigma : \nabla\nabla u$ is understands as $\sigma_{ij}.u_{ij,k} := \sigma_{ij}\left(u_{i,k}\right)_{,j}$. Consider the classical equilibrium equation in the quasi-static state $div\sigma + f = 0$, where the body forces density is given. Turning back to (3.1) we have

$$\frac{\partial\tilde{\psi}}{\partial x} = \nabla\psi - div\left(\nabla u^t.\sigma\right) + \nabla u^t.div\sigma$$

$$= div\left(\psi.1 - \nabla u^t.\sigma\right) - \nabla u^t.f,$$

otherwise written

$div\left(\psi.1 - \nabla u^t.\sigma\right) = \nabla u^t.f + \frac{\partial\tilde{\psi}}{\partial x}$. Denote by $C := \psi.1 - \nabla u^t.f$ the configurational stress tensor of *Eshelby* and by $g := -\nabla u^t.f - \frac{\partial\tilde{\psi}}{\partial x}$ the configurational forces, therefore the configurational balance equation is

$$divC + g = 0 \qquad (3.2)$$

Remark 3.1. If the body is homogeneous and no body configurational forces are applied, that is $\frac{\partial\tilde{\psi}}{\partial x}\left(\varepsilon(\tilde{x}),\tilde{x}\right) = -\nabla u^t(\tilde{x}).f(\tilde{x})$, for all $x \in R(t)$, then the configurational stress C is solenoidal, that is $divC = 0$.

Suppose that the total driving forces G, given by the formula

$$G = \int_{R(t)} g dx \qquad (3.3)$$

can be interpreted as a change $\delta\Pi$ of the total potential Π caused by a virtual displacement δx of the position x,

$$\delta\Pi = \frac{\partial\Pi}{\partial x}.\delta x := G.\delta x. \qquad (3.4)$$

The material body $R(t)$ is endowed with a potential Π generated by the configurational forces, the local equilibrium equation (3.3) may be written on a crack tip, considering sur-rounding closed contour Γ_ε of the crack tip, $\Gamma_\varepsilon = \partial B_\varepsilon$, where B_ε is the ball of radius ε, $\vec{n}$ is the inward normal vector of the ball,

$$G = \int_{D_\varepsilon} g dx = \int_{D_\varepsilon} div\left(\psi.1 - \nabla u^t.\sigma\right)dx =$$

$$-\int_{\Gamma_\varepsilon}\left(\psi.1 - \nabla u^t : \sigma\right)d\Gamma = -\int_{\Gamma_\varepsilon} C.nd\Gamma \quad (3.5)$$

This relation is related to the definition of $J-$ integral in fracture machanics, see J.C. *Hill* and other [11]: the derivative of the total potential Π of a system with respect to the crack length s as we find in S. *Kolling* and others [12] is given by

$$J := -\frac{\partial\Pi}{\partial s} = -G := \left(J_1, J_2\right)^t, \quad (3.6)$$

named the *energy release rate*, here the first component is given by $J_1 = -G.\vec{t}$, where $\vec{t}$ is the tangential vector at the crack tip and J_2 is the normal component. Taking account interaction, we focus on a misfitting inclusion and a straight crack, in order to investigate the equilibrium shape, that is the shape which minimizes the total potential energy of the body. In this way, we will calculate the driving forces acting on the interface of inclusion $S(t) = \partial D(t)$. Assume no body forces act on the body $R(t)$ and the total potential can be written as a sum of elastic strain energy, an interfacial part and a *Lagrangian* term considering mass conservation

$$\Pi = \frac{1}{2}\int_D \left(\varepsilon - \varepsilon^0\right) : C\left(\varepsilon - \varepsilon^0\right)dx +$$

$$\frac{1}{2}\int_{R-D} \varepsilon : C\varepsilon dx + \int_S \gamma d\Gamma + \lambda\left(V_D - V^0\right), \quad (3.7)$$

where γ is the interfacial energy density, assumed to be isotropic, $\gamma = ct.$, i.e. γ is not depending on the interface orientation or the curvature and V^0 is the initial volume of the inclusion, ε^0 the initial

strain, V_D is the current volume of the inclusion in expansion.

Defining $[[(.)]]$ the jump operator applied to the quantity $(.)$, defined as difference between outer and inner limit of the quantity $(.)$ across the interface S, suppose that $[[u]]=0$, for all $x \in S$, that is the displacement u is continuous for a coherent interface S. Taking account the expression of G, the total variation of the total potential is

$$\delta\Pi := -\int_S n^t [[C]] n \delta n.\delta\Gamma + \int_S \gamma k \delta n d\Gamma + \int_S \lambda \delta n.d\Gamma + \delta\lambda\left(V_D - V^0\right) = \int_S \left(-n^t [[C]] n + \gamma k + \lambda\right)\delta n.d\Gamma + \delta\lambda\left(V_D - V^0\right). \quad (3.8)$$

Since $\delta\Pi$ vanish on the extremum state, for arbitrary δn and $\delta\lambda$, then the necessary conditions for an equilibrium shape are the following relations:

$\lambda + \tau_n = -n^t [[C]] n + \gamma k + \lambda = 0$, so

$\tau_n = -\lambda = ct.$, $V_D = V^0$ if $\delta\lambda = 0$ and $V_D - V^0 \le 0$, if $\delta\lambda \ge 0$. (3.9)

As a measure of internal resistance we take $\langle \tau_n \rangle := \frac{1}{\sigma(S)} \int_S \tau_n .nd\Gamma$ the mean value of configurational forces on the interface S, here $\tau_n = -g$ and the resultant forces is deduced:

$$R_\tau = \int_S \tau_n .nd\Gamma . \quad (3.10)$$

We introduce

Definition 2.1. One say that an inclusion preserve its equilibrium position if and only if $R_\tau = 0$.

A deviation from the average value $\langle \tau_n \rangle$ of the driving forces, that is $\tau_n - \langle \tau_n \rangle$, acts as a *pressure* on the inclusion, if $\operatorname{sgn}\{\tau_n - \langle \tau_n \rangle\} = -1$ and as a *traction* if $\operatorname{sgn}\{\tau_n - \langle \tau_n \rangle\} = +1$.

4. ON THE CALCULATION OF CONFIGURATIONAL FORCES.

In order to compute the configurational forces, we introduce a weak formulation of the configurational balance equation as in *Kolling* and others [12], multiplying the balance law (3.2) by a test function $\zeta \in C^\infty(R(t))$ and integrating over the domain $R(t)$, then

$$0 = \int_B (\nabla C + g).\zeta dx = -\int_B C : \nabla\zeta dx + \int_B g\zeta dx + \int_{\partial B} Cn\zeta d\Gamma . \quad (4.1)$$

Suppose that ζ vanishes on the free boundary S, which is equivalent to the assumption of a stationary boundary, i.e. a boundary that does not change its position, thus the boundary integral $\int_{\partial R} Cn\zeta d\Gamma$ is identically equal to zero. Take $\zeta = \sum_{j=1}^{n} N_j \xi_j$, where N_i are called the isoparametric shape functions, $\xi_i \in R$ are the coefficients of expansion, $i = 1,2,...,n$, so that $\nabla\zeta = \sum_{j=1}^{n} \nabla N_j \xi_j$ and $\sigma : \nabla\zeta = \sigma : \left(\sum_{j=1}^{n} \nabla N_j \xi_j\right)$ with $B_j = \nabla N_j$. Because the stress tensor is symmetric, the derivatives are assembled in a matrix B_j. Let $R(t) = \bigcup_{l=1}^{n} \Omega_l$ be a finite discretization of the domain $R(t)$, occupied by the elastic-plastic material, inserting $\sigma : \nabla\zeta$ into (4.1) one get $0 = \bigcup_{l=1}^{n} \left\{ \sum_{j=1}^{n} \left[\int_{\Omega_l} \left(C : \nabla N_j - N_j .g\right) dx \right] \xi_j \right\}$, (4.2)

which defines the nodal configurational forces G_j to be $G_j = \bigcup_{l=1}^{n} \left\{ \int_{\Omega_l} N_j g dx \right\} = \bigcup_{l=1}^{n} \left\{ \int_{\Omega_l} C : \nabla N_j dx \right\}$, here C is given by

(2.3). In the same way, using $(3.9)_1$ we get the discrete values of the configurational forces G:

$$G_n^j = \int_{\Omega_j \cap S} \tau_n^j N_j d\Gamma, \ j = 1,2,...,n, \quad (4.3)$$

where $\Omega_j \cap S$ is an element of approach boundary and $N^j(\tilde{x})$ is a linear shape functions, $j = 1,2,...,n$. An equilibrium shape of the inclusion can be obtained changing the position proportional to the driving forces: $x^j \rightarrow$

$$x^j - \alpha G_n^j, \text{ for all } x \in S, \ \alpha \geq 0, \quad (4.4)$$

α is a relaxation parameter, choosing of α influence the convergence of the schema of approximation.

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SOME SIMILARITY BETWEEN MATH AND PROGRAMMING

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Abstract: *The goal of the paper is to describe some similarity between mathematics and programming from the point of view a military university environment – Department of Communication and Information Systems. The text is focused on the importance of these two disciplines for military university student's education development. The author means that both math and programming enable students to acquire very important base stones for technical thinking processes.*

Key words: *algorithmic thinking, math, military university, programming.*
MSC 2010: *97Q60.*

1. INTRODUCTION

It seems that according to the individual DNA constellation, previous type of education, social community and environment, two significant approaches to the problem solving can be recognized:

- database approach;
- creative approach.

The first one is often used by persons who have a very good memory and their previous education correspondents to social sciences. The second one is often used by persons who have the capability of a good analytical thinking and they like to infer from some set of base stones, conditions and logical rules.

2. NEW MILITARY UNIVERSITY STUDENTS' KNOWLEDGE

The author has got the experience that the knowledge of the secondary school math got worse in recent years. The knowledge of programming is generally very weak. Only one fifth of new students have some knowledge of programming.

The most of the students have no experience in programming from the secondary school. The time when almost every new military university student has known programming language possibilities and statements never comes again.

3. STARTING POINT QUESTIONNAIRE RESEARCH

The questionnaire surveys have given some data relevant to the choice of appropriate teaching methods usage. The past experience is that the most important questions are the questions oriented on:

- the type of the finished secondary school;
- next studies after the secondary school;
- the current access to the computer;
- the previous knowledge of IT from the secondary school and from the possible next studies after that secondary school;
- personal relationship to the programming;
- self-assessment of his/her own current IT knowledge oriented on programming.

4. POSSIBLE APPROACH TO PROGRAMMING AT THE MILITARY UNIVERSITY

The programming basics for non-IT oriented study branches are always valuable [1]. It is suitable to select programming language with no difficult integrated development environment (IDE). The students

should fully accept the selected set of terms and well understand possible connections among them. This core knowledge should serve as a base stone for the required algorithmic thinking. The top-down approach to problem solving (step by step refinement) is a key problem of the task.

5. POSSIBLE 'NIGHTMARE EVENT' ELIMINATION

Some students who feel not comfortable in math can have problems also in programming. They afraid of this topic and the 'nightmare event' can occur. In case of this situation, the teacher should solve it sensitively and individually. The self-confidence of those students should be rebuilt with the teacher's help purposefully. It should be done step by step.

6. EXPERIENCE FROM THE UOD IN BRNO

The interesting experience gained at the UoD in Brno in recent years is as follows:

- Students of non-IT branches can acquire the basics of programming without previous knowledge but in some cases it can be on the line of their possibilities.
- Some talented students can be discovered during the teaching process but in some cases some of those students need more time available for much better study results.
- One of the key prerequisite for the success is an unbroken study process during bounded time.
- It seems that the process needs some biological changes in the students' brains neurons connections and it is not possible to accomplish it in some limited time for every individual student.

MS Visual Basic can be used as the first programming language. Students' knowledge from the math can serve as a base stones for examples from the programming. Students can solve such problems in programming language as operations with vectors and matrix operations. A lot of inspiration can be obtained for instance from the books written by U.S. authors Halvorson and Petroutsos [2, 3, 4].

One of the most interesting challenges for students is:

- Database creation in MS Access – the topic of the database is selected according to the individual students' choice.
- Implementation of the interface between Visual Basic and the database.
- Implementing interventions to the database from Visual Basic.

7. CONCLUSION

Both math and programming give the students capabilities for creative logical approach to life problems solving. Underestimation of the math and the programming for future successful studies and work can be dangerous. The way of aiming the human thinking needs time enough and this needed time interval differs for individual students. The usage of an individual approach for specific students is often suitable.

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THE PROFITABLENESS AND THE RISK OF A BUSINESS

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Abstract: *The purpose of any business running in the market economy is to make profit, more precisely the positive difference between the revenues obtained by selling goods (services) and their cost. This indicator is the expression of the company's economic efficiency and it represents its capacity to make profit. If the company makes a negative difference between income and costs, then it has losses which, if repeated, do conduct to bankruptcy.*
The Profitableness Threshold (Pr) *means a measure of the company's flexibility in regard to the fluctuations of its activity, so it is a measure of risk (the Critical Point or the Operational Dead Point). It is the point of the business where turnover covers exploitation expenses, so the result is null.*

Keywords: *profitableness threshold, turnover, minimum turnover, fixed cost, total variable cost, variable cost of a product (service), sale price of a product (service), physical production, total revenues, profit .*

Introduction

As inflation is a threat to money, risk is a threat to gain as well. To invest in a business means to make a compromise between risk and gain. What partners (associates) must know about a business is the nature of the risk, its probable dimensions and the main factors influencing it. Risk also includes the occurrence possibility of some consequences that are not favourable to the business, materialized under the form of obtaining some performances inferior to the estimated ones.

The highest performance a manager can have is keeping under control the company risk and managing it without major turbulences, on the strategic established trajectory. In our opinion, the more severe risks managers can confront themselves with are:

- The risk of not producing the volume of activity covering the companies' costs out of the companies' revenues, risk that can lead to companies' bankruptcy (the exploitation risk);
- The risk of not producing the volume of activity generating the profit necessary to cover the dividends expected by capital owners (by stakeholders), risk that generally take to managers' replacement as a result of discontentment (the profit risk).

The internal risk originates in the specific of every company, being highly connected to the means of managing and developing of all the company's activities.

According to functional optics, the risk analysis needs to study:
- the (economic) exploitation risk;
- the profit risk;
- the bankruptcy or insolvability risk;
- the financial risk;

- the commercial risk.

The Profitableness of a Business

The purpose of any business running in the market economy is to make profit, more precisely the positive difference between the revenues obtained by selling goods (services) and their cost. This indicator is the expression of the company's economic efficiency and it represents its capacity to make profit. If the company makes a negative difference between income and costs, then it has losses which, if repeated, do conduct to bankruptcy.

In order to describe as correctly as possible the profitableness, the following notions shall be explained: profitableness threshold (Pr), turnover (CA) , minimum turnover (Camin), fixed cost (CF), total variable cost (CVt), variable cost of a product (service) (CV1), sale price of a product (service) (Pv), physical production (Q), physical production corresponding to the profitableness threshold (Qpr), total revenues (VT), profit (Pf).

The Profitableness Threshold (Pr) means a measure of the company's flexibility in regard to the fluctuations of its activity, so it is a measure of risk (the Critical Point or the Operational Dead Point). It is the point of the business where turnover covers exploitation expenses, so the result is null. After this threshold, the activity becomes profitable. The profitableness threshold is expressed in the number of produced and sold physical units for which the company collected the appropriate income equal to the sum of the expenses. Algebraically, it is calculated by using the following formula (1):

$$Pr = \frac{CF}{Pv - CV1} \quad (1)$$

The Turnover (CA) represents the revenues resulted of the proper activity of the company, on a determined time period (regularly, of 1 year). „It sums up all the income resulting from trade activities: goods sales, service providing, bank and financial institutions deposals, credit given, stock exchange operations" (Niță Dobrotă, Dicționar de economie, Editura Economică, Bucureşti. 1999, p.104).

Turnover is the indicator reflecting the value of the economic performance and it is used in ranking companies according to the criterion of their economic importance. Turnover is determined by calculating the product between total physical production (Q) and the sale price of a product (service), (Pv). (2)

$$CA = Q \times Pv \quad (2)$$

The Minimum Turnover (CAmin) can also be found in the specialty literature as Critical Turnover or the Operational Dead Point of the business. It also can be named the value expression of the profitableness threshold. It can be determined by calculating the product between the physical value of the profitableness threshold (Qpr) and the sale price of a product (service), (Pv). (3).

$$Camin = Qpr \times Pv \quad (3)$$

The Fixed Costs (CF) represent the value expression of an organization's expenses that do not depend, on a short term (of one year) of the physical production volume. On a medium term (of 3-5 years) and on a long term (of 6-10 years), fixed costs can be influenced of the quantity of the physical production as regards the increase or the decrease of their volume according to the increase of investment (the increase of the production capacity) or the round decrease of production. Moreover, fixed costs consist of: rents (real estate taxes),

administrative and management personnel's wages, costs generated by utilities (building administration, lightening, heating, etc.), value of credit interest rates, insurance, fixed capital amortization, etc.

The Total Variable Costs (CVt) represent the value expression of a company's expenses depending on the quantity of the realized physical production (Q). These expenses have a directly proportional relation with the quantitative evolution of the physical production. in their structure, there are: costs of raw materials necessary to make the products (services), the costs of fuels and energy, direct salaries (workers' wages), contributions to social insurance corresponding to those salaries, costs related to product packaging or service providing, cost for product design.

The Variable Cost of a Product (Service) (CV1) is determined according to the relation (4):

$$CV1 = \frac{CVt}{Q} \quad (4)$$

The Sale Price of a Product (Service) (Pv) represents the revenues obtained for each physical unit sold to clients.

The Physical Production (Q) is the indicator expressing in a quantitative manner all the goods (services) resulting from the organization's economic activity on a short term (of one year).

The Physical Production corresponding to the Profitableness Threshold (Qpr) is the indicator expressing the quantitative level of the physical production in the dead point of the business, more precisely the quantity of sold goods and services necessary to cover the total costs (CT = CF + CVt).

The Total Revenues (VT) or Total Income results from the money revenues corresponding to the sale of goods and services made by the organization.

The Total Costs (CT) result from the sum of CF and CVt.

The Profit (Pf) is an important indicator of the economic efficiency defining the positive difference between total revenues obtained after selling goods (services) and their cost.

The Algebraic Determination of the Profitableness Threshold for Mono-Productive Companies

Case Study: The Company "LUXOR S.A." located in PLOIEŞTI is a mono-productive company producing washing machines. It is managed by three shareholders. For 2009, the company established in its Business Plan the following data:

- Q, yearly physical production …3,000 physical units;
- CF, fixed costs ……600,000 Euros;
- CV, variable cost for a product ….500 Euros;
- P, sale price of a product …….800 Euros.

We have to determine:

a. the algebraic calculation of the profitableness rate of the business;

b. the graphical construction of the profitableness threshold.

Solution:

a. Algebraically, the profitableness rate is determined using the relation (1) as follows:

$$Pr = \frac{CF}{Pv - CV1} \quad (1)$$

$$Pr = \frac{600{,}000}{800 - 500} = 2{,}000 \text{ washing machines}$$

The relation (1) can be determined thus:

CA = CF +CVt (in this case, the exploitation result equals to 0).
CA = Pv*Q; CVt = CV1*Q;
It results that Pv*Q = CF +V1*Q; thus, Pv*Q – V1*Q = CF; Q*(Pv-V1)= CF ;
Pv-V1 represents the gross margin on the product unit and it is noted with MCV".

In an expression of value, the profitableness threshold can be determines by multiplying Qpr with Pv. This expression of value represents the turnover corresponding to the profitableness threshold, CApr (in this case: CApr = 2000*800 =1,600,000 €).

b. The Graphical Construction of the Profitableness Threshold

The graphical construction of the profitableness threshold is made according to the following algorithm:

- The axes OX and OY are drawn and Q and VT (CT) are represented;
- The value of the fixed costs is drawn;
- The values of the variable costs and CT (CF + CVt) are drawn;
- The value of total revenues is drawn;
- A perpendicular is drawn from the crossroads point of total costs and total revenues, on the axis OX;
- The point representing the foot of the perpendicular on OX indicates the dead point of the business or the profitableness threshold.

The determined and graphically represented profitableness threshold is valid for mono-productive company if the following two conditions are fulfilled:

- Variable cost is unitary in relation to the increase of sold production (Q);
- The unitary price "P" is constant, irrespective of Q, thus the market absorbs all the production at the same price.

This graph offers the possibility of analysing the profitableness threshold in QPr, so the company has neither profit nor loss:

- If CA is close to CApr, the profit is unstable;
- If CA < CApr, costs exceed CA, so the company operates with losses;
- If CA > CApr, costs are compensated by CA, so the company make profit.

In the case study already solved, CA >CApr, so the company is profitable.

Pf = CA – (CF + CV) = 2,400,000€ -
-(600,000€ + 1,500,000€) = 300,000€

Or

Pf = Pv*(Q – Qpr) – CV1*(Q – Qpr) =
= 800€*(3,000 – 2,000) - 500€*(3,000 –
- 2,000) = 800,000€ – 500,000€ =
= **300,000€**

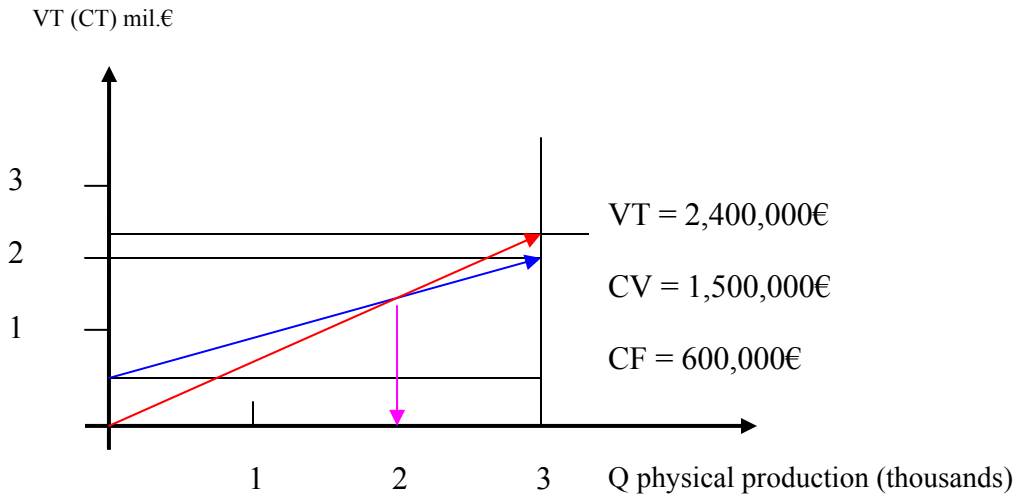

Fig. M1.U3.1. The Graphical Representation of the Profitableness Threshold

The Algebraic Determination of the Profitableness Threshold for Multi-productive Companies. Case Study.

The algebraic determination of the value profitableness threshold for organizations producing and selling a wide range of products. In this case, in order to determine the profitableness threshold value, we use the relation:

$$CApr = \frac{CF}{MCV\%}$$

where: CF are the fixed costs and MCV% represents the margin rate on total variable costs

A company produces three types of products X1, X2, X3. The parameters of the three products are:

For X1: Pv1 = 6€; CV1 = 2€; it results that MCV = 6-2 = 4€;

For X2: Pv2 = 10€; CV2 = 3€; it results that MCV = 10-3 = 7€;

For X3: Pv3 = 14€; CV3 = 7€; it results that MCV = 14-7 = 7€;

Fixed costs = 200,000€

In our case study,

$$MCV = \frac{4+7+7}{3} = 6$$ and

$$Pv = \frac{6+10+14}{3} = 10$$

MCV% represents the margin rate on variable costs, it is noted with Rmcv and calculated according to the following relation:

$$Rmcv = \frac{MCV*100}{Pv} = \frac{6*100}{10} = 60\%(0.60)$$

thus:

$$CApr = \frac{CF}{MCV\%} = \frac{200,000}{0.60} = 333.333\,€$$

and it represents the expression of value of the profitableness threshold of the multi-productive organization (company) for three types of products.

THE MATHEMATICAL MODELLING OF UNCERTAINTY IN BUSINESS

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Abstract: *From an economic point of view, risk is the occurrence chance or the probability of an unfavourable event as regards the decision variants in business. Any business has an inherent risk that can be considered an objective phenomenon. From an optimistic perspective, risk is a progress factor when it is optimally managed. Business risk means both the gain probability and loss probability as well.*
The narrower the distribution of the probability of the expected profitableness rates of a business (project) is, the more probable it is that the real profitableness would be closer to the expected profitableness and the lower the business (project) risk would be.

Keywords: uncertainty, profitableness, used capital, optimistic, realistic, pessimistic, the probability distribution, business, cash flow, the company.

Measuring uncertainty into business consists of calculating an estimated profitableness rate of the business (project), thus:

$$R_{er} = \sum_{i=1}^{n} p_i r_i \quad (1)$$

Source for the relation (1): **Dănescu Tatiana „Business financial management" Ed. Dacia, 2003, pg. 160**

where,
R_{er} - the estimated profitableness rate
p_i - the probability associated to the variant i;
ri – the expected profitableness rate of the variant i;
i - the variant of the alternative scenario;
n – the number of the variant.

We suppose we have a business operating in uncertainty conditions, so we elaborate 3 alternative scenarios:

- the optimistic variant;
- the realistic variant;
- the pessimistic variant.

It is important to associate to the estimated variants the probabilities whose sum to be equal to 1. For each variant, we calculated the probability associated to the respective variant (the expected probability), noted to **p_i – the probability associated to the variant i;**

According to the cash flow forecast to be realized in each of the 3 years and to the capital used in the business, we can determine **the expected profitableness rate** according to the relation:

$$C_u = \frac{Fn1}{1+r} + \frac{Fn2}{(1+r)^2} + \frac{Fn3}{(1+r)^3} \quad (2)$$

where, C_u = used capital;
F_n = the expected cash flow;
r = the expected profitableness rate.

After having determined the expected profitableness rate for every variant, we calculate **the business estimated profitableness rate**, given by the sum of the products of the associated probability and the expected profitableness rate, for every variant, according to relation 1. Source for relation (2)**: Dănescu Tatiana „Business financial management" Ed. Dacia, 2003, pg.158**

Conclusion:
The narrower the distribution of the probability of the expected profitableness rates of a business (project) is, the more probable it is that the real profitableness would be closer to the expected profitableness and the lower the business (project) risk would be.

Case Study:
The international company "Anastassia Oill" with headquarters in TBILISI was founded in 2007, its businesses focusing on fuel – lubricants production and trade, activity with a great future on the Romanian market. In order to settle a retail outlet in Romania, more specifically in the county of Braşov in 2010 (year), the managerial team of the company elaborated two variants of location, presented below:
V1. THE AREA OF THE RAILWAY STATION OF BRAŞOV (Project 1);
V2. THE BARTOLOMEU AREA (Project 2).

For both projects, the corresponding analyses regarding profitableness, profit and risk were made and there were taken into account three variants: OPTIMISTIC, REALISTIC and PESIMISTIC. The capital used for this project is of 284 million Euros. Table 1 presents the basic data necessary for determining the uncertainty and the risk for Project 1.

Alternative scenarios	**Associated probability**	**Cash flow forecast for 3 years - thousands EURO -**	**The profitableness rate of the project (r) - % -**
Optimistic variant	0.60	284 mil €	0.25
Realistic variant	0.30	100 mil €	0.05
Pessimistic variant	0.10	80 mil. €	0.05

$$Cu = \frac{Fn1}{1+r} + \frac{Fn2}{(1+r)^2} + \frac{Fn3}{(1+r)^3}$$

where, C_u = the used capital;
F_n = the expected cash flow;
r = the expected profitableness rate.

The calculation of the estimated profitableness of a business (project)

$$Cu = \frac{Fn1}{1+r} + \frac{Fn2}{(1+r)^2} + \frac{Fn3}{(1+r)^3}$$

- where: Cu = the used capital;

Fn = the expected cash flow;

r = the expected profitableness rate.

- by replacing in the 2nd relation:

1+ r = u and by knowing that $Fn_1 = Fn_2 = Fn_3 = Fn$,

- the relation becomes:

$$\frac{Cu}{Fn} = \frac{1}{u} + \frac{1}{u^2} + \frac{1}{u^3} \Rightarrow \frac{Cu}{Fn}u^3 = u^2 + u + 1 \Rightarrow \frac{Cu}{Fn}u^3 - u^2 - u - 1 = 0$$

$$\Rightarrow \frac{284}{142}u^3 - u^2 - u - 1 = 0 \Rightarrow 2u^3 - u^2 - u - 1 = 0$$

We can determine the value of "u", then the value of "r".

r = u – 1

Solving a third degree equation means applying the following graphical methods: the tangent, the chord and the interval bisectional.

How can we find out the value of "u"?

For the optimistic variant

By giving values to "u", every time we determine the left term. (E.g.: u = 0 ⇒ the left term is negative, then u = 0.1, u = 0.2, u = 0.3, etc. The value of "u" will be placed between the last value for which the left term is negative and the first value for which it is positive, thus: for u = 1.2, the left term of the equation is equal to -0.2; for u = 1.3, the left term of the equation equals 0.2. Consequently, the correct value of "u" will be placed at the half of the interval between 1.2 and 1.3, so it is **1.25**. Next, we can determine for the optimistic variant, the value of r1, by applying the relation:

$$r1 = u - 1 = 1.25 - 1 = 0.25$$

For the realistic variant

$$\frac{284}{100}u^3 - u^2 - u - 1 = 0$$

By calculating identically as for the optimistic variant, the value of "u" will be placed between 1 and 1.1, so it is 1.05. The value of r2 = **0.05**

For the pessimistic variant

$$\frac{284}{80}u^3 - u^2 - u - 1 = 0$$

By calculating identically as for the optimistic variant, the value of "u" will be placed between 0.9 and 1, so it is 0.95. It results that the value of r3 = **0.05**.

Scenarios	Associated probability	Project's (business's) profitableness	The estimated rate $Rer \sum_{i=1}^{n} p_i r_i$
Optimistic	0.60	0.25	0.150
Realistic	0.30	0.05	0.010
Pessimistic	0.10	0.05	0.005
			0.165

$$Rer = \sum_{i=1}^{n} piri = 0.150 + 0.010 + 0.005 = 0.165 \approx 16\%$$

where:

Rer = the estimated profitableness rate;

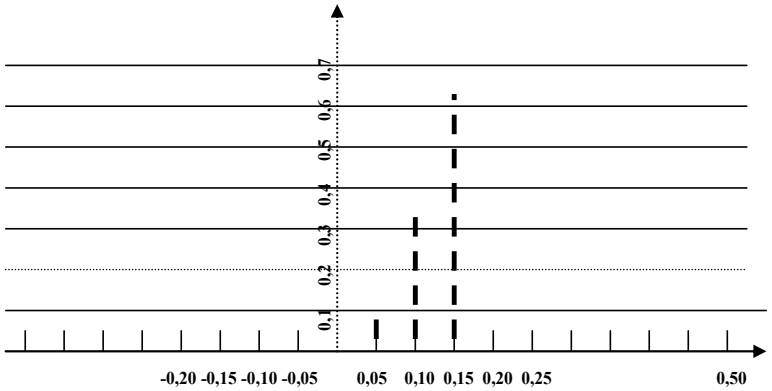
pi = the probability associated to the variant "i"

ri = the expected profitableness rate of the variant "i" ;

i = variant;

r = no. of variants

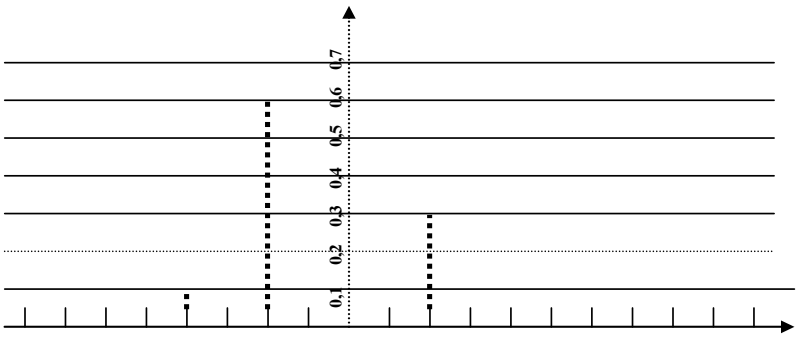
On the basis of data forecast for Project 1, the 1st variant, we can graphically draw the probability distribution, as follows:



The probability distribution Rer of Project 1 (V1)

We suppose that in the 2nd variant, the Project 2 has the probability distribution according to the graph presented below:

Project "2", the 2nd variant



The probability distribution Rer of Project 2 (V2)

Comparing the two probability distributions of the profitableness rates, it results that:

- the probability distribution of the project "V1" is narrower (lower), it is between 0.05 and 0.15;

- the probability distribution of the project "V2" is greater, it is placed on the interval between -0.20 and -0.10.

The narrower the probability distribution of the expected profitableness rates of a business (project), the more probable is that the real profitableness would be closer to the expected profitableness and lower the business (project) risk would be.

Consequently, the "V1" project has a lower risk than the "V2" project.

A MATHEMATICAL MODEL FOR THE STUDY OF VERTICAL AXLE WIND TURBINES

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Abstract: *The current methods used to calculate wind turbine power are presented. These are based on the dynamic equilibrium inside a current tube or on the Jukovsky law relative to the airfoil lift and the Biot-Savart law relative to the free vortex induced velocity. An original method is proposed which tries to couple the two approaches and introduces certain simplifying assumptions required for computing convenience.*

Keywords*: vertical axis wind turbine, lift, Jukovsky law, free vortex, Biot-Savart law*

1.INTRODUCTION

A wind turbine is made up of a wind energy catchment device and an assembly of devices that use the energy to serve the purpose for which the turbine was designed. In fact, the part that catches the wind energy turns it into mechanical power of rotation.

The topic of the present paper is the theoretical study of the turbine rotor. The paper deals with vertical axle rotors having a small number of aerodynamic section blades. The lift effect of the blades leads to the rotation movement of the rotor within a streamlined air stream. The present work aims at obtaining the aerodynamic forces that act upon the blades of the turbine for rotor sizing and for the aerodynamic output of the turbine. The output is expressed through the ratio between the power caught by the rotor and the power of the stream that travels through the projected surface of the rotor on a plane perpendicular to the wind direction. Because most of the vertical axle turbines are provided with straight blades, we will consider the case below.

Consider a horizontal cut through the rotor of a three blade turbine, figure 1.

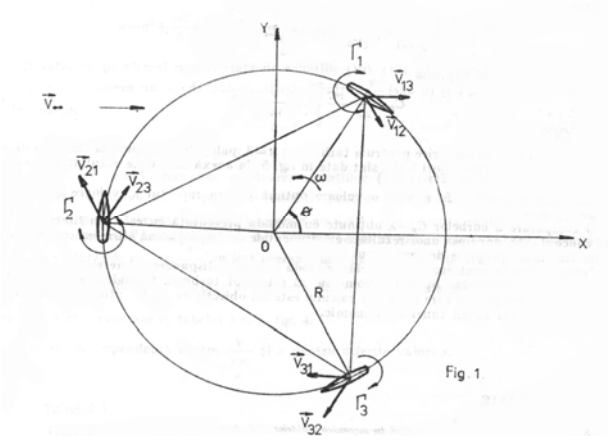

Fig. 1

Also consider a reference system having axis *Ox* in the direction of the speed of the air stream upstream of the turbine, axis *Oz* according to the vertical of the turbine axle, and axis *Oy* resulting from the position of the two just mentioned.

Suppose the air stream movement has a bi-dimensional character. This hypothesis is justified by the low rate of the ratio *c/b.* Let's acknowledge the incompressible fluid because the speed amounts that appear cannot point out the compressibility results.

Having these hypotheses in mind, the study can make use of the general model provided by the mechanics of fluids, the Euler equations system conditioned by appropriate limits. If we also admit the irrotational character of the air movement we obtain a problem of the Dirichlet type for multiply conex domains and an non-permanent state. This problem is difficult to solve in a way applicable to the designing of the wind turbine.

This brought about the building of a particular mathematic model based on the vortex theory and on the equations for the dynamic equilibrium in a stream tube. We anticipate that the proposed model can reveal some effects that cannot be covered by the well-known models already published, except for the model based on the vortex theory. However, the vortex theory model may lead to numerical instability while solving and requires the use of very powerful calculators for obtaining the results. In fact, we mainly take into account the influence of the asymmetry of pale mounting high above the performances of the turbine.

2.THE MATHEMATICAL MODEL

In order to state the aerodynamic performance of the turbine, one should first find the speed rate existing around each blade. Relating to blade *(i)* the relative speed is:

$$\vec{V}_{R_i} = \vec{V} - \vec{\omega}\times\vec{R} + \sum_{j=1}^{n}\vec{V}_{ij};\ j \neq i \qquad (1)$$

For finding the inducted velocity $\vec{V}_{ij}$, we will consider, in the place of blade *(j)*, a rectilinear vortex having the same intensity as the speed circulation around the aerodynamic section of the blade.

From the Bio-Savart law for determining the velocities inducted by a rectilinear vortex results the following:

$$\vec{V}_{ij} = \frac{1}{2\pi}\frac{\vec{e}_{ij}\Gamma_j}{h_{ij}} \qquad (2)$$

The intensity of the vortex filament Γ_j is obtained from the Kutta-Jucovski relation, which refers to the lifting power of a aerodynamic profile:

$$\Gamma_j = \frac{1}{\rho V_{R_j}} L_j \qquad (3)$$

We have used relation (3) in a dimensionless form

$$\overline{\Gamma}_j = \frac{\Gamma_j}{RV_\infty} = \frac{1}{2} C_{L_j}\frac{C}{R}\frac{V_{R_j}}{V_\infty} \qquad (4)$$

The vectors $\vec{e}_{ij}$ have been calculated as follows:

- If (x_i, y_i) are the coordinates of the attached point of the blade *(i)*, we consider the vector $\vec{l}_{ij}$,

$$\vec{l}_{ij} = \frac{x_j - x_i}{h_{ij}}\vec{i} + \frac{y_j - y_i}{h_{ij}}\vec{j}$$

in which

$h_{ij} = \left|\vec{h}_{ij}\right| = \sqrt{(x_j - x_i)^2 + (y_j - y_i)^2}$, $\vec{i}, \vec{j}, \vec{k}$ are the versors of axes *Ox, Oy, and Oz.*

$$\vec{e}_{ij} = \vec{l}_{ij}\times\vec{k} = -\frac{x_j - x_i}{h_{ij}}\vec{j} + \frac{y_j - y_i}{h_{ij}}\vec{i} \qquad (5)$$

The inducted velocity *Vi* results from relations (2) and (5)

$$\vec{V}_i = \sum_{j=1}^{n}\vec{V}_{ij} = \frac{1}{2\pi}\sum_{j=1}^{n}\left(\frac{y_j - y_i}{h_{ij}^{\,2}}\vec{i} - \frac{x_j - x_i}{h_{ij}^{\,2}}\right)\Gamma_j \quad ;$$

$j \neq i \qquad (6)$

It is easier to use the polar coordinates in the place of the cartesian coordinates,
$x = R\cos\theta$ and $y = R\sin\theta$

and

$$\vec{V}_i = \frac{1}{4\pi R}\sum_{j=1}^{n}\frac{1}{\sin\frac{\theta_j - \theta_i}{2}}\left(\cos\frac{\theta_j + \theta_i}{2}\vec{i} + \sin\frac{\theta_j + \theta_i}{2}\vec{j}\right)\Gamma_j$$

$; j \neq i \qquad (7)$

The relative velocity will be:

$$\vec{V}_{R_i} = \left(V + R\omega\sin\theta_i + \frac{1}{4\pi R}\sum_{j=1}^{n}\frac{\cos\frac{\theta_j + \theta_i}{2}}{\sin\frac{\theta_j - \theta_i}{2}}\Gamma_j\right)\vec{i} +$$

$$+\left(-R\omega\cos\theta_i + \frac{1}{4\pi R}\sum_{j=1}^{n}\frac{\sin\frac{\theta_j + \theta_i}{2}}{\sin\frac{\theta_j - \theta_i}{2}}\Gamma_j\right)\vec{j} \qquad (8)$$

The dimensionless values of the velocity module are

$$\frac{V_{R_i}}{V_\infty} = \left\{ \left(\frac{V}{V_\infty} + \lambda \sin\theta_i + \frac{1}{4\pi} \sum_{j=1}^{n} \frac{\cos\frac{\theta_j + \theta_i}{2}}{\sin\frac{\theta_j - \theta_i}{2}} \overline{\Gamma}_j \right)^2 \right.$$

$$\left. + \left(-\lambda \cos\theta_i + \frac{1}{4\pi} \sum_{j=1}^{n} \frac{\sin\frac{\theta_j + \theta_i}{2}}{\sin\frac{\theta_j - \theta_i}{2}} \overline{\Gamma}_j \right)^2 \right\}^{1/2} \quad (9)$$

in which $\lambda = \frac{\omega R}{V_\infty}$

The non-linear system for finding the values $\overline{\Gamma}_i$ results from (4) and (9):

$$\overline{\Gamma}_i = \frac{1}{2} C_{L_i} \frac{C}{R} \left\{ \left(\frac{V}{V_\infty} + \lambda \sin\theta_i + \frac{1}{4\pi} \sum_{j=1}^{n} \frac{\cos\frac{\theta_j + \theta_i}{2}}{\sin\frac{\theta_j - \theta_i}{2}} \overline{\Gamma}_j \right)^2 + \right.$$

$$\left. \left(-\lambda \cos\theta_i + \frac{1}{4\pi} \sum_{j=1}^{n} \frac{\sin\frac{\theta_j + \theta_i}{2}}{\sin\frac{\theta_j - \theta_i}{2}} \overline{\Gamma}_j \right)^2 \right\}^{1/2} ;$$

$j \neq i$ (10)

The non-linearity of the system (10) also results from the expression of the lifting power coefficient C_{L_i} as a function of Γ_j through the incidence angle α_i.

For finding the value of the incidence angle we consider the projections of the relative velocity on the normal line and the tangent line to the blade path, figure 2. (the chord of the blade profile is tangent to the path).

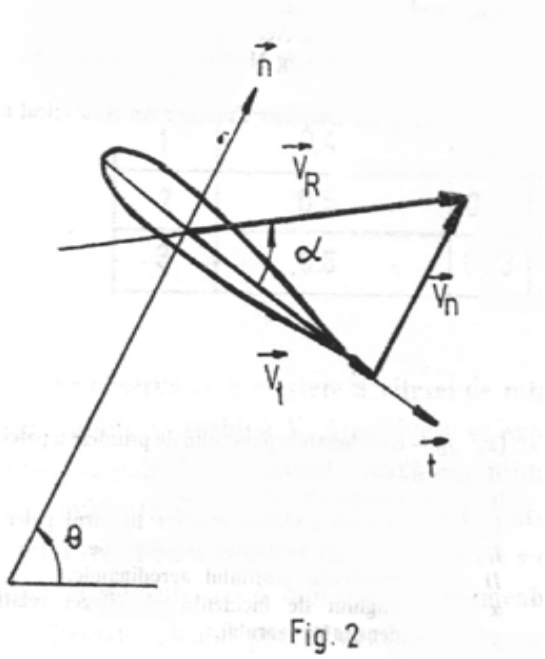

Fig. 2

The equations of the normal versor and of the tangent versor are:

$$\begin{cases} \vec{n} = \cos\theta \vec{i} + \sin\theta \vec{j} \\ \vec{t} = \sin\theta \vec{i} - \cos\theta \vec{j} \end{cases} \quad (11)$$

The expressions of the projections are:

$$\begin{cases} V_{ti} = \vec{V}_{Ri} \cdot \vec{t}_i = V_\infty \left(\frac{V}{V_\infty} \sin\theta_i + \lambda - \frac{1}{4\pi} \sum_{j=1}^{n} \overline{\Gamma}_j \right) \\ V_{ni} = \vec{V}_{Ri} \cdot \vec{n}_i = V_\infty \left(\frac{V}{V_\infty} \cos\theta_i + \frac{1}{4\pi} \sum_{j=1}^{n} \operatorname{ctg} \frac{\theta_j - \theta_i}{2} \overline{\Gamma}_j \right) \end{cases}$$

$j \neq i$ (12)

The incidence angle results from the following relation:

$$\operatorname{tg}\alpha_i = \frac{V_{ni}}{V_{ti}} = \frac{\frac{V}{V_\infty} \cos\theta_i + \frac{1}{4\pi} \sum_{j=1}^{n} \operatorname{ctg} \frac{\theta_j - \theta_i}{2} \overline{\Gamma}_j}{\frac{V}{V_\infty} \sin\theta_i + \lambda - \frac{1}{4\pi} \sum_{j=1}^{n} \overline{\Gamma}_j}$$

(13)

The relation C_L - α is not expressed analytically. Therefore it is necessary that we experimentally test the aerodynamic profile in order to obtain the correspondences through points. For the symmetrical profile NACA 0012 the relation $C_L - \alpha$ is given in tables at various Reynolds numbers and calculations could be done in order to solve systems (10) and (13) with a given value $\frac{V}{V_\infty}$

If $\frac{V}{V_\infty} = 1$, the results for the power coefficient, when λ has high values, are substantially different from the ones cited in publications and obtained experimentally or by other mathematical models. If we consider the area described by the blades of the turbine in rotation closed in a stream tube with the axis in the direction $V\infty$ and if we write the equation of the dynamic equilibrium in this stream tube an estimation for V/V_∞ is obtained.

The average power exerted by the air stream on the turbine is:

$$F_{xc} = 2\rho \cdot 2RbV_\infty^2\left(1-\frac{V}{V_\infty}\right)\frac{V_\infty}{V} \qquad (14)$$

The aerodynamic forces developed on a blade give a component *Fxp* that opposes the air stream, (fig 3),

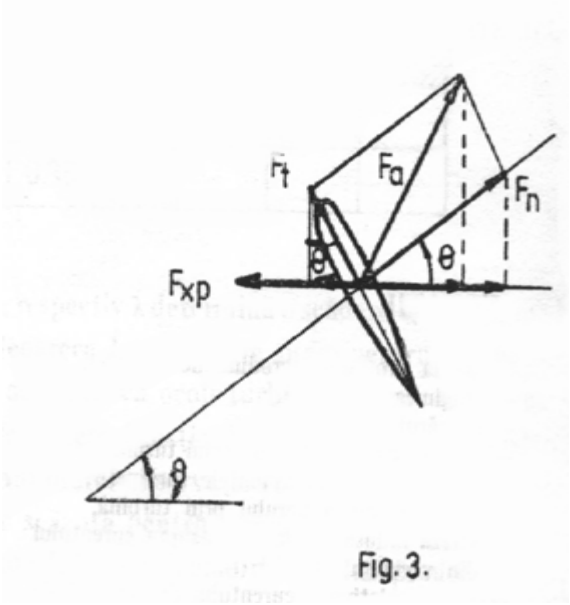

Fig. 3.

$$F_{xp} = -F_t \sin\theta + F_n \cos\theta =$$
$$= \frac{1}{2}\rho cb(-C_t \sin\theta + C_n \cos\theta)V_R^2$$

Ct and *Cn* depend on the lifting power coefficient C_L and on the resistance coefficient C_D as in the following relations:

$$\begin{cases} C_t = C_L \sin\alpha - C_D \cos\alpha \\ C_n = C_L \cos\alpha + C_D \sin\alpha \end{cases} \qquad (15)$$

For *Fxp* the following expression is obtained:

$$F_{xp} = \frac{1}{2}\rho cb[C_L \cos(\alpha+\theta) + C_D \sin(\alpha+\theta)]V_R^2 \qquad (16)$$

The average resistance force exerted by the n blades will be:

$$F_{xp}^* = \frac{n}{4\pi}\rho cb\int_0^{2\pi}[C_L \cos(\alpha+\theta) + C_D \sin(\alpha+\theta)]V_R^2 d\theta \qquad (17)$$

From (14)and (17) the equation for finding V/V_∞ is obtained:

$$\left(1-\frac{V}{V_\infty}\right)\frac{V}{V_\infty} = \frac{1}{16\pi}\frac{nc}{R}\int_0^{2\pi}[C_L \cos(\alpha+\theta) + C_D \sin(\alpha+\theta)]\left(\frac{V_R}{V_\infty}\right)^2 d\theta \qquad (18)$$

We note then $1-V/V_\infty = a$. (18) becomes

$$a = a^2 + \frac{nc}{R}\frac{1}{16\pi}\int_0^{2\pi}[C_L \cos(\alpha+\theta) + C_D \sin(\alpha+\theta)]\left(\frac{V_R}{V_\infty}\right)^2 d\theta \qquad (19)$$

Solving the problem represented by equations (10),(13),(19) is an iterative process that begins by considering a set of initial values for V/V_∞ (or *a)* and $\overline{\Gamma}_i$. We took as initial values the following:

$$\begin{cases} a = 0 \\ \overline{\Gamma}_i = 0 \end{cases} \qquad i = \overline{1,n} \qquad (20)$$

3.REZULTATE NUMERICE

The algorithm supposes solving equations (10) and (13) for given *a* and then, with (19 get new values for a. A theoretical study of the convergence of the method could not be done but the numerical calculations revealed the rapid convergence of the method. To determine the values $\overline{\Gamma}_i$ with 0,01 precision four iterations at the most were needed. The total amount of iterations, including the ones for V/V_∞ smaller the 100.

By this method, the dependence between V/V_∞ and $\lambda = \omega R/V_\infty$, $s = nc/R$ was obtained. The results are presented in table 1 and figure 4.

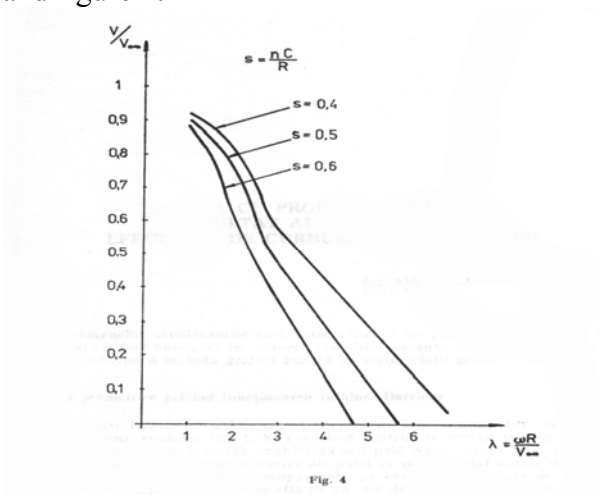

Fig. 4

Table 1. The dependence between V/V_∞ and λ for different values of *s*.

Nr. crt.	$s = \frac{n \cdot c}{R}$	$\lambda = \frac{\omega \cdot R}{V_\infty}$						
		1	2	3	4	5	6	7
1	0.4	0.92	0.82	0.57	0.43	0.29	0.14	
2	0.5	0.90	0.75	0.47	0.29	0.11		
3	0.6	0.88	0.61	0.36				

We can notice that an increase of the rotation speed ω, λ respectively, cause a decrease of the average speed of the stream in the turbine *V*. This is explained by the fact that when the value of λ is high, the area described by the blades becomes stream proof and the air will avoid the turbine. This will also be shown by the representation of the power coefficient based on λ. Likewise, the decrease in speed *V* will be more obvious if *s* value is higher. This remark is in accordance with the assimilation of the rotor surface by a surface having low permeability in favor of a higher *s*.

For the calculation of the power developed by the rotor axle the moment produced by the blades was fixed

$$M = \sum_{i=1}^{n} F_{ti} \cdot R = \frac{1}{2} \rho c b R V_\infty^2 \sum_{i=1}^{n} C_{ti} \left(\frac{V_{Ri}}{V_\infty} \right)^2 \qquad (21)$$

The value of coefficient *Cp* was obtained from the relation $P = M \cdot \omega$.

$$C_p = \frac{P}{\frac{1}{2} \rho 2 R b V_\infty^3} = \frac{\lambda}{2} \cdot \frac{c}{R} \sum_{i=1}^{n} C_{ti} \left(\frac{V_{Ri}}{V_\infty} \right)^2 \qquad (22)$$

Relation (22) gives an instantaneous *Cp* (which was represented at a certain moment by θ).

For the projection practice the average value of *Cp* during one rotation is needed:

$$\overline{C}_p = \frac{1}{2\pi} \int_0^{2\pi} C_p d\theta = \frac{\lambda}{4\pi} \cdot \frac{c}{R} \int_0^{2\pi} \sum_{i=1}^{n} C_{ti} \left(\frac{V_{Ri}}{V_\infty} \right)^2 d\theta$$

But

$$\int_0^{2\pi} \sum_{i=1}^{n} C_{ti} \left(\frac{V_{Ri}}{V_\infty} \right)^2 d\theta = n \int_0^{2\pi} C_t \left(\frac{V_R}{V_\infty} \right)^2 d\theta$$

The final expression is:

$$\overline{C}_p = \frac{\lambda}{2\pi} \cdot \frac{nc}{R} \int_0^{2\pi} C_t \left(\frac{V_R}{V_\infty} \right)^2 d\theta \qquad (23)$$

4. CONCLUZII

Numerical calculations have been done for a turbine with n = 3 and the blades 120° from each other. The different results concerning values of λ and *s* are provided in

figure 5. (the appendix contains the results of the diagram calculation).

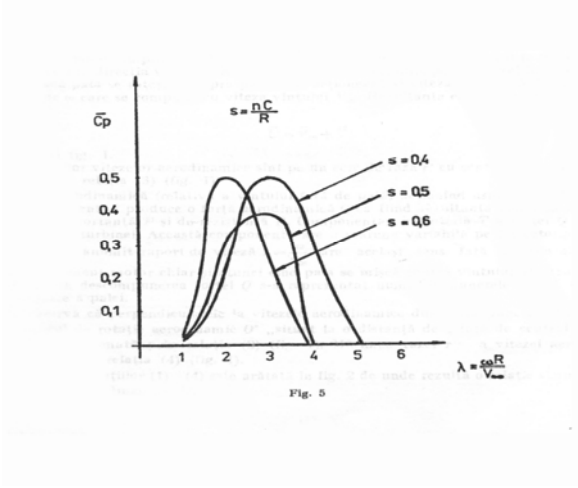

Fig. 5

Examining figure 5, we can notice an optimal value for the ratio λ. This value is characterized by a maximum *Cp*.

The comparison between the curves obtained by this method and the ones from other publications reveals good correspondence, but the lack of some experimental results prevents us from stating which of these results are closer to reality.

We are not going to give up applying the method for an asymmetrical disposition of the blades of a turbine in order to determine the geometrical optimum of the turbine rotor. One of our objectives is to consider other blades, different from the ones for which we have done the calculation. This objective will be met when we have access to a wind tunnel.

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NOTES

c - the chord of the streamlined profile of the blade
b - the length of the blade
n - the number of blades
ω - the angular speed of the turbine rotor
V_∞ - the air speed upstream of the turbine
V - the average speed of the air through the turbine
V_{ij} - the speed inducted by blade (j) upon the stream in the vicinity of blade (i)
V_{Ri} - the relative speed of the air stream reported to blade (i)
h_{ij} - the distance between blades (i), (j)
$\vec{h}_{ij}$ - the direction given by the blade mounting points
$\hat{l}_{ij}$ - direction versor $\vec{h}_{ij}$

(x_i, y_i) - the coordinates of the nipping point of blade (i)
R - radius of the rotor
θ - angular coordinate
Γ_i - the circulation of the relative speed around blade (i)
L - the lifting power of the streamlined profile
D - the resistance of the streamlined profile
α - the incidence angle of the relative speed
ρ - air density
C_L - lifting power coefficient
C_D - resistance coefficient

ABOUT COMPARATIVE ASPECTS OF EDUCATIONAL SOFTWARE APPLICABLE PRE-UNIVERSITY EDUCATION

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Abstract: *The educational environment is growing to include not only the traditional classroom, but also a virtual space on the Internet. For some students, there is no longer a need to spend hours in typical classrooms, entire degrees can be completed using web-based software. This paper discusses current state of the Virtual Classroom Software (VCS.) After having an overview on e-learning starting for the definition itself, I reviewed some of the main aspects, which make e-learning difficult to introduce in the current educational system, such as the old mentality and the lack of technology.*
In this paper is presented a comparative study summary on the class of educational software applied by the author over several years. The study aimed at three specific software: AEL, Moodle and NetSupport SchoolPro with the class that actually worked, the High School "Trades and Services" Buzau. During the work the author has observed features of these programs and the relative advantages of one over the other. These issues are presented in the paper.

Key words: *Distance learning, Computer-based training, I-net-based training*
ACM Computing: *H.3.5.Web-based services*

INTRODUCTION

Virtual education is a term that describes an online education via the Internet. This term is used primarily in higher education but also in higher education. "Virtual classroom" - is a synonym for online courses - courses that are delivered over the Internet. "Virtual" is used here to describe that course is taught in a classroom face-to-face but through platforms that may be associated with teaching in the classroom. A virtual program (or a virtual course of study) is a program of study in which all courses or at least a significant part of training courses are virtual.

Many virtual learning programs are primarily text-based, using HTML, PowerPoint or PDF documents. Multimedia technologies have been studied for many years and eventually found their way into practice. Today, a wide range of training modes available, including the following:

• *Virtual Classroom*: a virtual classroom, a learning environment created in cyberspace. The objectives of virtual classrooms are: improving access to advanced educational experiences for students and instructors who are able to participate in remote learning communities using personal computers to improve education quality and efficiency by using a computer to support learning collaborative.

• *Hypertext Courses*: structured course material is used as a conventional distance education program. However, all materials are delivered electronically and can be viewed with a browser. Hyperlinks connect text and multimedia parts of exercises in a meaningful way.

• *Video-based courses*: are courses like face-to-face class, a lecturer and talk using PowerPoint slides or online examples for illustration. Video streaming technologies are also used. Students watch videos using some freeware software or plug-ins (eg Windows Media Player, RealPlayer).

• *Audio-based courses*: are similar, but instead of moving images, sound files are provided only lecturer. Course pages are often enhanced with a text transcript of course.

• *Animated Training*: text and audio course materials are enriched with animations which generally is a good way to make it more interesting content and appearance. Animations are created using Macromedia Flash or similar technologies. These animations help in understanding key concepts and also to enable better retention of learning.

• *Training-supported Web handbook* based on textbooks. Students read and reflect in their chapters. Review questions, discussion topics, exercises, case studies, etc.. are posted on a website and in contact with the lecturer. Class meetings can be organized to discuss a framework for discussion, for example - forum.

• *Peer-to-peer learning:* courses are taught on demand and without a prepared curriculum. A new area of online education, appeared in 2007 through new online education platform.

Essentials for Computer-mediated communication systems is the concept of being able to use computer skills to adapt a process of human communication in the nature of demand and nature of the group take this call. The specific problem addressed is how to adapt specific functionality that enables a group of instructors and students to make learning in a virtual electronic environment is designed to replace physical class.

Sophistication and flexibility of software structures for supporting distance education vary greatly, from simple electronic mail systems to conferencing systems that have been specially reinforced to support similar classroom experiences, particularly in group discussions and projects.

The methodology used in education to reflect the virtual classroom concept of asynchronous communications group and collaborative approach to education and training. Students are an active part of a group of learning, but learning and understanding is made individually, regardless of the speed of other learners in the group.

Virtual classroom is a teaching and learning environment located within a computer-mediated communication system. Objectives of a Virtual Classroom are to improve access to advanced educational experiences by allowing students and instructors participate in remote learning communities using personal computers at home or at work and to improve quality and efficiency of education using a computer to support collaborative learning. Through collaborative learning means a learning process that emphasizes group or cooperative efforts between the school and students, active participation and interaction from the students and instructors, and new knowledge stemming from an active dialogue among those who exchanged ideas and information.

Learning can be seen as a type of cooperative work. Studies using computer-mediated communication means, the components form a virtual classroom environment have tended to support the view that, for motivated students, this way of learning can be more interactive and more effective than traditional classes (physical).

1. COMMUNICATION AND INTERACTION

Virtual school students can acquire knowledge in a manner typically unidirectional (for example, by studying a video, reading a chapter from the manual). Discussions on problems solving exercises, case studies, review questions, etc.. help students better understand what they have learned before. Electronic media provides a discussion forum, chat rooms, voice mail, email, etc.. to be used for communication.

The topics are usually presented in electronic form, for example, attached to an e-mail. When help is needed, lecturers, tutors, or colleagues, or help available, just like a real school. The difference is that all communications go through the electronic media.

A virtual classroom is a learning environment that exists only as digital content is stored, accessed and changed via a computer network and information systems. Everything in

a virtual classroom takes place in a non-physical, virtual classroom nature means that in terms of access, the geographical location of students is not a problem.

Although the term refers to virtual classrooms especially in some areas of learning that exist completely independent of the physical classroom, but they can also work in conjunction with traditional classroom environments. Some activities in the real class can be presented differently in the virtual space thus providing a wider range to the needs of students.

The virtual classroom are evident two main learning styles: active and collaborative. Virtual classrooms tend to encourage collaborative learning, as more information and knowledge can be gained through interaction and involvement with virtual class members than just receiving information from an instructor.

2. VIRTUAL CLASS PLATFORMS

Most virtual study programs use an e-learning platform to administer students and courses and to provide learning content.

- **Macromedia Breeze** is one of the newest VCS. Macromedia Breeze has three different functions:

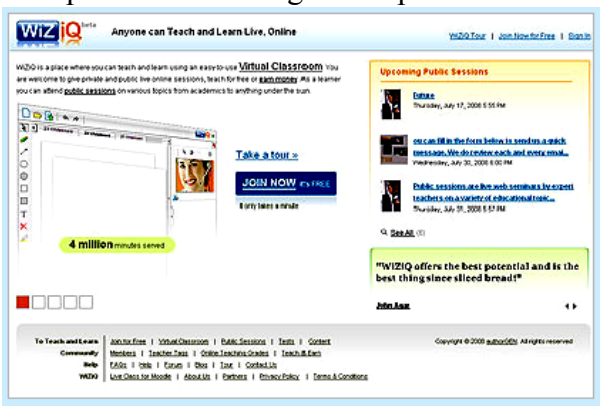
- Breeze presentation platform – converts PowerPoint presentation to simpler flash presentation.
- Breeze training – offers course management assessment and tracking tools.

- Breeze Live – allows users to show live or recorded video and audio, screen sharing, and application
- sharing

- **Horizon Live** is one of the best programs. It had all the features that make great virtual classroom software. Horizon Wimba Live Classroom is virtual classroom software that combines state-of-the-art interactive technologies such as voice, application sharing, polling and whiteboarding. It enables teachers to add greater interaction to their online delivery and to foster better communication with students.

Organisations can also use it for online meetings, briefing sessions, presentations, conference sessions and professional development events. It has special benefits for cross-campus, interstate or international communication and networks.

- **Microsoft Office Live Meeting** is a commercial subscription-based web conferencing service operated by Microsoft. Live Meeting includes software that is installed on client PCs, and uses a central server for all clients to connect to. Currently, those servers are under the control of Microsoft, however, Microsoft also produces Office Communications Server which is an enterprise conferencing server product.



- **WiZiQ** is a web-based platform for anyone and everyone who wants to teach and learn live, online. Teachers and students use WiZiQ for its state-of-the-art virtual classroom, to create and share online educational content and tests, and to connect with persons having similar subject interests. Whether you are a teacher or a learner, signing up for a WiZiQ account is free and simple. In the virtual classroom, you can interact online using:

- Images, PowerPoint presentations and documents
- Full way audio and video sharing
- Live chat enhances the interaction amongst the participants
- Control Privileges with you having full control over the session like in real-world classroom

All sessions on WiZiQ are automatically recorded so that you can revisit and even search for a certain topic anytime at your convenience.

- **Ning** is an online platform for people to create their own social networks, launched in October 2005. Ning was co-founded by Marc Andreessen and Gina Bianchini. The social networks running on Ning's service are programmed with PHP and the platform itself is built in Java.

We have used Ning to manage a circle of informations and methods for teachers who use IT & C didactic activity in Buzău County (http://infotehbz.ning.com)

3. E_LEARNING PLATFORMS USED

Since 2003, I have always been concerned about the use of PC in the training process, the use of the lesson as the main instrument or accessory. First I used the computer illustration or help support physics lessons through dedicated software. Are many such softwares which allow to illustrate physical phenomena, if properly formulate a statement by the teacher.

I used **LabView** software to do simulations of physical phenomena, laboratory devices and experiences. In fact the application of visual software category was created specifically for the management and simulation of electronic equipment and automation.

The first program dedicated to teaching that I used and which **ToolBook** has worked well, a software product company Assimetrix.

Since 2006, we started Platforms: AeL, NetSupport School Pro and Moodle.

The first program in this category that we used, **AeL** (Electronically Assistant Lecturer), produced by the firm SIVECO was made available to schools in Romania with a government project. AeL program, launched in 2001, reached High School "Trades and Services" Buzău, in 2005 once the AeL lab. Its implementation at country level and therefore in our school was difficult for several reasons, among which the fact that SIVECO Company, producer of the program could not provide specialists to truly master the program in sufficient high.

The program is designed to manage the complete business school: the teachers, the class catalog by year-end statistical statements. This involves building a database with many records and many required fields. Obviously for a large school building becomes a true database performance.

This aspect requires automatic formation of a specialist network administrator tasks.

These issues have led to project implementation at the country level have more weaknesses, despite certain qualities that you have the program:

• Structuring the herd of students per class, the real official profile class.

• When using the database platform is effective and genuine activities for preparing high school (enrollment, preliminary database, etc..) become export operations.

• Allows work at virtual classroom: auto-complete catalog the activities of that class. These lessons are conducted under the supervision of Professor (synchronous mode) which may require rate, recovery, restructuring in other words, a great flexibility in relation to the content.

• The student can connect to the library of lessons and can browse the contents independently. Because student work is not recorded, the teacher has no information about his work and therefore can not appreciate.

• About 50% of lessons are available free of charge by the net site www.edu.ro. This allows students to bouts lessons anytime and anywhere.

• Package lessons are supplemented with new lessons by providing care company.

• Allows the development of independent learning units which can then be connected to any lesson.

• to build a library of questions that facilitate the creation and customizing tests.

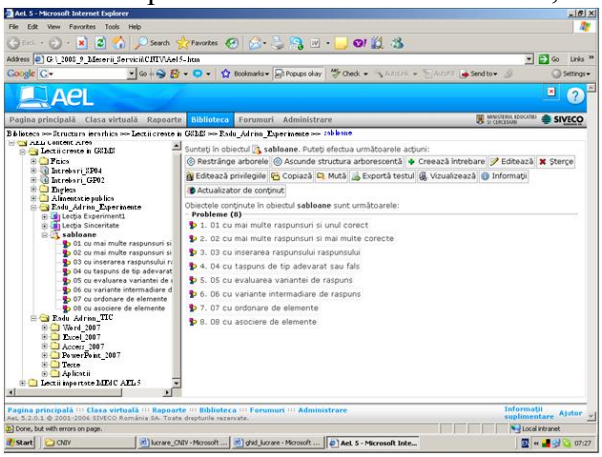
• Has default template for testing.

• Does the channel for discussion.

• AeL schedules filled with ASM software to generate schedules automatically.

Unfortunately, schools were not interested to make their servers connected to the Internet. Lesson preparation, building test that is done only locally. Time's testing is relatively high, so very few teachers are willing to do so. Lately, there was quite a community of teachers concerned with the AeL, which is likely to ensure real success in the final stages of program implementation.

Figure is a screenshot AeL 5.2.0.1, the School Group "Trades and Services" Buzău, the



types of questions that may be included in a test.

Two years ago we started testing programs NetSupport School Pro and Moodle. Are powerful software that allows a complex activity.

NetSupport School Pro program has the following main features:

• to build a virtual classrooms

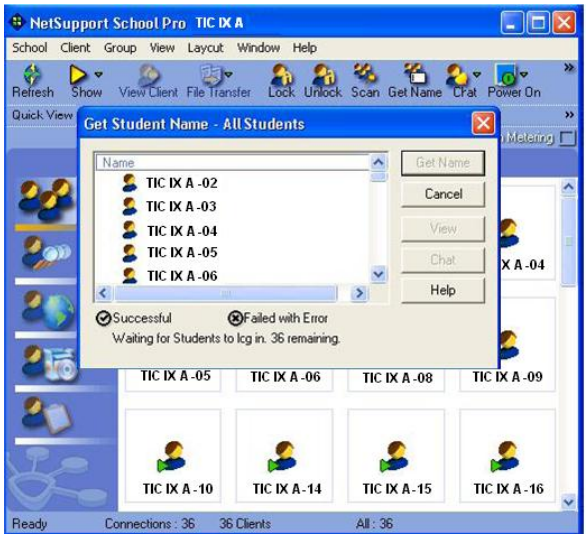
• to build lesson materials as independent units,

• to build a library of test questions,

• material on computers enables students to work independently
• can take over files on the stations where the candidate does or does not do a deal,
• allows you to restrict activity on the net either partially (some address) or total
• the teacher can take over control of the student station,
• has a channel for questions and chat service.

In other words, the program allows the management of classroom teachers with the opportunity for each monitoring station, but does not offer lesson packages. Disadvantages:

• no library lessons
• has included tests
• no test models,
• have export and import opportunities for lessons and tests, but only in its form,
• Automatic scoring can not test



Moodle enable work program of distance learning. Is a program in the category of free (open source), which is a big advantage.

The program is thought to how opposite AEL program. After the teacher creates conditions for the activity (lectures, laboratory activities, homework, tests, support materials for information, etc..), The student takes all the work and support materials used independently, through lessons, tests solve predetermined times (activity calendar can be planned), then receives a note.

This program has no library of lessons or tests, but has a powerful engine for achieving tests with multiple choice questions. Using templates for testing, questions may be constructed on computers which have access to the net. If access to the net, then questions can be built online.

Once made, the categories of questions can be exported in various formats (GIFT, TXT, XML) and subsequently imported into the lessons. These facilities eventually produce large savings in time for the benefit of teachers who create courses or test questions. Tests can be built in a very flexible, and could also test includes questions from different categories, with varying degrees of difficulty. Access courses may be restricted by keys and passwords. It also can restrict the computers IP that you have access.

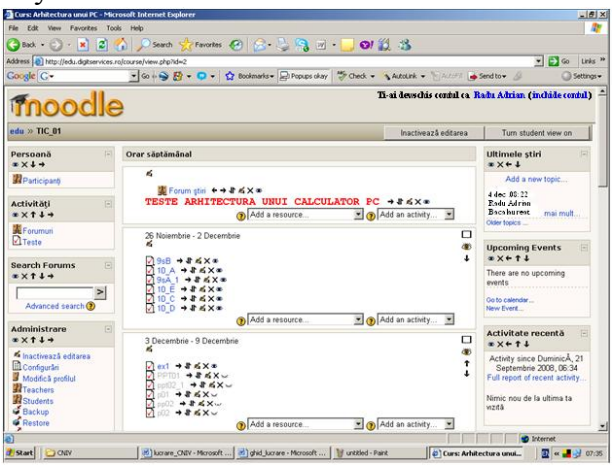


Figure presents a screenshot of this program on a test page.

With this program I worked about 2 years and I think that we achieved good results. I did test package for the Windows operating system, Windows operating system accessories, Word, Excel, PowerPoint, Exercise. These packages can be used in teaching as fasteners, as well as initial assessment and final tests.

Other programs being tested but we have not shown are:

ATutor http://www.atutor.ca
Claroline http://www.claroline.net
Logicampus: http://logicampus.sourceforge.net
TYPO3 http://www.typo3.com
Sakai http://sakaiproject.org

Table 1 presents some comparative aspects of the 3 programs used. Because I used more

time programs, we were able to observe some features that can be advantages but also disadvantages.

In Table 2 are presented data on synthetic work on e-learning systems to High School "Trades and Services" Buzău.

Table 1

Activity	AeL	NetSupport School Pro	Moodle
- allows catalog	Yes	Yes	Yes
- has pre-school profiles	Yes	Not	Not
- a model lesson	Yes	Yes	Not
- has its own library classes	Yes	Not	Not
- is documented in Romanian	Yes	Not	Partly
- is open source	Not	Not	Yes
- can define user roles	Yes	Yes	Yes
- enables import export operations	Yes	Yes	Yes
- enables import export operations in different formats for tests	Not	Not	Yes
- allow monitoring stations during work	Not	Yes	Not
- capture screen allows the student teacher	Not	Yes	Not
- capture screen allows the teacher station	Not	Yes	Not
- can access the net	Yes	Yes	Yes
- school situation can extract statistical	Yes	Nu	Not
- can plan actions (lessons) that students access to certain data	Not	Not	Yes

Table 2

Activity	Number		
	AeL	NetSupport School Pro	Moodle
Printed materials	14	8	5
Lessons supported	46	22	8
Lessons supported (the undersigned)	18	18	8
Accounts teachers	28	5	
Accounts students	380	200	90
Teachers who have played at least one lesson	24	5	2
Open lessons (from the department or to the country level)	9	4	3

Table 3

Question	Responses
AeL system you worked with?	Yes/Not
This year was the first time?	Yes/Not
Do you think it's hard to remember your account working?	Yes/Not
You hardly accustomed to the system interface?	Yes/Not
Do you like lessons in the library system?	Yes/Not
Your rating from 1 to 10 for lessons that you have open.	
You like to work independently with lessons in the library?	Yes/Not
Get higher marks than the **AeL system** by classical tests?	Yes/Not
Give a note between 1 and 10 to operate.	
Considers a percentage from 0 to 100% confidence that you have the notation made by the system.	

Table 4

Class	Weighted average trust the notes given (%)	Average grade for lessons completed	Running average score
10A	95,3	96,3	90,1
10B	90,5	96,9	93,2
10C	92,4	95,4	92,5
10D	97,2	98,8	91,7
11A	94,5	97,7	95,3
11B	87,5	97,9	90,2
11C	89,3	99,2	90,4
12A	92,4	97,3	91,3
12B	79,3	98,4	9,30
12C	79,5	94,5	9,25

At the end of school, I applied a questionnaire to most class (Table 3) the use AeL system. Among the scoring system was also concerned by students on a scale of 1 to 10 and providing a confidence factor percentage from 0 to 100% functioning. The result was surprisingly good for the system, see Table 4, although the marks obtained in the tests were

systematically significantly lower than in conventional assessments.

CONCLUSION

While one can conceptualize most of the functionality that would make up an advanced learning system and even point to ways to implement it, the integration into a single interface that is easy to learn is still a key challenge. An interesting and appropriate interface metaphor adds to the usability and user acceptance of software. That is one reason why we have viewed this as an evolutionary process that must be tied into an evaluation program that provides feedback to the design process. Furthermore, the objective of doing better than the standard approach to education requires that we evaluate effectiveness.

Once we free ourselves from the mental limits of viewing this technology as a weak sister to face-to-face synchronous education, the potentials to revolutionize education and learning become readily apparent.

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AN ALGORITHM FOR QUASI-ASSOCIATIVE AND QUASI-MARKOVIAN RULES OF COMBINATION IN INFORMATION FUSION

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***Abstract**: In this paper one proposes a simple algorithm of combining the fusion rules, those rules which first use the conjunctive rule and then the transfer of conflicting mass to the non-empty sets, in such a way that they gain the property of associativity and fulfill the Markovian requirement for dynamic fusion. Also, a new fusion rule, SDL-improved, is presented.*
***Keywords:** Conjunctive rule, partial and total conflicts, Dempster's rule, Yager's rule, TBM, Dubois-Prade's rule, Dezert-Smarandache classic and hybrid rules, SDL-improved rule, quasi-associative, quasi-Markovian, fusion algorithm*

ACM Classification: I.2.4.

1. Introduction.

We first present the formulas for the conjunctive rule and total conflict, then try to unify some theories using an adequate notation. Afterwards, we propose an easy fusion algorithm in order to transform a quasi-associative rule into an associative rule, and a quasi-Markovian rule into a Markovian rule. One gives examples using the DSm classic and hybrid rules and SDL-improved rule within DSmT. One studies the impact of the VBF on SDLi and one makes a short discussion on the degree of the fusion rules' ad-hoc-ity

2. The Conjunctive Rule:

For n m 2 let T = $\{t_1, t_2, \ldots, t_n\}$ be the frame of discernment of the fusion problem under consideration.

We need to make the remark that in the case when these n elementary hypotheses $t_1, t_2, \ldots, t_n$ are *exhaustive and exclusive* one can use the Dempster-Shafer Theory, Yager's, TBM,

Dubois-Prade Theory, while for the case when the hypotheses are *not exclusive* one can use Dezert-Smarandache Theory, while for non-exhaustivity one uses TBM.

Let m: $2^T \to [0, 1]$ be a basic belief assignment or mass.

The conjunctive rule works in any of these theories, and it is the following in the first theories:

$$\text{for } A \in 2^T, m_c(A) = \sum_{\substack{X,Y \in 2^T \\ X \cap Y = A}} m_1(X) m_2(Y) \quad (1)$$

while in DSmT the formula is similar, but

instead of the power set 2^T one uses the hyper-power set D^T, and similarly m: $D^T \rightarrow [0, 1]$ be a basic belief assignment or mass:

$$A \in D^T, m_c(A) = \sum_{\substack{X,Y \in D^T \\ X \cap Y = A}} m_1(X) m_2(Y) \quad (2)$$

The power set is closed under $\cup$, while the hyper-power set is closed under both $\cup$ and $\cap$ Formula (2) allows the use of intersection of sets (for the non-exclusive hypotheses) and it is called DSm classic rule.

The conjunctive rule (1) and its extension (2) to DSmT are associative, which is a nice property needed in fusion combination that we need to extend to other rules derived from it.
Unfortunately, only three fusion rules derived from the conjunctive rule are known as associative, i.e. Dempster's rule, Smets's TBM's rule, and Dezert-Smarandache classic rule,
the others are not.
For unification of theories let's note by G either 2^T or D^T depending on theories.
The conflicting mass k_{12} is computed similarly:

$$k_{12} = m_c(\varnothing) = \sum_{\substack{X,Y \in G \\ X \cap Y = \phi}} m_1(X) m_2(Y)$$

Formulas (1), (2), (3) can be generalized for any number of masses $s \geq 2$.

3. Associativity.

The propose of this article is to show a simple method to combine the masses in order to keep the associativity and the Markovian requirement, important properties for information
fusion.

Let $m_1, m_2, m_3 : G \rightarrow [0,1]$ be any three masses, and a fusion rule denoted by $\oplus$ operating on these masses. One says that this *fusion rule is associative* if:

$((m_1 \oplus m_2) \oplus m_3)(A) = (m_1 \oplus (m_2 \oplus m_3))(A)$ for all $A \in G$, (4)
which is also equal to $(m_1 \oplus m_2 \oplus m_3)(A)$ for all $A \in G$. (5)

4. Markovian Requirement.

Let $m_1, m_2, m_3 : G \rightarrow [0,1]$ be any $k \geq 2$ masses, and a fusion rule denoted by / operating on these masses. One says that this *fusion rule satisfies Markovian requirement* if: $(m_1 \oplus m_2 \oplus \ldots \oplus m_n)(A) = (m_1 \oplus m_2 \oplus \ldots \oplus m_{n-1}) \oplus m_n)(A)$ for all $A \in G$. (6)

Similarly, only three fusion rules derived from the conjunctive rule are known satisfying the Markovian Requirement, i.e. Dempster's rule, Smets's TBM's rule, and Dezert-Smarandache classic rule.

The below algorithm will help transform a rule into a Markovian rule.

5. Fusion Algorithm.

A trivial algorithm is proposed below in order to restore the associativity and Markovian properties to any rule derived from the conjunctive rule.
Let's consider a rule ® formed by using: first the conjunctive rule, noted by ©, and second the transfer of the conflicting mass to non-empty sets, noted by operator "O" (no matter how
the transfer is done, either proportionally with some parameters, or transferred to partial or total ignorances and/or to the empty set; if all conflicting mass is transferred to the empty set, as in Smets's rule, there is no need for transformation into an associative or Markovian
rule since Smets's rule has already these properties).
Clearly ® = O(©).
The idea is simple, we store the conjunctive rule's result (before doing the transfer) and, when a new mass arises, one combines this new mass with the conjunctive rule's result, not

with the result after the transfer of conflicting mass.
Let's have two masses m_1, m_2 defined as above.
a) One applies the conjunctive rule to m_1 and m_2 and *one stores* the result:
$m_1 © m_2 = m_{c(1,2)}$ (by notation).
b) One applies the operator O of transferring conflicting mass to the non-empty sets, i.e. $O(m_{c(12)})$.
This calculation completely does the work of our fusion rule, i.e. $m_1 © m_2 = O(m_{c(12)})$ that we compute for decision-making proposes.
c) When a new mass, m_3, arises, we combine using the conjunctive rule this mass m_3 with the previous conjunctive rule's result $m_{c(12)}$, not with $O(m_{c(12)})$. Therefore:
$m_{c(1,2)} © m_3 = m_{c(c(1,2),3)}$ (by notation).
One stores this results, while deleting the previous one stored.
d) Now again we apply the operator O to transfer the conflicting mass, i.e. compute $ô(m_{c(c(1,2),3)})$ needed for decision-making.
e) …And so one the algorithm is continued for any number $n \geq 3$ of masses.

The properties of the conjunctive rule, i.e. associativity and satisfaction of the Markovian requirement, are transmitted to the fusion rule ® too.

This is the algorithm we use in DSmT in order to conserve the associativity and Markovian requirement for DSm hybrid rule and SDL improved rule for $n \geq 3$.

Depending on the type of problem to be solved we can use in DSmT either the hybrid rule, or the SDL rule, or a combination of both (i.e., partial conflicting mass is transferred using DSm hybrid, other conflicting mass is transferred using SDL improved rule).

Yet, this easy fusion algorithm can be extended to any rule which is composed from a
conjunctive rule first and a transfer of conflicting mass second, returning the associativity
and Markovian properties to that rule.

One can remark that the algorithm gives the same result if one applies the rule ® to $n \geq 3$ masses together, and then one does the transfer of conflicting mass.
Within DSmT we designed *fusion rules that can transfer a part of the conflicting mass to partial or total ignorance and the other part of the conflicting mass to non-empty initial sets*, depending on the type of application.

A non-associative rule that can be transformed through this algorithm into an associative rule is called *quasi-associative rule*. And similarly, a non-Markovian rule than can be transformed through this algorithm into a Markovian rule is called *quasi-Markovian rule*.

6. SDL-improved Rule. Let $T = \{t_1, t_2, \ldots, t_n\}$ be the frame of discernment and two masses m_1, $m_2 : G \rightarrow [0, 1]$. One applies the conjunctive rule (1) or (2) depending on theory, then one calculates the conflicting mass (3). In SDL improved rule one transfers partial conflicting masses, instead of the total conflicting mass. If an intersection is empty, say $A \cap B = \varnothing$, then the mass $m(A \cap B)$ is transferred to A and B proportionally with respect to the non-zero sum of masses assigned to A and respectively B by the masses m_1, m_2. Similarly, if another intersection, say $A \cap C \cap D = \varnothing$, then again the mass $m(A \cap C \cap D)$ is transferred to A, C, and D proportionally with respect to the non-zero sum of masses assigned to A, C and respectively D by the masses m_1, m_2. And so on 'til all conflicting mass is distributed. Then one cumulates the corresponding masses to each non-empty set.

For two masses one has the formula: (7)

$$\phi \neq A \in D^T,\ m_{SDLi}(A) = \sum_{\substack{X,Y \in G \\ X \cap Y = A}} m_1(X)m_2(Y) + c_{12}(A) \cdot \sum_{\substack{X \in G \\ X \cap A = \phi}} \frac{m_1(X)m_2(A) + m_1(A)m_2(X)}{c_{12}(A) + c_{12}(X)}$$

where $c_{12}(A)$ is the non-zero sum of the mass matrix column corresponding to the set A, i.e. $c_{12}(A) = m_1(A) + m_2(A) \neq \emptyset$. (8)

For more masses one applies the algorithm to formulas (7) and (8).

7. Ad-Hoc-ity of Fusion Rules.

Each fusion rule is more or less ad-hoc. Same thing for SDL improved. There is up to the present no rule that fully satisfies everybody. Let's analyze some of them. *Dempster's rule* transfers the conflicting mass to non-empty sets proportionally with their resulting masses. What is the reasoning for doing this? Just to swallow the masses of non-empty sets in order to sum up to 1?

Smets's rule transfers the conflicting mass to the empty set. Why? Because, he says, we consider on open world where unknown hypotheses might be. Not convincing. *Yager's rule* transfers the conflicting mass to the total ignorance. Should the conflicting mass be ignored? *Dubois-Prade's rule* and DSm hybrid rule transfers the conflicting mass to the partial and total ignorances. Not completely justified either. *SDL improved rule* is based on partial conflicting masses, transferred to the corresponding sets proportionally with respect to the non-zero sums of their assigned masses. But other weighting coefficients can be found. Inagaki (1991), Lefevre-Colot-Vannoorenberghe (2002) proved that there are infinitely many fusion rules based on the conjunctive rule and then on the transfer of the conflicting mass, all of them depending on the weighting coefficients that transfer that conflicting mass. How to choose them, what parameters should they rely on – that's the question! There is not a measure for this. In my opinion, neither DSm hybrid rule nor SDLi rule are not more ad-hoc than other fusion rules. "No matter how you do, people will have objections" (Wu Li).

8. Numerical Examples.

We show how it is possible to use the above fusion algorithm in order to transform a quasi-associative and quasi-Markovian rule into an associative and Markovian one.

Let T = {A, B, C}, all hypotheses exclusive, and two masses m_1, m_2 that form the corresponding mass matrix:

	A	B	$A \cup C$
m_1	0.4	0.5	0.1
m_2	0.6	0.2	0.2

8.1 Let's take the DSm hybride rule:

8.1.1. Let's check the associativity:

a) First we use the DSm classic rule and we get at time t1:
$m_{DSmC12}(A)=0.38$, $m_{DSmC12}(B)=0.10$, $m_{DSmC12}(A \cup C)=0.02$, $m_{DSmC12}(A \cup B)=0.38$, $m_{DSmC12}(B \cap (A \cup C))=0.12$, and one stores this result. **(S1)**

b) One uses the DSm hybrid rule and we get:
$m_{DSmH12}(A)=0.38$, $m_{DSmH12}(B)=0.10$, $m_{DSmH12}(A \cup C)=0.02$, $m_{DSmH12}(A \cup B)=0.38$, $m_{DSmH12}(A \cup B \cup C)=0.12$. This result was computed because it is needed for decision making on two sources/masses only. **(R1)**

c) A new masses, m_3, arise at time t2, and has to be taken into consideration, where
$m_3(A)=0.7$, $m_3(B)=0.2$, $m_3(A \cup C)=0.1$.
Now one combines the result stored at (S1) with m_3, using DSm classic rule, and we get:
$m_{DSmC(12)3}(A)=0.318$, $m_{DSmC(12)3}(B)=0.020$, $m_{DSmC(12)3}(A \cup C)=0.002$, $m_{DSmC(12)3}(A \cap B)=0.610$, $m_{DSmC(12)3}(B \cap (A \cup C))=0.050$, and one stores this result, **(S2)**
while deleting (S1).

d) One uses the DSm hybrid rule and we get:
$m_{DSmH(12)3}(A)=0.318$, $m_{DSmH(12)3}(B)=0.020$, $m_{DSmH(12)3}(A \cup C)=0.002$, $m_{DSmH(12)3}(A \cup B)=0.610$, $m_{DSmH(12)3}(A \cup B \cup C)=0.050$. This result was also computed because it is needed for decision making on three sources/masses only. **(R2)**

e) And so on for as many masses as needed.

First combining the last masses, m_2, m_3, one gets:
$m_{DSmC23}(A)=0.62$, $m_{DSmC23}(B)=0.04$, $m_{DSmC23}(A\cup C)=0.02$, $m_{DSmC23}(A\cap B)=0.26$, $m_{DSmC23}(B\cap(A\cup C))=0.06$, and one stores this result. **(S3)**
Using DSm hybrid one gets:
$m_{DSmH23}(A)=0.62$, $m_{DSmH23}(B)=0.04$, $m_{DSmH23}(A\cup C)=0.02$, $m_{DSmH23}(A\cup B)=0.26$, $m_{DSmH23}(A\cup B\cup C)=0.06$.
Then, combining m_1 with m_{DSmC23} {stored at (S3)} using DSm classic and then using DSm hybrid one obtain the same result (R2).
If one applies the DSm hybride rule to all three masses together one gets the same result (R2).
We showed on this example that DSm hybrid applied within the algorithm is associative (i.e. using the notation DSmHa one has):
$DSmHa((m_1, m_2), m_3) = DSmHa(m_1, (m_2, m_3)) = DSmHa(m_1, m_2, m_3)$.

8.1.2. Let's check the Markov requirement:
a) Combining three masses together using DSm classic:

	A	B	$A\cup C$	
m_1	0.4	0.5	0.1	**(M1)**
m_2	0.6	0.2	0.2	
m_3	0.7	0.2	0.1	

one gets as before: $m_{DSmC123}(A)=0.318$, $m_{DSmC123}(B)=0.020$, $m_{DSmC123}(A\cup C)=0.002$, $m_{DSmC123}(A\cap B)=0.610$, $m_{DSmC123}(B\cap(A4C))=0.050$, and one stores this result in (S2).

b) One uses the DSm hybrid rule to transfer the conflicting mass and we get: $m_{DSmH123}(A)=0.318$, $m_{DSmH123}(B)=0.020$, $m_{DSmH123}(A\cup C)=0.002$, $m_{DSmH123}(A\cup B)=0.610$, $m_{DSmH123}(A\cup B\cup C)=0.050$.

c) Suppose a new mass m_4 arises, $m_4(A)=0.5$, $m_4(B)=0.5$, $m_4(A\cup C)=0$. Use DSm classic to combine m_4 with $m_{DSmC123}$ and one gets: $m_{DSmC(123)4}(A)=0.160$, $m_{DSmC(123)4}(B)=0.010$, $m_{DSmC(123)4}(A\cup C)=0$, $m_{DSmC(123)4}(A\cap B)=0.804$, $m_{DSmC(123)4}(B\cap(A\cup C))=0.026$, and one stores this result in (S3).

d) Use DSm hybrid rule: $m_{DSmH(123)4}(A)=0.160$, $m_{DSmH(123)4}(B)=0.010$, $m_{DSmH(123)4}(A\cup C)=0$, $m_{DSmH(123)4}(A\cup B)=0.804$, $m_{DSmH(123)4}(A\cup B\cup C)=0.026$. **(R4)**

Now, if one combines all previous four masses, m_1, m_2, m_3, m_4, together using first the DSm classic then the DSm hybrid one still get (R4). Whence the Markovian requirement. We didn't take into account any discounting of masses.

8.2. Let's use the SDL improved rule on the same example.
a) One considers the above mass matrix (M1) and one combines m_1 and m_2 using DSm classic and one gets as before:
$m_{DSmC12}(A)=0.38$, $m_{DSmC12}(B)=0.10$, $m_{DSmC12}(A\cup C)=0.02$, $m_{DSmC12}(A\cap B)=0.38$, $m_{DSmC12}(B\cap(A\cup C))=0.12$, and one stores this result in (S1).

b) One transfers the partial conflicting mass 0.38 to A and B respectively:
$x/1 = y/0.7 = 0.38/1.8$; whence $x=0.223529$, $y=0.156471$.
One transfers the other conflicting mass 0.12 to B and $A\cup C$ respectively:
$z/0.7 = w/0.3 = 0.12/1$; whence $z=0.084$, $w=0.036$.
One cumulates them to the corresponding sets and one gets:
$m_{SDLi12}(A) = 0.38+0.223529 = 0.603529$;
$m_{SDLi12}(B) = 0.10+0.156471 + 0.084 = 0.340471$;
$m_{SDLi12}(A\cup C) = 0.02+0.036 = 0.056000$.
c) One uses the DSm classic rule to combine the above m_3 and the result in (S1) and one gets again:
$m_{DSmC(12)3}(A)=0.318$, $m_{DSmC(12)3}(B)=0.020$, $m_{DSmC(12)3}(A\cup C)=0.002$, $m_{DSmC(12)3}(A\cap B)=0.610$, $m_{DSmC(12)3}(B\cap(A\cup C))=0.050$, and one stores this result in (S2) while deleting (S1).

d) One transfers the partial conflicting masses 0.610 to A and B respectively, and 0.050 to B and A4C respectively. Then one cumulates the corresponding masses and one gets:
$m_{SDLi(12)3}(A) = 0.716846$;
$m_{SDLi(12)3}(B) = 0.265769$;
$m_{SDLi(12)3}(A \cup C) = 0.017385$.
Same result we obtain if one combine first m_2 and m_3, and the result combine with m_1, or if we combine all three masses m_1, m_2, m_3 together.

9. Vacuous Belief Function.

SDLi seems to satisfy Smets's impact of VBF (Vacuum Belief Function. i.e. m(T)=1), because there is no partial conflict ever between the total ignorance T and any of the sets of
G. Since in SDLi the transfer is done after each partial conflict, T will receive no mass, not
being involved in any partial conflict. Thus VBF acts as a neutral elements with respect with the composition of masses using SDLi. The end combination does not depend on the number of VBF's included in the combination. Let's check this on the previous example. Considering the first two masses m_1 and m_2 in (M1) and using SDLi one got: $m_{SDLi12}(A) = 0.603529$, $m_{SDLi12}(B) = 0.340471$, $m_{SDLi12}(A \cup C) = 0.056000$.
Now let's combine the VBF too:

	A	B	$A \cup C$	$A \cup B \cup C$
VBF	0	0	0	1
m_1	0.4	0.5	0.1	0
m_2	0.6	0.2	0.2	0

(M2)

a) One uses the DSm classic rule to combine all three of them and one gets again: $m_{DSmC(VBF12)}(A)=0.38$, $m_{DSmC(VBF12)}(B)=0.10$, $m_{DSmC(VBF12)}(A \cup C)=0.02$, $m_{DSmC(VBF12)}(A \cap B)=0.38$, $m_{DSmC(VBF12)}(B \cap (A \cup C))=0.12$, $m_{DSmC(VBF12)}(A \cup B \cup C)=0$ and one stores this result in (S1). b) One transfers the partial conflicting mass 0.38 to A and B respectively: x/1 = y/0.7 = 0.38/1.8; whence x=0.223529, y=0.156471. One transfers the other conflicting mass 0.12 to B and $A \cup C$ respectively: z/0.7 = w/0.3 = 0.12/1; whence z=0.084, w=0.036.
Therefore nothing is transferred to the mass of $A \cup B \cup C$, then the results is the same as above: $m_{SDLi12}(A) = 0.603529$, $m_{SDLi12}(B) = 0.340471$, $m_{SDLi12}(A \cup C) = 0.056000$.

10. Conclusion.

We propose an elementary fusion algorithm that transforms any fusion rule (which first uses the conjunctive rule and then the transfer of conflicting masses to non-empty sets, except for Smets's rule) to an associative and Markovian rule. This is very important in information fusion since the order of combination of masses should not matter, and for the Markovian requirement the algorithm allows the storage of information of all previous masses into the last result (therefore not necessarily to store all the masses), which later will be combined with the new mass. In DSmT, using this fusion algorithm for $n \geq 3$ sources, the DSm hybrid rule and SDLi are commutative, associative, Markovian, and SDLi also satisfies the impact of vacuous belief function.

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THE CALCULUS OF VARIATIONS FOR PROCESSES WITH INDEPENDENT INCREMENTS

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Abstract: *The aim of this paper is to construct the stochastic calculus of variations for general zero mean processes with independent increments and, in particular for general Levy processes without drift. The calculus based on the operators D and δ, is such that for the Gaussian processes they coincide with the Malliavin derivative and Skorohod integral. We introduce the family of polynomials which contains the Sheffer set of polynomials. By using these polynomials it is proved the chaos decomposition theorem of $L^2(\Omega)$. The definition of Malliavin derivative and Skorohod integral for a certain class of stochastic processes is given and it is shown that they are equal.*

Key words: *processes with independent increments, Levy processes, Malliavin's calculus, chaos decomposition, Skorohod integral, orthogonal polynomials.*
MSC 2010*: 60G51, 60H07*

1. INTRODUCTION

The stochastic calculus of variations for general zero mean processes with independent increments developed by Malliavin [7] is a powerful tool in the studying the smoothness of the densities of the solutions of stochastic differential equations.

Some years ago it was shown by Karatzas and Ocone [4] how this calculus can be used in probabilistic numerical methods in financial mathematics. This discovery led to an increase in the interes in the Malliavin calculus and several monographs on this subject are available nowadays: Nualart [8], Oksendal [9], Ikeda Watanabe [3].

The calculus of variations is based on the operator D called Malliavin derivative and Skorohod integral denote with δ. There are two equivalent approaches to definition of the operator D: one as a weak derivative in canonical space and the other one through the chaos decomposition of $L^2(\Omega)$.

The point of view of people working in concrete applied mathematics, Malliavin calculus appears as a rather sophisticated and technical theory which requires an important investment, and this may be discouraging.

The stochastic calculus of variations or Malliavin calculus is a differential calculus on a Gaussian space. In the presentation of the stochastic calculus of variations we have chosen the framework of an arbitrary family of infinitely divisible random variables. The Gaussian part of this family can be described in the terms of the σ-finite measure μ defined on the measurable space (T, A), while the non Gaussian part can be described the σ-finite measure ν on the other measurable space $(T\times X_0, B)$. In Section 2 we combine these measures into the measure π and obtain the analog of the Wiener space for the infinitely divisible distributions. We define a system of generalized orthogonal polynomials, which include, in particular, the Sheffer system of polynomials, and obtain chaos decomposition in the term of these polynomials.

In Section 3 we define the operator D and show that it is generalization of the Malliavin derivative.

In the last section we introduce the operator δ which is adjoint of the operator D. Then we show that this operator can be considered as

Skorohod integral in the Gaussian case (see [13]).

2. THE CHAOS DECOMPOSITION

Let *(Ω, K, P)* be a probability space. Suppose that μ and ν are random measures defined on the measurable spaces (T, A) and (T×X$_0$, B) respectively. Denote $X = X_0 \cup \{\Delta\}$, $G = \sigma(A \times \{\Delta\}, B)$ where $\Delta \notin X_0$. Define a new measure

$$\pi(dtdx) = \mu(dt)\delta_\Delta(dx) + \nu(dtdx \cap (T \times X_0))$$

on the σ-algebra G. Here $\delta_\Delta(dx)$ is the measure which gives mass one the point Δ.

Consider that H = $L^2(\Omega, B, \pi)$ is a real separable Hilbert space with scalar product and the norm of an $h \in H$ will be denoted by $\langle .,. \rangle_H$ and $\|h\|_H$ respectively, i. e. for any $f, g \in H$

$$\langle f; g \rangle_H = E(\pi(hg)) = E\int_{T\times X} h(t,x)g(t,x)\pi(dxdt),$$

$$\|f\|_H^2 = E(\pi(h^2))$$

where through $\pi(f)$ noted the integral of with respect to measure π:

$$\pi(f) = \int_{T\times X} f(t,x)\pi(dtdx)$$

Definition 2.1 We say that a stochastic process $L = \{L(h), h \in H\}$ is an isonormal Levy processes (Levy processes on H) if the following conditions are satisfied:

1. $L(\alpha h + \beta g) = \alpha L(h) + \beta L(g)$ *for all* $h, g \in H$ *and* $\alpha, \beta \in L^\infty$

2. $E[e^{izL}] = \exp(-\frac{1}{2}z^2\int_T h^2(t,\Delta)\mu(dt) + \int_{T\times X_0}(e^{izh(t,x)} - 1 - izh(t,x))\nu(dtdx))$ *for* $z \in \Re$ *and* $h \in H$

Now we will introduce the generalized orthogonal polynomials P$_n$ (see, e.g. [14]). C

Denote by $\bar{x} = (x_1, x_2, ..., x_n, ...)$ a sequence of real numbers.

Define a function F (z, $\bar{x}$) by

$$F(z,\bar{x}) = \exp\left(\sum_{k=1}^{\infty}(-1)^{k+1}\frac{z^k}{k}x_k\right) \qquad (2.1)$$

If $R(\bar{x}) = \left(\lim sup|x_k|^{\frac{1}{k}}\right)^{-1} > 0$ then the series in (2.1) converges for all $|z| < R(\bar{x})$. So the function $F(z,\bar{x})$ is analytic for $|z| < R(\bar{x})$.

Consider an expansion in powers of z of the function $F(z,\bar{x})$

$$F(z,\bar{x}) = \left(\sum_{n=0}^{\infty} z^n P_n(\bar{x})\right).$$

Using this development, one can easily show the following equalities:

$$(n+1)P_{n+1}(\bar{x}) = \sum_{k=0}^{n}(-1)^k x_{k+1} P_{n-k}(\bar{x}), \quad n \geq 0 \qquad (2.2)$$

$$\frac{\partial}{\partial x_1}P_n(\bar{x}) = \begin{cases} 0, & \text{if } l > n, \\ (-1)^{l+1}\frac{1}{l}P_{n-l}(\bar{x}), & \text{if } l \leq n \end{cases} \qquad (2.3)$$

Really, (2.2) and (2.3) follow from

$\frac{\partial F}{\partial z} = \sum_{k=0}^{\infty}(-1)^k z^k x_{k+1} F$, respectively, and

$\frac{\partial F}{\partial x_l} = (-1)^{l+1}\frac{F}{l}z^l$. From (2.3) it follows that

P$_n$ depends only on finite number of variables, namely $x_1, x_2, ..., x_n$. Since $P_0=1$, then (2.2) implies that $P_n(x_1, x_2, ..., x_n)$ is a polynomial with the highest order term $\frac{x_1^n}{n!}$. The first polynomials are $P_1(x_1)=x_1$ and

$$P_2(x_1, x_2) = \frac{1}{2}(x_1^2 - x_2).$$

Using the equality

$F(z,\bar{x}+\bar{y}) = F(z,\bar{x})F(z,\bar{y})$, where

$\bar{y} = (y_1, y_2, ..., y_n, ...)$ and

$\bar{x} + \bar{y} = (x_1 + y_1, x_2 + y_2, ..., x_n + y_n, ...)$ it is easy

to show that

$$P_n\left(\bar{x}+\bar{y}\right)=\sum_{k=0}^{n}P_k\left(\bar{x}\right)P_{n-k}\left(\bar{x}\right) \qquad (2.4)$$

If $\bar{u}(y)=(y,y^2,y^3,...,y^n,...)$ then

$F\left(z,\bar{u}(y)=1+zy\right)$ for $|zy|<1$..

Hence $P_1\left(\bar{u}(y)=y\right)$ and $P_n\left(\bar{u}(y)\right)=0$ for all n≥2. Furthermore, equation (2.4) implies that

$$P_n\left(\bar{x}+\bar{u}(y)\right)-P_n\left(\bar{x}\right)=yP_{n-1}\left(\bar{x}\right) \qquad (2.5)$$

It is possible to find the explicit formula for polynomials P_n. Really, P_n can be written in the following form:

$$P_n\left(x_1,x_2,...,x_n\right)=\sum_{i_1+i_2+...+i_n\le n}a_{i_1,i_2,...i_n}x_1^{i_1}x_2^{i_2}...x_n^{i_n}$$

It is easy to see that

$$\frac{\partial^{i_1+i_2+...+i_n}}{\partial x_1^{i_1}\partial x_2^{i_2}...\partial x_n^{i_n}}=i_1!i_2!...i_n!a_{i_1,i_2,...,i_n}$$

It follows from the equality (2.3) that

$$\frac{\partial^{i_1+i_2+...+i_n}}{\partial x_1^{i_1}\partial x_2^{i_2}...\partial x_n^{i_n}}=\begin{cases}0,\ if\ \ i_1+2i_2+3i_3...+ni_n\neq n\\ (-1)^{n+i_1+i_2+...+i_n}2^{-i_2}3^{-i_3}...n^{-i_n},\\ if\ \ i_1+2i_2+3i_3...+ni_n=n\end{cases}$$

Hence

$$P_n\left(x_1,x_2,...x_n\right)=\sum_{i_1+2i_2+3i_3+...+ni_n}(-1)^{n+i_1+i_2+...+i_n}\cdot\frac{x_1^{i_1}x_2^{i_2}...x_n^{i_n}}{i_1!i_2!...i_n!2^{i_2}3^{i_3}...n^{i_n}} \qquad (2.6)$$

For $h\in H\cap L^{\infty}\left(TxX_0,B,\nu\right)$ let

$$\bar{x}(h)=\left(x_1(h),\ x_2(h),...,x_n(h),...\right)$$

denote the sequence of the random variables, such that

$$x_1(h)=L(h)$$

$$x_2(h)=L\left(h^2\mathbf{1}_{X_0}\right)+\int_{TxX_0}h^k(t,x)\pi(dtdx)=$$
$$=L\left(h^2\mathbf{1}_{X_0}\right)+\pi\left(h^2\right)$$

...

$$x_k(h)=L\left(h^k\mathbf{1}_{X_0}\right)+\int_{TxX_0}h^k(t,x)\nu(dtdx)=$$
$$=L\left(h^k\mathbf{1}_{X_0}\right)+\pi\left(h^k\mathbf{1}_{X_0}\right),\quad k=3,4,...$$

The relation ship between generalized orthogonal polynomials and isonormal Levy process is given by the following result.

Lemma 2.2 Let $h,g\in H\cap L^{\infty}\left(TxX_0,B,\nu\right)$. Then for all *n, m* ≥ *0* we have $P_n\left(\bar{x}(h)\right)$ and

$P_m\left(\bar{x}(g)\right)\in L^2(\Omega)$, and

$$E\left(P_n\left(\bar{x}(h)\right)P_m\left(\bar{x}(g)\right)\right)=\begin{cases}0, & if\quad n\neq m\\ \frac{1}{n!}\left(E\left(L(h)L(g)\right)\right)^n, & if\ n=m\end{cases}$$

For each n≥1 we will denote by $\mathcal{P}_n$ the closed linear subspace of $L^2\left(\Omega,F,P\right)$ generated by the random variables

$$\left\{P_n\left(\bar{x}(h)\right),h\in H\cap L^{\infty}\left(TxX_0,B,\nu\right)\right\}.$$

$\mathcal{P}_0$ will be the set of constants. For *n=1*, $\mathcal{P}_1$ coincides with the set of random variables $\{L(h),h\in H\}$. From Lemma 1 we obtain that $\mathcal{P}_n$ and $\mathcal{P}_m$ are orthogonal whenever $n\neq m$. We will call the space $\mathcal{P}_n$ chaos of order n.

Theorem 2.3 The space $L^2\left(\Omega,F,P\right)$ can be decomposed into the infinite orthogonal sum of the subspace P_n:

$$L^2\left(\Omega,F,P\right)=\bigoplus_{n=0}^{\infty}P_n.$$

Proof. Let $\xi\in L^2\left(\Omega,F,P\right)$ such that ξ is orthogonal to all, n≥0. We have to show that $\xi=0$. For all $h\in H\cap L^{\infty}\left(TxX_0,B,\nu\right)$ we get $E\left(\xi\,P_n\left(\bar{x}(h)\right)\right)=0$. Since from the proof of Lemma 1 we have that $F\left(z,\bar{x}(h)\right)\in L^2(\Omega)$ for all $z<\frac{1}{\|h\|_{L^{\infty}}}$, then $F\left(z,\bar{x}(h)\right)=0$ for $z<\frac{1}{\|h\|_{L^{\infty}}}$.

Using Lemma 1 we obtain:

$$0 = E\left(\xi F\left(z,\bar{x}(h)\right)\right) = E\left(\xi e^{\phi\left(z,\bar{x}(h)\right)}\right) =$$
$$= E(\xi \exp(L\left(\ln\left(1+zh\mathbf{1}_{X_0}\right)\right) + \int_{TxX_0}\left(\ln(1+zh(t,x)) - zh(t,x)\right)$$
$$\cdot \nu(dtdx) + L(zh\mathbf{1}_{\Delta}) - \frac{1}{2}\int_T z^2 h^2(t,\Delta)\mu(dt)))$$

Thus for any $z < \dfrac{1}{\|h\|_{L_\infty}}$

$$E\left(\xi \exp\left(L\left(ln\left(1+zh\,\mathbf{1}_{X_0}\right)\right) + L(zh\mathbf{1}_{\Delta})\right)\right) = 0 \qquad (2.7)$$

Since $E\left(\xi\, F\left(z,\bar{x}(h)\right)\right)$ is an analytic function for

$z < \dfrac{1}{\|h\|_{L_\infty}}$, then

$$E\left(\xi \exp\left(L\left(\ln\left(1+zh\mathbf{1}_{X_0}\right)\right) + L(zh\,\mathbf{1}_{\Delta})\right)\right)$$

has an analytic extension to $z \in [0;1]$ if $h\mathbf{1}_{X_0} > -1$. For any $g \in H \cap L^\infty(TxX_0, B, \nu)$ we have $\left(e^g - 1\right) \in L^\infty(TxX_0, B, \nu)$ and $\left(e^g - 1\right)\mathbf{1}_{X_0} > -1$.

Putting in (2.7) $h = \left(e^g - 1\right)\mathbf{1}_{X_0} + g\mathbf{1}_{\Delta}$ and z=1 we deduce that $E\left(\xi e^{L(g)}\right) = 0$ for all $g \in H \cap L^\infty(TxX_0, B, \nu)$.

3. THE DERIVATIVE OPERATOR

In this section we introduce the operator D. Then we will show that it is equal to the Malliavin derivatives in the Gaussian case (see, e.g., [8]) and to the difference operator defined in [11] in the Poisson case. We will also proof that the derivatives operators defined via the chaos decomposition in [1, 2, 4, 5, 10, 12] for certain Levy processes coincide with the operator D.

We denote by $C_b^\infty\left(R^n\right)$ the set of all infinitely continuously differentiable functions $f : R^n \to R$ such that f and all of its partial derivatives are bounded.

Let S denote the class of smooth random variables such that a random variable $\xi \in S$ has the form

$$\xi = f\left(L(h_1), ..., L(h_n)\right) \qquad (3.1)$$

where f belongs to $C_b^\infty\left(R^n\right)$, $h_1, \ldots, h_n$ are in H, and $n \geq 1$.

Definition 3.1 The stochastic derivative of a smooth random variable ξ of the form (3.1) is the H-valued random variable

$D\xi = \left\{D_{t,x}\xi, (t,x) \in TxX\right\}$ given by

$$D_{t,x}\xi = \sum_{k=1}^{n} \frac{\partial f}{\partial y_k}(L(h_1),..., L(h_n))h_k(t,x)\mathbf{1}_{\Delta}(x) +$$
$$+ (f\left(L(h_1) + h_1(t,x), \ldots, L(h_n) + h_n(t,x)\right) \qquad (3.2)$$
$$- f\left(L(h_1), \ldots, L(h_n)\right))\mathbf{1}_{X_0}(x)$$

We will consider $D\xi$ as an element of

$$L^2(TxX x\Omega) \cong L^2(\Omega, H)$$

namely, $D\xi$ is a random process indexed by the parameter space *TxX*.

Remark 3.2

1. If the measure *ν* is zero or h_k, k=1, … , n from (3.1) such that

$$h_k(t,x) = 0 \quad k = 1, \ldots, n$$

when $x \neq \Delta$ then $D\xi$ coincides with the Malliavin derivative (see, for example, [8]).

2. If the measure μ is zero or h_k, k=1, …, n from (3.1) such that

$$h_k(t,x) = 0 \quad k = 1, \ldots, n$$

when $x = \Delta$ then $D\xi$ coincides with the difference operator defined in [11].

3. If $T = R_+$, the measure μ is the Lebesque measure and X is a metric space and the measure ν is the product of the Lebesque measure times the measure β satisfying

$$\int_M \left(|x|^2 \wedge 1\right)\beta(dx),$$

then D is the operator ∇^- from [12].

Lemma 3.3 Suppose ξ and η are the smooth functionals and $h \in H$ then

$$E(\xi\eta L(h)) = E\left(\xi\langle D\eta; h\rangle_H\right) + E\left(\eta\langle D\xi; h\rangle_H\right)$$
$$+ E\left(\left\langle D\eta; h\mathbf{1}_{X_0} D\xi\right\rangle_H\right) \qquad (3.3)$$

As a consequence of the above lemma we obtain the following result.

Lemma 3.4 The expression of the derivative $D\xi$ given in (3.2) does not depend on the particular representation of ξ in (3.1).

Proof. Let

$$\xi = f(L(h_1),\dots,L(h_n)) = 0.$$

We have to show that $D\xi = 0$. For any $\eta \in S$ and $h \in H$

$$0 = E(\xi\eta L(h)) = E\left(\xi\langle D\eta; h\rangle_H\right) + E\left(\eta\langle D\xi; h\rangle_H\right) + E\left(\left\langle D\eta; h\mathbf{1}_{X_0} D\xi\right\rangle_H\right)$$

Hence

$$E\left(\eta\langle D\xi; h\rangle_H\right) + E\left(\left\langle D\eta; h\mathbf{1}_{X_0} D\xi\right\rangle_H\right) = 0 \qquad (3.4)$$

Replacing η by ξ in (3.6) we obtain

$$\int_{TxX_0} E\left(D_{t,x}\xi\right)^2 h(t,x)\nu(dtdx) = 0$$

Hence $D_{t,x}\xi = 0$.

Substituting this expression into (3.6) we have for all $h \in H$ and $\eta \in S$

$$\int_T E\left(\eta D_{t,\Delta}\xi\right)h(t,\Delta)\mu(dt) = 0$$

The set S is dense in $L^2(\Omega)$ (see Lemma 4.1 [14]) then $D_{t,\Delta}\xi = 0$, which implies the desired result.

4. THE SKOROHOD INTEGRAL

In this section we consider the adjoint of the operator D, and we will show that it coincides with the Skorohod integral [13] in the Gaussian case. So it can be considered as a generalization of the stochastic integral. We will call Skorohod integral and will establish the expression of it in terms of the chaos expansion as well as prove some of its properties.

Definition 4.1 We denote by δ the adjoint of the operator D and will call it Skorohod integral.

The operator δ is closed unbounded operator on $L^2(\Omega; H)$ with values in $L^2(\Omega)$ defined on Dom δ, where Dom δ is the set of processes $u \in L^2(\Omega; H)$ such that

$$\left| E\int_{TxX} D_{t,x}\xi u(t,x)\pi(dtdx)\right| \le c\|\xi\|_{L^2(\Omega)}$$

for all ξ, where c is some constant depending on u.

If $u \in Dom\,\delta$, then $\delta(u)$ is the element of $L^2(\Omega)$ such that

$$E(\xi\delta(u)) = E\int_{TxX} D_{t,x}\xi u(t,x)\pi(dtdx) \text{ for any } \xi. \qquad (4.1)$$

The following proposition shows the behavior of ξ in terms of the chaos expansion.

Proposition 4.2 Let $u \in L^2(\Omega; H)$ with the expansion

$$u(t,x) = \sum_{k=0}^{\infty} I_k\left(f_k(\bullet,t,x)\right) \qquad (4.2)$$

Then $u \in Dom\,\delta$ if and only if the series

$$\delta(u) = \sum_{k=0}^{\infty} I_{k+1}\left(\overline{f}_k\right) \text{ converge in } L^2(\Omega).$$

Recall that $\overline{f}_k$ is a symmetrization of f_k in all its variables is given by

$$\overline{f}_k(t_1,x_1,\dots,t_k,x_k,t,x) = \frac{1}{k+1}\left(f_k(t_1,x_1,\dots,t_k,x_k,t,x)\right.$$
$$\left. + \sum_{i=1}^{k} f_k(t_1,x_1,\dots,t_{i-1},x_{i-1},t,x,t_{i+1},x_{i+1},\dots,t_i,x_i)\right)$$

Proof. The proof is the same as in the Gaussian case (see [8]).

It follows from proposition above that *Dom* δ is the subspace of $L^2(\Omega)$ formed by the processes that satisfy the following condition:

$$\sum_{k=1}^{\infty}(k+1)!\left\|\overline{f}_k\right\|^2_{L^2(TxX)^{k+1}} < \infty \qquad (4.4)$$

If $u \in Dom\,\delta$ then the sum of the series (5.4) is equal to $E\delta(u)^2$.

Note that the Skorohod integral is a linear operator and has zero mean, e.g., $E(\delta(u))=0$ if $u \in Dom\,\delta$. The following statements prove some properties of δ.

Proposition 4.3 Suppose that u is a Skorohod integrable process. Let $\xi \in D^{1,2}$ such that

$$E\left(\int_{TxX}\left(\xi^2+\left(D_{t,x}\xi\right)^2 \mathbf{1}_{X_0}\right)u(t,x)^2\pi(dtdx)\right)<\infty .$$

Then it holds that

$$\delta\left(\left(\xi+1_{X_0}D\xi\right)u\right)=\xi\delta(u)-\int_{TxX}\left(D_{t,x}\xi\right)u(t,x)\pi(dtdx) \quad (4.5)$$

provided that one of the two sides of the equality (4.5) exists.

Proof. Let $\eta \in S$ be a smooth random variables. Then by the duality relation (4.1), we get

$$E\left(\int_{TxX}\left(D_{t,x}\eta\right)\left(\xi+1_{X_0}(x)D_{t,x}\xi\right)u(t,x)\pi(dtdx)\right)=$$
$$=\int_{TxX}E\left(u(t,x)\left(D_{t,x}(\xi\eta)-\eta D_{t,x}\xi\right)\right)\pi(dtdx)=$$
$$=E\left(\eta\left(\xi\left(\delta(u)-\int_{TxX}\left(D_{t,x}\xi\right)u(t,x)\pi(dtdx)\right)\right)\right)$$

and the result follows.

5. CONCLUSIONS

In conclusion, this paper aims to explain the role played by the stochastic calculus of variations in mathematical finance, and it will be useful for researchers working in these fields.

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MATHEMATICAL MODELS IN CHAOTIC SYSTEMS

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Abstract: *In this paper I want to refer to the identification of models of nonlinear dynamic systems using evolutionary algorithms. I will address issues of genetic programming multiobiectiv applicable for dynamic system modeling with chaotic algorithms 'evolutionary' search and optimization are the foundation on the principles of natural evolution and genetics, suitable for a wide range of application domains. Chaos is common in nature, can be found, for example, chemical reactions, optical (laser), electronic circuits, fluid dynamics (convection heat) and so many natural phenomena can be also characterized as chaotic, such as weather, solar activity and many living systems of the body such as nervous system.*

Key words: *Intelligent agents , Neural nets , Chaotic system*
ACM Computing: *I.2.11.Intelligent agents*

INTRODUCTION

One of the most important properties of chaotic systems is their strong dependence over the initial conditions.

A chaotic system is characterized by "unpredictable", which means that simply can not predict how a system will in future carry on a series of observations over time. Due to their critical dependence over the initial conditions and because, in general, initial conditions are not known perfectly, even when we try to control them, these systems are inherently unpredictable.

Any communication system can be considered as a special case of general dynamical system composed of many interacting units. If the components are allowed to interact freely, without external control strictly, then an unreduced interaction process inevitably leads to complex, dynamic, emergence, essentially nonlinear and chaotic structure, or generalized (dynamic, multiple values) self-organization [1-3], extending conventional regular practice of self-organization concept.

Communication practices based on strong human control and completely regular, with predictable dynamics and environmental control systems. In the event that unforeseeable events may take the form of failures or unwanted noise by increasing volume and complication of communication system connections and functions inevitably leads to increased likelihood of unwanted deviations from regular or preprogrammed behaviors, benefits greatly compromising its.

Moreover, such properties are increasingly creativity inherent in autonomous systems and adaptability to environmental changes and individual user requirements. In this paper we analyze these issues in a rigorous analysis by presenting unreduced, nonperturbative of an arbitrary system of interacting with their bodies and to show that such a process of interaction is unreduced.

Unreduced interaction process in any real system leads to the intrinsic, authentic random and ubiquitous in system behavior that can be done in several typical schemes and dynamic complexity lead to universally defined.

Change in strategy and practice new communication system that shape the construction and use, resulting from such

unreduced analysis of system interactions. Universality of our analysis is of particular importance here, because results can be applied at different levels of communication naturally entangled operating system. In particular, we demonstrate the origin of complex dynamics through enormous growth, high efficiency exponential unreduced, causally random system dynamics, with the standard operating system of regular practice. Finally, dynamic derivative universal symmetry or conservation of complexity is introduced as the new guiding principle and a tool for complex dynamic system that should replace the normally scheduled programming.

Paradigm of intelligent communication system is so specified, as we also show [1, 5], a property of intelligence that can be described as a constantly quite high levels, the unreduced dynamic complexity.

1. COMPLEX DYNAMICS OF UNREDUCED INTERACTION PROCESS

We begin with a general expression of multi-component system dynamics (or many-body problem), called here existence equation, fixing the fact of interaction between the system components, and generalizing various model equations:

$$\left\{\sum_{k=0}^{N}\left[h_k(q_k)+\sum_{l>k}^{N}V_{kl}(q_k,q_l)\right]\right\}\psi(Q)= \\ =E\psi(Q), \tag{1}$$

where $h_k(q_k)$ is the "generalized Hamiltonian" of the k-th system component in the absence of interaction, q_k is the degree(s) of freedom of the k-th component (expressing its "physical nature"), $V_{kl}(q_k,q_l)$ is the (generally arbitrary) interaction potential between the k-th and l-th components, (Q) is the system state-function, $Q \equiv \{q_0, q_1, ..., q_N\}$, E is the Eigen value of the generalized Hamiltonian, and summations are performed over all (N) system components.

The generalized Hamiltonian, Eigen values, and interaction potential represent a suitable measure of dynamic complexity defined below and encompassing practically all "observable" quantities (action, energy, momentum, current, etc.) at any level of dynamics. Therefore (1) can express the unreduced interaction configuration at any level of communication network of arbitrary initial structure. It can also be presented in a particular form of time-dependent equation by replacing the generalized Hamiltonian Eigen value E with the partial time derivative operator (for the case of explicit interaction potential dependence on time).

One can separate one of the degrees of freedom, e.g. $q_0 \equiv \xi$, corresponding to a naturally selected, usually "system-wide" entity, such as "embedding" configuration (system of coordinates) or common "transmitting agent":

$$\left\{h_0(\xi)+\sum_{k=0}^{N}\left[h_k(q_k)+V_{0k}(\xi,q_k)\right]+ \right. \\ \left. +\sum_{l>k}^{N}V_{kl}(q_k,q_l)\right\}\psi(\xi,Q)=E\psi(\xi Q) \\ Q\equiv\{q_1,q_2,...,q_N\} \tag{2}$$

One of the most important properties of chaotic systems is their strong dependence on initial conditions. A single drop of rain running down a window pane is a good example of a chaotic system. Each drop is a different way, and there are many initial conditions, such as size and position, conditions of glass, etc. that will influence the road.

Other examples are provided to form a candle flame, the size and direction of formation of bubbles in a liquid when boiling water is boiling, etc.

Due to their critical dependence on initial conditions and because, in general, initial conditions are not known perfectly, even when we try to control them, these systems are inherently unpredictable. As in the example with a drop of rain, any chaotic phenomenon can be described in terms of its trajectory, for

example, the route of many variables over time, tends to evolve. In such a system, developing trajectory, even from very close initial conditions vary exponentially over time, for each instance of repetition of the phenomenon, so the distance between the trajectories (the difference between trajectories successor), also increases Over time, this is the mathematical model chaotic.

A chaotic system often has an apparently alternate aleatoar, but if its trajectory appears in an appropriate graphic, we see that they tend to spread reps, defining areas (or groups of behaviors) phase -space. Phase space can be described by a graph in two dimensions, which are two variables of the phenomenon.

Areas where the trajectory of the system seems to "focus" are known as chaotic attractors, and are often called "wings" because an early model used in the discovery of chaos theory (Lorenz attractor) has two fields, so that when the represented graphically resemble butterfly wings (see illustration below).

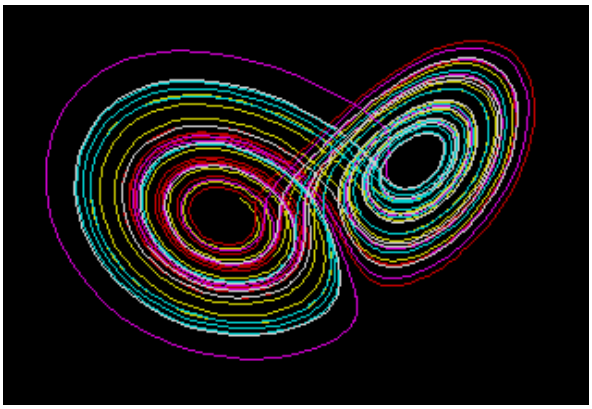

Fig.1 *Picture of the trajectory of a random phenomenon, forming a strange attractor, the shape of butterfly wings.*

2. NEURONAL ACTIVITY AND THE EEG

Fundamental unit of brain called neurons - it is just a scientific term for a single brain cell. A neuron communicates with other neurons through electrical impulses, also called potential, and chemical secretions called neurotransmitters, whose effect is not fully understood.

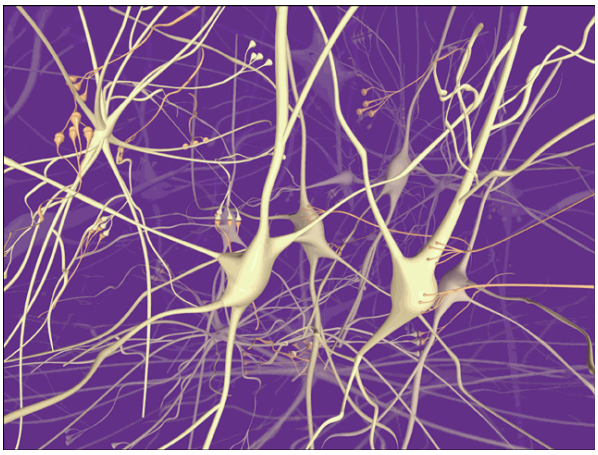

Fig.2 *Graphic representation of neuron*

Electrical signal input to a neuron comes from many others, each with a certain amount of influence, or weight per neuron. When neural networks are activated, they produce a noticeable change in voltage potential that can be captured by a special device called an electroencephalograph (EEG). These changes appear as broken lines along the long axis of a typical EEG recording.

Fig.3 *A typical EEG recording*

EEG data are important for many branches of neuroscience, and in fact more sophisticated experiments in cognitive science have shown that EEG and evoked potentials are strongly correlated with specific cognitive tasks. They also serve to diagnose specific diseases such as epilepsy.

From various experiments, has been well established that neuronal activity in EEG records show many features of chaotic behavior, in other words, the overal system giving origin to the EEG potential, namely the brain, is in chaos.

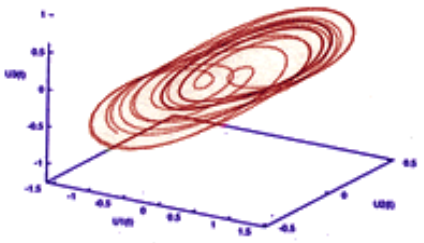

Fig.4 *A 3D periodicity of a neuron attractor Picture by Diek Wheeler*

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EVOLVABLE HARDWARE

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Abstract: *In the recent decades researchers have been working on the application of artificial evolution to autonomous mobile robots capable of adapting their behaviors to changes in the physical environments. For example, the robots in the next generation should be able to interact with humans and carry out work in unstructured environments. As a result, an infant research field called Evolutionary Robotics (ER) has been developed rapidly, which primarily concerned with the use of evolutionary computing techniques for automatic design of adaptive robots. Meanwhile, much attention has been paid to the development of Evolvable Hardware (EHW), which is a new set of integrated circuits capable of reconfiguring their architectures using artificial evolution techniques. Hardware evolution dispenses with conventional hardware designs in solving complex problems in a variety application areas, ranging from pattern recognition to autonomous robotics.*

Key words: *reconfigurable hardware, evolvable hardware, genetic algorithms.*

1. BASIC CONCEPT OF EHW

EHW is based on the idea of combining reconfigurable hardware devices with evolutionary algorithms (e.g., genetic algorithm (GA)) to execute reconfiguration automatically. Artificial evolution and reconfigurable hardware device are two essential elements in EHW. The basic concept behind the combination of these two elements in EHW is to regard the configuration bits for reconfigurable hardware devices as chromosomes for genetic algorithms (1, 2).

Figure 1 illustrates the general evolution process in an evolvable hardware. Typically, an initial population of individuals is randomly generated. Using a user defined fitness function (the desired hardware performance), the GA selects promising individuals in the population to reproduce offspring for the next generation based upon the Darwinian principle of survival of the fittest, If the fitness function is properly designed for a specific task, then the GA can automatically find the best hardware configuration in terms of architecture bits to realize the desired task.

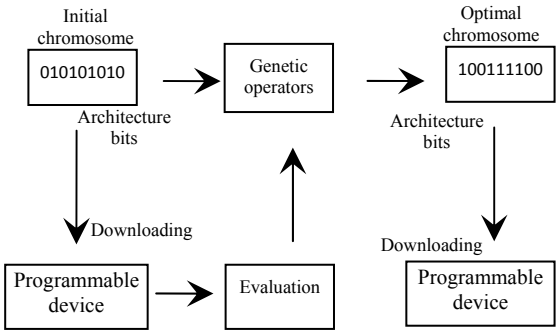

Figure 1 The evolution mechanism of evolvable hardware using genetic algorithms

2. ADVANTAGES OF EVOLVABLE HARDWARE

There are a number of features of evolvable hardware that give the technique some advantages over standard hardware design techniques and standard evolutionary techniques. These new features are discussed as follows.

Novel Hardware Designs

All circuits contain a large number of components. Human designers need to reduce the search space of all function of these components to a manageable size. To do this, they tend to work in a space of lower dimensionality in which they are expert. The evolutionary approach may allow to define the search space in a way that is more natural to both the problem and the implementation, so exploration of designs from the much larger and richer solution space beyond the realms of the traditional hardware search spaces is possible.

Conventional designers work with the abstract models of an implementation, or more general device independent models. Intristic evolvable hardware works directly with the hardware implementation, and can take advantage of any features the device offers over and above those standard hardware models.

Another features arises from real-time interactions between the particular hardware implementation of an evolvable hardware system and its environment, which by definition cannot be simulated perfectly. This class of behaviors is particularly important for real time systems such as industrial or robot controllers, and is different from the normally non simulated dynamic interactions between individual hardware components within the system.

A major distinction between conventional and evolutionary design is that in the latter case the designer must specify the behavior of the circuit, not the architecture. In addition to modeling component and environmental behavior poorly, humans tend to use a restrictive top-down 'divide and conquer' approach to understand the problem through the use of modules. These are normally defined with respect to space or time. The clear benefit that modularization brings with regard to functionality is to circuits with strict global timing rules, for instance digital circuits. In these circuits, task must be completed within a certain time, usually a clock cycle. This means that signal lengths are limited by the width of the clock cycle, or vice versa. Modularization allows the timing constraint to be local each module, allowing these circuit to operate faster, as their critical paths are shorter. Even without phase, evolution may still find modules useful, but modules defined in dimensions other than space and time may be more natural for a given problem, and so lead to better solutions. Artificial evolution is well suited to exploring these areas of space.

LOW COST

Evolution can provide a way to reduce the input needed from a hardware designer, hence reduce the final cost of the design. It is important to note that moving the designer's job from hardware design to fitness function design does not necessarily infer that the job is easier, or quicker to complete. However, it is highly expected that evolving hardware for which the fitness function are easy to design should yield cost savings over standard design techniques. Low cost reconfigurable hardware is often used to embody evolved design, which further reduces the cost for low volume designs, which further reduces the cost for low volume designs by avoiding the need for a VLSI fabrication process. Utilization of reconfigurable hardware also allows changes in specification to be applied not only to new applications of design, but also allows changes in specification to be applied not only to new applications of a design, but also to examples already in use, thus avoiding hardware replacement costs. Risk, with its associated cost, is also reduced since design faults can be corrected, either by hand or through further evolution.

SPEED OF EXECUTION

Hardware implementation of any software system can provide an advantage in terms of speed of execution. This allows evolutionary systems to be applied to many areas requiring real-time responses at a cost level that is unattainable at present stage with traditional software evolutionary implementations. Evolvable hardware has a speed advantage not only for the execution of the final solution, but also for the generic learning process which involves the evaluation of many trial solutions

by their repeated execution. Use of hardware for this part of the evolutionary algorithm can result in a speedup of many orders of magnitude for in genetic learning. This speedup means that evolvable hardware can be used for real-time learning applications that were previously irresolvable with software-based evolutionary algorithms.

ECONOMY OF RESOURCES

Evolvable hardware systems that are implemented on a single silicon die can be applied to many areas where resources, for instance the area, power or mass of the solution, are limited. Again, this gives an advantage over more resource-hungry software evolutionary systems. Resource constraints can also be included in the evolutionary specification, allowing exploitation of limited hardware resources to be explored much more thoroughly than conventional hardware design methodologies afford.

3. EVOLUTION AND ADAPTATION

According to the number of hardware configurations at each generation during the evolution, the fitness evaluation strategy along the dimensions of extrinsic and intrinsic evaluation is first discussed. The approaches of off-line and on-line adaptation are then discussed according to the phase where the evolution takes place.

Much of the current research on evolutionary autonomous agents is centered around simulations of neuro-mimetic networks performed on a general-purpose computer. In the context of hardware evolution, this method should be classified into extrinsic evolution. The extrinsic evolution makes the assumption that simulated characteristics of the hardware are carefully designed. Obviously, the method of extrinsic evolution is not suitable for all applications, since it is very difficult to simulate all the hardware characteristics. Hardware abstraction often makes full exploitation of the hardware resources and dynamics infeasible.

Intrinsic evolution is realized in the hardware system instead of the host computer. Each genotype in the population describes functions and connections of the cells of FPGA as well as other parameters that define the reconfigurable hardware. Once a new generation of individuals is established via genetic recombination, they will be implemented, one genotype at a time, on board the FPGA. The performance of the FPGA (phenotype) is then evaluated by the evaluation mechanism. The genotype also dictates the selection of cell functions and inter-cell connections. The real-time physical implementation results show that intrinsic hardware evolution is powerful and capable of exploiting hardware resources by using a small portion of the FPGA cells.

Most of the research in EHW adaptation is based on off-line evolution. In the approach, the adaptation phase precedes the execution phase. Adaptation happens during the learning phase of EHW instead of in a execution mode. One merit of using the off-line hardware evolution is that it allows the preliminary studies of evolutionary process prior to the real-time implementation (4). The physical results show that with the implementation of off-line learning and intrinsic EHW, the number of learning and computation time needed to derive the evolvable hardware is considerably reduced and the hardware resources are exploited to the full.

The implementation results obtained by on-line evolution were unsatisfactory. The poor individuals could cause severe damage to EHW or the physical environment in which it is being evaluated, if there is no additional technique to prevent them from happening (5). On-line adaptation is computationally expensive due to real-time interaction with environment and faces the problem of evaluating fitness function.

4. CLASSIFICATION OF EHW

EHW can be classified along the lines of artificial evolution, hardware device, evolution process, adaptation method and application area as illustrated in Fig. 2 (3).

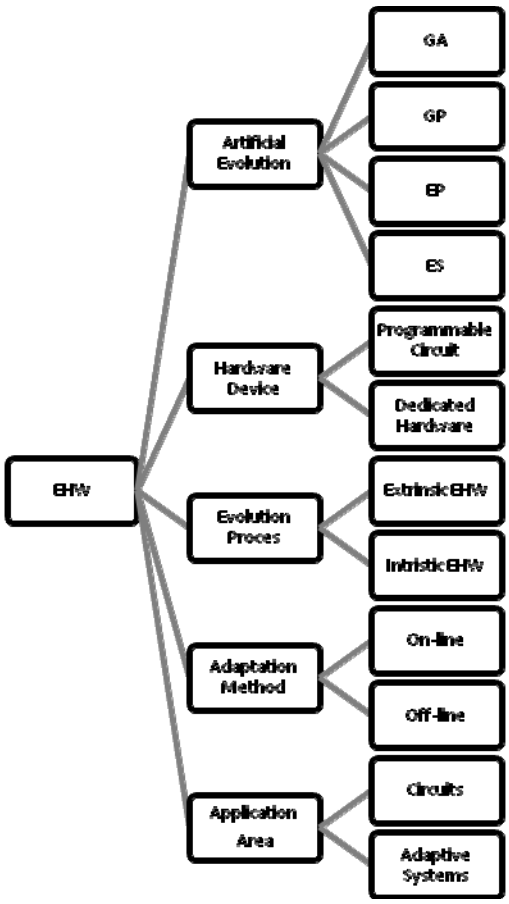

Figure 2 Classification of the EHW

The two essential elements in EHW are artificial evolution and hardware device. Genetic Algorithms (GA) (1, 2) are currently the most often used Evolutionary Algorithms (6) in EHW research, which are capable of seeking solution effectively from a vast and complex search space. The GA is a stochastic search algorithm that has proved useful in finding the global optimum in both the static and dynamic environments. Another field of study in EHW is the application of Genetic Programming (GP) (7) principles to high-level hardware design languages. The GP is also based upon the Darwinian idea of natural selection and genetic recombination, where individuals are often represented as tree-structures. Other EAs such as Evolutionary Strategies (ES) (8) and Evolutionary Programming (EP) (9) have also been used in EHW research, and many concerns and discussions are shared among these paradigm.

There are many reconfigurable hardware devices in the market, and the prevalent technology used in the field of EHW today is Field Programmable Gate Arrays (FPGA). The FPGA has an array of logic cells places in an infrastructure of interconnections, which can be configured via a string of bits called architecture bits.

EHW can be classified into the categories of extrinsic and intrinsic EHW. Extrinsic EHW simulates the evolution in software and downloads the best configuration to hardware in each generation, the hardware is reconfigured only once in each generation. Intrinsic simulates the evolution directly in the hardware. Every chromosome is used to reconfigure the hardware and therefore the EHW is reconfigured that many times as the population size in each generation.

The main attractiveness of EHW comes from its potential as an on-line adaptive hardware which is capable of changing its behavior to achieve better performance while executing in a real physical environment. In off-line EHW, the adaptation happens during the learning phase instead of the execution mode of the EHW.

According to the application domains as shown in Figure 2, EHW could be applied to design circuits and adaptive systems. The first view regards EHW as the application of evolutionary methods to circuit synthesis. This definition describes the EHW as an alternative to conventional specification-based electronic circuit designs. Another view regards EHW as the hardware capable of on-line adaptation by reconfiguring its architecture dynamically and automatically.

5. SUMMARY

The problems of electronic circuit design are increasing as demand for improvements increases. In this review we have introduced a promising new type of solution to these difficulties - evolvable hardware. This emerging field exists at the intersection of electronic engineering, computer science and biology. The benefits brought about by evolvable hardware are particularly suited to a number of applications, including the design of low cost hardware, poorly specified problems, creation of adaptive systems, fault tolerant systems and innovation.

As research in this field accelerates, new methods of classifying the many strands of research must be found. Here we identified two viewpoints: the level of abstraction and the hardware evaluation process. With these in mind, current research trends in evolvable

hardware were reviewed and analyzed. This work presented the basic concept of EHW, advantages of evolvable hardware and classification of EHW.

Evolvable hardware is still a young field. It does not have all the answers to the problems of circuit design and there are still many difficulties to overcome. Nevertheless, these new ideas may be one of the brightest and best hopes for the future of electronics.

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NATO NEC C2 MATURITY MODEL

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Abstract: *The ability to represent and study systems of Command and Control (C2), utilizing CIS, as well as new network centric concepts of C2 is getting a priority not only of the NATO countries, but also of the other countries transforming their Armed Forces. The conceptual model of C2 is the result of the work of the SAS-065 task group (nowadays followed by SAS-085). The model can be utilized by the key „managers" as a tool for understanding key concepts of Command and Control and consequences of various C2 approaches. The aim of the paper is to introduce the NATO NEC C2 Maturity Model (NNEC C2 MM) – a maturity model for network centric operations.*

Keywords: *NNEC, NATO NEC C2 MATURITY MODEL.*
MSC 2010: *93C41, 93C83.*

1. INTRODUCTION

Two key realities dominate thinking about command and control (C2) in the 21st century. The first is the nature of the 21st century military mission space. This space is characterized by its extreme uncertainty. In addition to the high intensity combat operations that are traditionally associated with military operations, the 21st century mission space has expanded to include a wide spectrum of mission challenges, ranging from providing support to multi-agency disaster relief operations to complex coalition efforts within a political-military environment involving a large variety of military and non-military actors; which we describe as Complex Endeavors.

The second reality is the ongoing transformation of 21st century militaries, and for that matter, other 21st century institutions and actors from the Industrial Age to the Information Age. With this transformation comes the ability to leverage new information technologies. This has had, and will continue to have, a profound effect on how institutions manage themselves and how they can work with coalition partners.

2. NEC CONCEPT AND CHALLENGES

The development of a NATO NEC is viewed by many nations as the most effective way for their nation to be able to use their own investments to the full in information age technologies and 'NCW type' capabilities in supporting future coalition operations. NNEC provides the right environment for developing a common approach to the conduct of these future operations, developing the architectures, standards, process and procedures necessary to enable the flexibility and agility needed to conduct future network-centric operations in a collation context.

The 21st century mission challenges described above are referred to as Complex Endeavors [1]. The complexity of future endeavors will require greater agility, not only in terms of thought processes, but also in terms of the means to enable the transformation of those processes into action. Past endeavors were defined by a fairly small subset of

activities in which military commanders were assured virtual "ownership" of the entirety of the operational environment. The complex endeavors of today and tomorrow encompass a more inclusive and broader environment. In some circles this is referred to by the acronym PMESII (Political, Military, Economic, Social, Information, and Infrastructure). Other terms for this are "Hybrid War" and "4 Block War."
This also means that the complex endeavors undertaken in the 21st century by NATO, its member Nations, and others require broad civil-military coalitions. These endeavors are characterized by a high degree of complexity, dynamics, and uncertainty. The variables by which these characteristics may be described and measured include:

- The nature and objectives of the endeavor (combat, peacekeeping, stability, counter-terrorism, humanitarian assistance, disaster relief);
- The number, nature, and diversity of entities comprising the endeavor (friendly, neutral and adversarial actors including the relationships and interactions between them);
- The nature of the military contribution;
- The stability of the environment;
- The predictability of the environment;
- The transparency or uncertainty concerning interactions and variable values;
- The degree to which entities are familiar with the situation and each other;
- The nature of the infrastructure available (ranging from austere to well-developed);
- The degree of clarity and unity of intent (purpose) and strategy;
- The nature of the effects space (from one to multidimensional), including interactions between and among the physical, information, cognitive, and social domains.

NATO is committed to developing the capability to conduct network enabled operations. The ability to conduct such operations, referred to as NEC or Network Enabled Capability, is considered critical for mission success in the challenging complex civil-military operations that have been described above and will challenge NATO in the 21st century.
The accumulating evidence points to the operational value of NEC [2]. As a result, a number of NATO nations are committed to increasing their levels of Network Enabled Capability. The competitive advantage of NEC derives from a value chain, depicted below (see Fig. 1), that begins with a robustly networked force or, in the case of complex endeavors, with a set of participating entities that are connected. If these participating entities are willing and able to share information and to collaborate in the Information and Cognitive Domains, they can create improved information positions (individually and collectively), turn their improved information positions into improved awareness and understanding, and develop high levels of shared awareness and understanding across a collective. Achieving a significant amount of shared understanding enables a collective to be more agile and span more of the C2 approach space, which is needed to realize higher levels of NEC capability. Higher levels of C2 maturity and NEC capability promise to be both more effective and more agile.

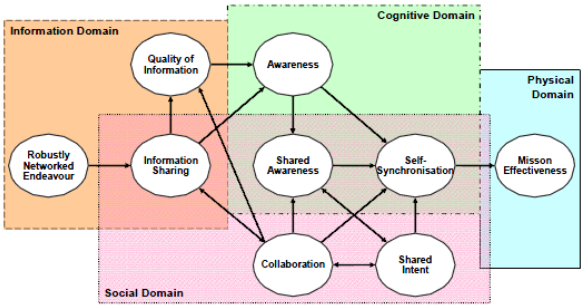

Fig. 1 Network Centric Value Chain

Thus, new network-enabled command and control concepts and capabilities are critical to the success of operations. The need to achieve higher levels of C2 maturity (i.e., the ability to appropriately span the C2 Approach Space) has been recognized at the highest levels of NATO. This need is not simply a reflection of a desire to leverage advancing technology but instead a recognition that more capable C2 approaches are needed to meet mission challenges. Of course, not every mission will require the most capable C2 approaches and sophisticated processes and technologies. Since there are both benefits and costs associated with operating a given C2 approach, there will not be a one-size-fits-all solution. Different C2 approaches will be most

appropriate for different kinds of missions and circumstances. Thus, the appropriate C2 approach is what is sought, not simply an Edge C2 approach all the time. On the other hand, the highest C2 Maturity Level 5 is always sought because this level contains all possible C2 approaches and the ability to transition between approaches depending on the situation.

The new C2 approaches required for NATO's most complex and dynamic missions will differ in fundamental ways from traditional C2 practices. Transforming traditional military organizations into network-enabled ones will require the co-evolution of doctrine, organization, training, education, materiel, and network-centric approaches to command and control. This will take considerable time and effort. Therefore, it is important to define interim milestones on the road to a more network-centric C2 approach.

NATO has defined five such milestones representing increasing levels of operational capability. Each succeeding level is related to increasing the coherence of the operation or endeavor. These five levels, in increasingly degrees of capability, are:

- Stand alone (Disjointed) operations;
- De-Conflicted operations;
- Coordinated operations;
- Integrated operations;
- Transformed (coherent) operations.

Increasing C2 maturity levels are required to support levels of increasing operational capability. This is described in detail later in this report. These five levels and their relationship to the NEC operational levels are depicted in Fig. 2.

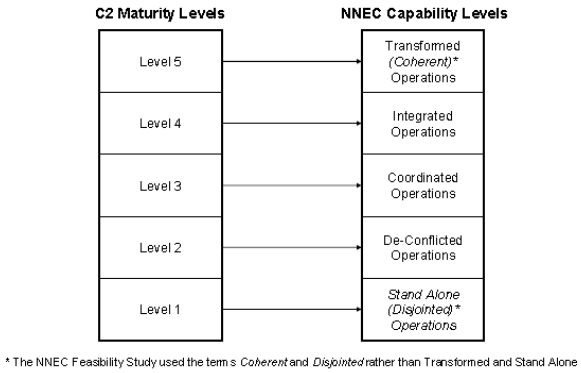

Fig. 2 Levels of C2 Maturity and NNEC Capability.

3. NNEC C2 MATURITY MODEL

The NATO NEC C2 Maturity Model (N2C2M2) provides a framework that can be used to assess appropriateness of the C2 approaches and related capabilities possessed by a collection of entities (both military and non-military). The model consists of five C2 maturity levels that are associated with the degree to which an entity or a collective is able to effectively conduct network centric operations.

Operating at a higher level of C2 maturity provides collections of entities (or an entity) with a larger set of C2 approach options from among which to employ. Having options is of little value unless one understands which of the available options is appropriate for the situation at hand. Thus, a maturity level not only involves being able to select from a particular set of C2 approaches but also the ability to recognize the appropriate C2 approach and the ability to transition from one approach to another, as appropriate. This dynamic applies not only to preparing for an endeavor but also during an endeavor as required.

Since increasing command and control capability is not an end unto itself, progress towards NEC requires that links be made between C2 maturity levels and NNEC capability levels. The maturity model establishes these performance-related links.

Knowing where you are is not sufficient for the journey at hand. One also needs a roadmap that shows how to get to the next step along the way. The N2C2M2 helps in this regard by identifying what is needed to move an entity (a nation, or a coalition) from one maturity level to the next.

Thus, the N2C2M2 provides a set of milestones that can be used by NATO as well as nations for C2 and NEC planning (strategic planning for an expected set of mission contexts or planning for a particular mission). It also provides a set of metrics to measure progress toward the achievement of a desired level of C2 maturity which, in turn, is required to achieve a desired level of NNEC operational capability.

Links Between NEC C2 Maturity Levels and NNEC Operational Capability Levels

The degree of operational coherence (the ability to generate synergy across a set of participants) that can be achieved, as reflected by increased levels of NATO NEC operational capability, will depend upon the nature of the command and control arrangements that exist (both within entities and across a set of entities) and the degree to which the functions associated with C2 are achieved (e.g. shared awareness). Thus, the ability to command and contro0 the endeavor determines the operational capability level that can be achieved. The five NEC C2 Maturity Levels and their relationship to the NEC Operational Levels61 are depicted below in Fig. 2. The horizontal arrows imply that a particular level of C2 maturity is adequate to achieve the corresponding NNEC capability level.

C2 APPROACH SPACE

The NATO NEC C2 Maturity Model associates the ability to appropriately adopt different sets of representative approaches to accomplishing the functions that are associated with different levels of C2 maturity. Increased C2 maturity corresponds to the ability of an entity to adopt a wider range of approaches to command and control that, in turn, covers a larger portion of the C2 Approach Space. This ability to approach C2 in a variety of ways must be accompanied by an ability to recognize the appropriate approach. The appropriateness of an approach is determined by the nature of the situation and how it is likely to evolve. The entity must also be able to change its C2 approach if necessary in a timely manner. A particular C2 approach differs from other approaches along one or more of three interrelated dimensions.62 These dimensions are (1) the allocation of decision rights, (2) the patterns of interaction that take place between and among entities, and (3) the distribution of information.

Normally the concept of C2 approach is applied to a single organization. SAS-065, however, is concerned with complex endeavours63. These are endeavors in which there are two or more entities present and where one or more of the following conditions exists: the entities have a degree of common intent; the entities are operating in the same space at the same time; and, the actions taken by an entity can come into conflict with those taken by other entities. The temporal dynamics of the situation and the timeliness requirements associated with a response can vary widely.

Therefore, we will interpret the dimensions of C2 approach from the perspective of a collective, i.e., the set of entities engaged in a complex endeavor. Thus, while each of the individual entities will have its own C2 approach, the way these entities work together (or fail to work together) is what is of interest. In other words, we are interested in collective C2. Looking at C2 approach from a collective perspective implies the following re-interpretation of the dimensions of a single organization's C2 approach:

I. Allocation of decision rights to the collective

In a collection of entities, the allocation of decision rights reflects the actual rights exercised by the entities in a complex endeavor. This allocation can be the result of explicit or implicit laws, regulations, roles, and practices or it can be as a result of emergent behavior. The allocation of the rights of participating entities to the collective can likewise be explicit, implicit or emergent. An allocation of a right to the collective refers to the degree to which individual entities have given up their respective rights for the benefit of the endeavor as a whole.

II. Patterns of interaction among participating entities

Patterns of interaction between and among participating entities are a function of their respective abilities and willingness to interact as well as the opportunities they have as a result of the actual occurrence of interactions and collaborations. Interactions are enabled and their quality is enhanced by the ability to have (face-to-face or virtual) meetings, the connectivity of the infostructure, and the degree of interoperability that exists between

and among a set of participants (technical, semantic, and cooperability).

III. *Distribution of information across participating entities*

The distribution of information across participating entities refers to the extent to which the information needed to accomplish required tasks is available to each participant.

The manner in which decision rights are allocated influences who interacts with whom and the frequency and nature of the interactions that take place between and among endeavor participants. These interactions take place within an entity and between and among individuals in different entities. These three dimensions form a three-dimensional space, as illustrated in Fig. 3.

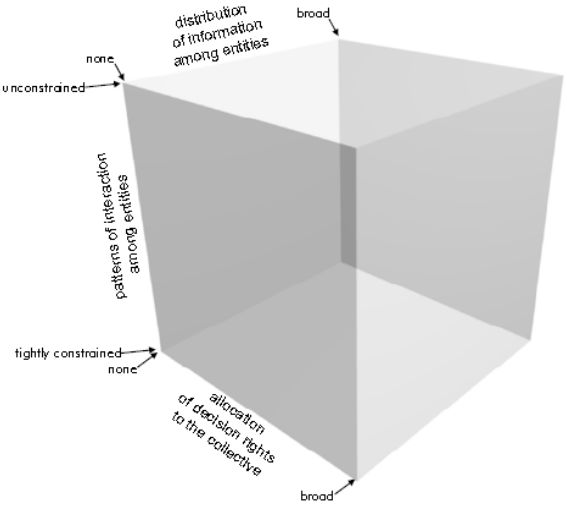

Fig. 3 C2 Approach Space and three interrelated dimensions: allocation of decision rights to the collective, patterns of interaction among entities, and distribution of information across entities

Different regions in this space equate to different approaches to collective command and control. Clearly the appropriateness of a particular approach to command and control, as well as the selection of an option or course of action, involves a consideration of responsiveness. In the discussions that follow, it is assumed that the frequency of information sharing, the frequency of interactions and, the allocation of decision rights all match mission requirements.

Furthermore, information sharing and other forms of working together require willingness on the part of the participating entities. Such willingness is assumed in the discussions that follow. As a practical matter, it is possible that entities will agree to operate at a certain level of maturity but not have or have limited willingness to do what is necessary to make the selected approach to command and control work. For the purposes of this discussion we consider this to be a failure to implement.

4. C2 APPROACHES

We have grouped C2 approaches into five classes that are described in the following sections. The objectives of each of these C2 approaches and the implications for information sharing, collaboration, and delegations of decision rights are briefly discussed. Note that each entity that is participating in a collective is expected to have its own (internal) approach to command and control, one that may or may not be compatible with the approach adopted (or defaulted into) by the coalition or collective.

Conflicted C2

There is no collective objective. The only C2 that exists is that exercised by the individual contributors over their own forces or organizations. There is no distribution of information between or among the entities, all of the decision rights remain within each of the entities, and there are no interactions (in a C2 sense) between or among the entities. Given that, the only C2 present with Conflicted C2 is the organic C2 within each of the entities. In the case of Conflicted C2, all interactions are within individual entities. That is all of the interactions that take place occur between and among individuals within some entity.

De-Conflicted C2

The objective of De-Conflicted C2 is the avoidance of adverse cross-impacts between and among the participants by partitioning the problem space. In order for entities to de-conflict their intents, plans, or actions, they need to be able to recognize potential conflicts and attempt

to resolve them by partitioning across geography, function, echelon, and/or time. This involves limited information sharing and limited interactions. It requires that entities give up the freedom to operate without any constraints and thus, in effect, agree to delegate those decision rights that are necessary to ensure de-confliction. It also requires that participating entities delegate their rights associated with operating without any constraints. Instead, participating entities agree not to act in a manner that violates any agreed upon constraint. This is the most limited form of collective decision rights in the set of C2 approaches, which includes De-Conflicted, Coordinated, and Collaborative.

Coordinated C2

The objective of Coordinated C2 is to increase overall effectiveness by (1) seeking mutual support for intent, (2) developing relationships and linkages between and among entity plans and actions to reinforce or enhance effects, (3) some initial pooling of non-organic resources, and (4) increased sharing in the Information Domain to improve the quality of information. Coordination involves more than an agreement to modify one's intent, plans, and actions to avoid potential conflicts. It involves development of a degree of common intent and an agreement to link actions in the various plans being developed by the individual entities. This in turn requires a significant amount of information sharing (broader dissemination) and a richer set of interactions, both formal and informal (relative to those required for de-confliction), among those in the various elements that are involved in establishing intent and developing plans. While the interactions required may be quite frequent, they do not approach continuous interaction. A Coordinated C2 approach requires participating entities be constrained by common intent and linked plans. Thus, operating with a Coordinated C2 approach requires the delegation of decision rights to the collective that are associated with the coordination process and the implementation of agreements that are a result of this process.

With a Coordinated C2 approach, more decision rights need to be allocated to the collective. Specifically, the decision of individual entities related to links between and among entities' plans are now collective decisions. Correspondingly, the need for interactions, the amount and frequency of information sharing, and the amount of shared information are all increased. Thus the region of the C2 Approach Space that corresponds to Coordinated C2 occupies a region that extends considerably along the information dissemination and interactions dimensions but only a small distance along the distribution of decision rights dimension.

Collaborative C2

The objective of Collaborative C2 is to develop significant synergies by (1) negotiating and establishing collective intent and a shared plan, (2) establishing or reconfiguring roles, (3) coupling actions, (4) rich sharing of non-organic resources, (5) some pooling of organic resources, and (6) increasing interactions in the Social Domain to increase shared awareness. This approach to C2 involves more than common intent; it involves the collaborative development of a single shared plan. The intents of the entities/elements are subordinate to common intent. Entities may have other intents as long as they do not conflict with, or detract from, common intent. Similarly, entity plans need to be supportive of the single integrated plan. Entities employing a Collaborative C2 approach accept symbiotic relationships and are interdependent. Very frequent interactions, indeed approaching continuous interactions between/ among identified individuals/ organizations, involving richer and more extensive interchange in both the Information and Cognitive Domains, is required to establish shared understanding and the development of a single shared plan. Collaborative C2 involves a considerable amount of delegation of decision rights to the collective. However, once common intent has been established and an integrated plan has been developed, the collective "delegates" back to the entities—the rights to develop supporting plans and to dynamically adjust these plans collaboratively.

Thus, Collaborative C2 requires that entities accept significant constraints on their plans and actions. This C2 approach corresponds to a

region in the C2 approach space that extends across almost the full range of information dissemination and interaction dimensions and along a great deal of the decision rights dimension.

Edge C2

The objective of Edge C2 is to enable the collective to self-synchronize. The ability to self-synchronize requires that a rich, shared understanding exists across the contributing elements. This, in turn, requires a robustly networked collection of entities with widespread and easy access to information, extensive sharing of information, rich and continuous interactions, and the broadest possible distribution of decision rights. Self-synchronization includes self-organization. Thus, entities or collections of entities can look and behave as if they are employing other approaches to C2. The key differences are: In Edge C2 the rights to decisions are broadly distributed even when it appears that decisions are being made by a limited set of individuals or entities. This is because other entities maintain their decision rights. In Edge C2, patterns of interaction are dynamic and reflect the confluence of mission and circumstances. The resulting distribution of information is emergent as a function of the emergent decision-related and interaction-related behaviors.

An Edge approach to C2 distinguishes itself from the other C2 approaches by replacing deliberate and formal coordination-collaboration mechanisms with the dynamics of emergence and self-synchronization. In Edge C2 the entities, enabled by a high degree of shared awareness, widespread access to information, and unconstrained interactions, self-synchronize. In terms of the C2 approach space, an Edge C2 approach allows the collection of entities to operate in a region where collective decision rights can be dynamically allocated by rich and continuous interactions and wide-spread sharing of information.

5. C2 MATURITY AND C2 AGILITY

C2 maturity and C2 agility are not free; more maturity or agility is not always desirable. There are a variety of costs associated with operating at a given level of C2 maturity and thus possessing a given level of C2 agility. These include both costs to individual entities and to the collective as a whole (investment in infostructure, time, and efforts to develop shared awareness and understanding). Therefore, it makes sense for both individual entities and the collective as a whole to operate at the level of C2 maturity required by the situation. The appropriate level of C2 maturity is referred to as requisite C2 maturity and is determined by the capabilities and agility required by the situation.

In other words, if every potential mission could be successfully accomplished by de-confliction, it might not be worth the effort to develop a capability to function at a C2 maturity level equal to Level 3. An organization or collective possessing the ability to operate at Level 3 may choose a De-Conflicted C2 approach if the situation permits. This being said, however, it has become clear from real-world exercises and the case studies that SAS-065 conducted, that the mission challenges faced in the 21st century are indeed complex and dynamic enough to require higher levels of collective C2 maturity. An endeavor is not likely to be successful operating with a De-Conflicted C2 approach when a situation is complex and dynamic to begin with, or when the situation increases in complexity or becomes more dynamic over time. Success, in these situations, requires that a collective must recognize this aspect of the challenge and be able to choose the appropriate C2 approach.

Transitioning from one approach of command and control to another is a significant challenge. An entity or collective may be better off operating at an approach to C2 that provides a “cushion” of capability that would be needed if the situation became more stressful, even though it may initially require greater investments in infostructure and/or training, but by doing so eliminates the need to adapt in real time. Thus, for example, even though operating with an Edge approach may not be initially required by the situation, (1) it may be required if the situation deteriorates and (2) it may be easier to stay an Edge than (a) to transition to an Edge from another C2

approach or (b) to transition from an Edge to another C2 approach. At this time, these are all hypotheses which need to be tested.

Edge organizations have the potential to operate with a Coordinated or Collaborative C2 approach. However, operating as an Edge will require a greater degree of intra- and inter-entity interoperability than many entities currently possess (particularly inter-entity). It also requires cultural changes for many entities, particularly military organizations. However, NATO is committed to NNEC and, along with this commitment, is on the road to creating an infostructure that will support Edge approaches to command and control.

6. CONCLUSION

There are many potential uses for this maturity model. Among these uses are to help organizations and coalitions:

- understand their current approach to command and control (or management and governance);
- determine their level of C2 maturity;
- determine what they need to do in terms of organization, doctrine, process, training, and/or materiel investments to develop a capability to operate at a more mature level;
- measure progress;
- understand what is needed to be effective in a greater variety of situations;
- develop a strategic C2 vision;
- create educational and training materials to increase C2 related awareness and competence;
- develop appropriate experiments and/or exercises to enhance their ability to employ various approaches to C2-related awareness and competency;
- understand what C2 approach and level of C2 maturity is appropriate or inappropriate for a given situation;
- develop an associated investment plan and roadmap to develop a capability to conduct network-enabled operations;
- formulate appropriate campaigns of research and experimentation designed to improve our understanding of command and control.

Thus, the N2C2M2 supports a variety of users—from senior management to project managers, from strategic planners to budget analysts, from doctrine developers to commanders in the field, and from educators to researchers to analysts.

7. ACKNOWLEDGEMENT

The paper contains research results achieved during work of NATO RTO SAS-065 task group „SAS-065 NATO Network Enabled Capability (NNEC) C2 Maturity Model“ - study leader Dr. David Alberts, for full list of participants see reference [3].

This work is part of project MO SR ŠPP 118_06-RO02_RU21-240 „NATO Network Enabled Capability and implementation in Slovak Armed Forces“.

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ACCURACY OF THE DIGITAL MAPS

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Abstract: *In this paper are presented the types of errors that occur when a geographical database is created. All data sources and methods for acquiring spatial data have errors. The type, size and implications of these inherent errors in a database of Geographic Information Systems influence the accuracy of the digital maps.*

Key words: *accuracy, map, GIS.*
MSC2010: 86A30.

1. INTRODUCTION

The accuracy of maps was analyzed and defined in different ways. The accuracy refers to the relative correctness of objects position on a map against their true position on the Earth surface.

The absolute accuracy is given by the error estimated for a single point relatively to a spatial reference (Krasovski etc.).

The relative accuracy is given by the error estimated for a distance between two points or the accuracy of a point in comparison with another point.

The accuracy of a digital map does not depend on the display scale. It depends on the accuracy of the original data used, on the processing algorithms and on the resolution at which the map is printed or displayed.

2. TYPES OF ERRORS

For digital maps four types of errors can occur:

a) position error;
b) attributes error (thematic data);
c) conceptual error;
d) consistency error.

a) Position error

The positioning error represents the displacement of an object on the map against its true position in the field. In the instructions for acquiring topographical maps is specified a planimetric accuracy of details of 0.4 mm at the map scale, at a confidence level $(1-\alpha)=95\%$. The probable position of a point on the topographical map at 1:25 000 scale is presented in fig. 1 and that of a line segment in fig. 2.

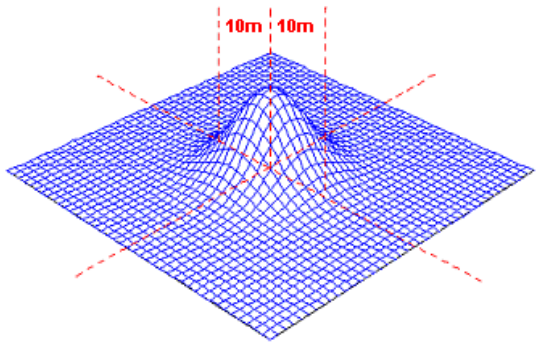

Fig. 1 Probability distribution for one point.

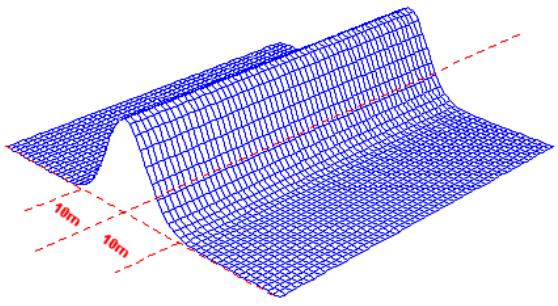

Fig. 2 Probability distribution for one segment line.

For the estimation of the accuracy, the mean square error is used - relation (01). The accuracy is reported as a value in meters, with a confidence level of 95%, meaning that 95% of the elements of the database are positioned complying with the reported accuracy.

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(V_i - V_c)^2}{n}} \qquad (01)$$

where: V_i - measured values;

V_c - true values of V_i;

n – number of measurements.

b) Attributes error

Whereas the position of elements does not change in time, the attributes can change frequently. The attributes accuracy is analyzed in different ways according to the nature of the data:

- for continuous values of the attributes, the accuracy is expressed as error of measurement (the assessment of the accuracy is done by methods which are similar to the determination of the positioning accuracy);
- for discrete values of the attributes, the accuracy is expressed as an error of classification (fig. 3 - a built area was erroneously classified as a forest). The assessment of the classification accuracy is influenced by the number of classes defined in the database.

Fig. 3 Error of attributes.

c) Conceptual error

The conceptual error refers to the omission of the information in the database and is defined by the degree of generalization and abstracting (selective omission). The most generalized database can be considered as complete if it contains all the objects described in specifications. The conceptual accuracy gives the user information about the available volume of spatial, temporal and thematic data.

The conceptual error is influenced by the scale, the generalization of the database elements and the rules of selection of the elements and phenomena stored in the database.

Fig. 4 Conceptual error.

In fig. 4 are presented sets of geographical data that are not uniform (one can see that some elements were overlooked because of the generalization of the database).

d) Consistency errors

The consistency errors refer to the apparent contradictions in a geographical database. The accuracy of consistency is a measure of internal validity of the database. It can be distinguished many types of consistency of the database:

- the spatial consistency refers to the respecting of the topological rules (the common boundary of two polygons should coincide – fig. 5);
- the temporal consistency represents the fact that in a point, at a given moment, only a single event can exist;
- the thematic consistency (of the attributes) refers to the lack of contradictions in the thematic data (storing data about the number of inhabitants, the surface of the localities and the density of population errors can occur because of the redundancy of the information; the redundancy of the attributes is a way for the insurance of database consistency);
- the logical consistency refers both to the topologic aspects and the validity of the

definition domain of the data stored in the database.

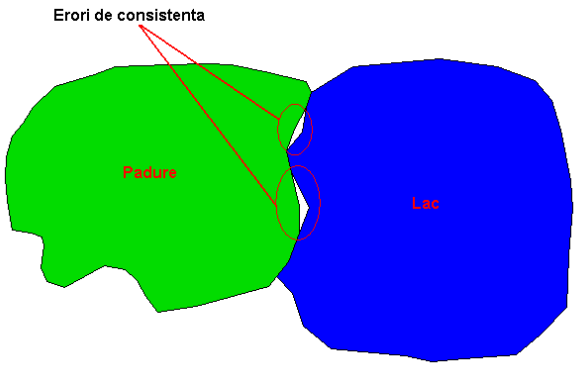

Fig. 5 Consistency error

2. SOURCES OF ERRORS

Unlike geodesy, cartography and photogrammetry, less importance has been given to GIS data accuracy until recently. It is known that data contain systematic errors and random errors, but it was not stressed the way how GIS procedures and solutions take into account these errors. A good approach of this problem allows the selection of the best data sources, the selection of the most correct methods of data collection and the selection of the most correct procedure of processing and achievement of the final products. In GIS are combined many data types from many sources.

Depending on the error sources, they are classified as follows:

1. errors due to data sources:
   - errors due to data collection instruments;
   - errors due to cartographic materials:
     - age of the data;
     - recording (printing);
     - deformation of the cartographic materials;
     - map scale;
     - type of projection;
     - cartographic generalization and classification;
   - errors due to the physico-geographical changes of the environment;
   - errors due to boundary definition;
2. errors due to data introduction:
   - errors due to digitization;
   - errors due to scanning;
   - errors due to the operator;
3. errors due to the methods and processing algorithms:
   - numerical errors;
   - errors given by data density;
   - errors due to data combination;
   - errors due to cartographic interpretation;
   - errors due to conversions;
   - errors of proper processing.

3. ACCURACY ASSESSMENT

The accuracy assessment of the spatial data is essential for data exchange and integration. The geographical and non-geographical data should be verified in order to ensure the accuracy imposed to GIS database. The measurements of data quality verify the position, attributes, conceptual and consistency accuracy.

Testing of data quality is done using manually or automated methods.

The manually verifying methods include control printings, field measurements and statistical tests. The control printing supposes tracking of geographical data at the same scale as the source cartographic material. After the printing of the digital map, this one is overlapped on the source map and are verified both the position of elements and the inscriptions and the symbolistic of the characteristics. Although this method is rapid and less expensive, the verification by field measurements is preferred.

The methods for automated verification look for the logical incompatibilities and the values of attributes that no not comply with the definition domain. The logical incompatibilities are determined by verifying of the topology (for example, a layer of polygons should contain only closed polygons). To verify the attributes it should be known the way of their classification. It is difficult to establish common ways of GIS community concerning the development of standards for classification of spatial data. This depends on the user's needs.

The automated methods can be performed by the majority of GIS software (ArcInfo, MapInfo, AutoCAD Map etc.). These methods are rapid but the results are less accurate than manually methods.

The data accuracy should be stored in all the stages of a GIS database acquiring, especially during collection and updating. Any type of data processing affects their accuracy.

Among the presented types of errors, the position accuracy is essential in the geographical database achievement. This accuracy is important to be known for the development of GIS dedicated applications. Further on it is presented the way to determine this accuracy.

The position accuracy is tested by comparing the coordinates of some control points from the database with the coordinates of the same points extracted from high accuracy independent sources, such as:

- larger scale maps;
- GPS field measurements;
- satellite and photogrammetric recordings.

At least 20 control points covering the concerned area should be tested. Testing of 20 points at a confidence level of 95% means that only a single point among them can have the accuracy lower than the imposed specifications. The control points should be densely in the neighborhood of the important elements [1].

The mean square error components on the two axes are determined by:

$$\sigma_x = \sqrt{\frac{\sum_{i=1}^{n}(x_{date,i} - x_{control,i})^2}{n}} \qquad (02)$$

$$\sigma_y = \sqrt{\frac{\sum_{i=1}^{n}(y_{date,i} - y_{control,i})^2}{n}} \qquad (03)$$

where: - $x_{date,i}$, $y_{date,i}$ - coordinates of the control points in the database;

- $x_{control,i}$, $y_{control,i}$ - coordinates of the control points in higher accuracy independent sources;

- n – the number of control points.

The mean square error is given by the following:

$$\sigma_r = \sqrt{\sigma_x^2 + \sigma_y^2} \qquad (04)$$

If $\sigma_x = \sigma_y$ then the relation (03) becomes

$$\sigma_r = \sqrt{2 \cdot \sigma_x^2} = 1.4142 \cdot \sigma_x \qquad (05)$$

The relations (02)÷(05) are valid if it is considered that the systematic errors have been eliminated. If the errors have a normal distribution and their components on the two axes are independent, then for the calculation of the planimetric accuracy at a confidence level of 95%, the value of 2.4477 can be used. [2].

$$\Pr ecizia_r = 2.4477 \cdot \sigma_x = \frac{2.4477 \cdot \sigma_r}{1.4142} \qquad (06)$$

$$\Pr ecizia_r = 1.7308 \cdot \sigma_r \qquad (07)$$

4. CONCLUSIONS

All the data sources and the methods for data spatial acquiring have errors. The type, size and implications of these inherent errors in the database of an information system determine the accuracy of the digital maps. It is impossible to remove completely the errors of the spatial data, but GIS users can reduce and manage errors in an efficient manner, improving so the data accuracy.

In our country it is used the standard of accuracy with a confidence level of 95%. In some military applications it is used a confidence level of 50%.

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RESEARCH STUDIES IN ALGORITHM DEVELOPMENTS FOR AUTOMATIC AND SEMIAUTOMATIC GEOGRAPHIC DATA ACQUIRING – ACQUIRING THE DATA IN THE FIELD

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Abstract: *In this paper it is presented the stage of a research project named "Research studies in algorithm developments for automatic and semiautomatic geographic data acquiring". There are presented the methods for measurement processing and the manner of achieving the geographical database.*

Key words: *database, map, GIS.*
MSC2010: 86A30.

1. INTRODUCTION

The research project named "Research studies in algorithm developments for automatic and semiautomatic geographic data acquiring" aims to achieve, test and validate new algorithms that will increase the efficiency of topographical maps vectorization.

In the second stage, "Acquiring the data in the field" (partial data acquiring) the geographical databases for Otopeni test area were designed and created. These databases will be used in the future phases of the project in order to test and evaluate the accuracy of vectorization algorithms. To obtain the geographical database for the test area, field measurement was conducted using three Leica TCR 407 Power Total Stations and a GPS Trimble 5700 receiver. The processing of GPS and topographical measurements was made using Trimble Geomatics Office software.

2. MEASUREMENTS PROCESSING

After processing all types of measurements, this stage of the project will be concluded.

The accuracy of measurements cannot be improved by processing itself, but if it is inappropriate the accuracy can be altered or, extremely, supplying bad results.

The main advantage of network adjustment by Least Square method, using indirect measurements is that each measurement has a corresponding correction equation, allowing a rigorous control of the functional model. The direct relation between the number of measurements and the number of the equations offers the possibility to make the adjustment process completely automated.

The Least Square adjustment of indirect measurements consists in several stages, having the possibility of choosing better intermediate values or better models.

a) Preliminary processing of observations

The first stage of the adjustment process consists in establishing the preliminary coordinates. They are established with a lower accuracy; depending on the final purpose.

The projection system officially used in Romania is *Stereographic System 1970* and it will be used to reduce and process the observations.

b) Calculation of preliminary elements

After the calculation of preliminary elements and the reduction of observations on the reference surface, it follows the determination of coordinates for the new points of the network.

c) The functional model

The functional-stochastic model for the processing of the carried out observations in a planimetric network is represented by the following relation:

$$v = A \cdot x + l \qquad (01)$$

where:

v – vector of corrections;
A – matrix of coefficients;
x – vector of parameters (unknown values);
l – vector of the free terms;

d) Normalization of the linear equation system

The writing of correction equations is followed by the normalization of the equations system and its solving. By solving of the normal system of equations first are determined the unknown values and then the corrections of the observations.

$$N = A^T \cdot A \qquad (02)$$

$$x = -N^{-1} \cdot A^T \cdot l \qquad (03)$$

where:

N – normal matrix of the system equations;
A – matrix of coefficients;
x – vector of the unknown values;
l – vector of the free terms.

e) Calculation of the adjusted elements

The adjusted values of the coordinates are established by adding to the preliminary values the solutions of the system obtained with the relation (03).

3. ACHIEVEMENT OF THE DATABASE

To design the geographical databases a georelational model was used in which the attributes are associated to some points, lines and areas. In this approach, the spatial entities are connected with the associated attributes by the means of an unique identifier. The sets of attributes are stored in different tables and the relevant information for a spatial object is accumulated by the relationships of two or more information tables.

The following layers were created, each of them being stored in distinct files:

- localities (polygonal elements);
- roads (linear elements);
- hydrographic (linear elements);
- level curves (linear elements);
- churches (punctual elements);
- disposed mines (punctual elements).

For the logical design of the database the technique of data analysis was used in order to create a clearly defined conceptual model of the relations between different sets of data. If this conceptual model it is not correctly built, it can result an inefficient structure of the database, with unwanted data redundancy and inefficient accessing and recovering of the observations [1].

4. CONCLUSIONS

This project aims the achievement, testing and validation of new logarithms that will increase the efficiency of topographical maps vectorization. For this purpose, in the second stage were carried out measurements in the field, in Otopeni area, Ilfov district. Based on these measurements, the geographical databases required to test the algorithms of semi automated vectorization have been created.

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DEVELOPMENT PLATFORM FOR CRYPTANALYTIC APPLICATIONS

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Abstract: *The traditional platforms for cryptanalytic applications use ASICs (Application Specific Integrated Circuit). Although these circuits achieve best performances regarding processing power, they lack flexibility and have high developments costs. A possible alternative to ASICs is the use of FPGA (Field Programmable Gate Array) circuits. The paper describes a development platform for cryptanalytic applications based on Xilinx FPGAs.*

Keywords: *cryptanalytic applications, ASICs (Application Specific Integrated Circuit), FPGA (Field Programmable Gate Array), Xilinx FPGAs*

1. INTRODUCTION

This paper describes a development platform for cryptanalytic applications, why this architecture was used and what is the role that FPGA plays. When trying to develop a platform for cryptanalytic applications, the following features should be kept in mind:

- the architecture must have high computing resources;
- the architecture must be reconfigurable;
- algorithm agility;
- development costs and time.

2. PARALLEL ARCHITECTURES

Traditional software cryptanalytic applications (using day-to-day microprocessors), even if are reconfigurable and relative easy to design, do not achieve the high performance or high physical protection and key protection that hardware implementation do (Figure 1).

	HARDWARE		SOFTWARE
	ASIC	FPGA	µP
Processing speed	very high	high	moderate
Development process			
Development costs	very high	moderate	low
Development cycle	long	moderate	short
Development tools	very expensive	cheap	cheap
Maintenance and up-grade	expensive	cheap	cheap
Cryptographic features			
Physical protection	strong	limited	weak
Key protection	strong	limited	weak
Algorithm agility	no	yes	yes

Figure 1.The main features of hardware and software cryptographic applications

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The operating system installed on the personal computers is Microsoft Windows XP Professional Service Pack 2 due to its technical support.

Application-specific integrated circuits (ASIC) are the standard hardware implementation solution for cryptographic applications, due to its security and computing power. However, ASIC lacks the flexibility of software applications. That is why the only viable solution is the use of Field Programmable Gate Areas (FPGA). In the figure below, you ca see a comparison between hardware and software implementation of cryptographic applications.

The parallel architectures using FPGA can be classified as follows:

- level 1: many FPGA circuits on the same board, connected to a computer (FPGA parallelism);
- level 2: many FPGA circuit boards connected to the same computer (FPGA circuit parallelism);
- level 3: many computers connected in a network (computer parallelism);
- level 4: many interconnected networks (network parallelism).

The first class contains hardware accelerators for processors. The level 1 architecture is composed from a circuit board connected through an expansion slot to a processor. The board contains one or several interconnected FPGA, volatile memories (SRAM and/or DRAM), non volatile (EEPROM, Flash etc.), an interface for the processor bus and a high speed interface bus for external devices. The FPGA circuits can be interconnected using a distributed topology and ring topology. Also, a programmable switch (crossbar) can be used for connected the designated FPGA.

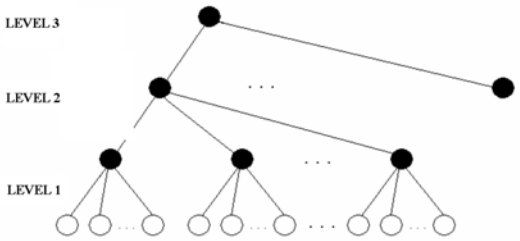

Figure 2.FPGA parallel architectures

The second class uses several interconnected hardware accelerators described in the first class and it is used for very complex computations.

It is a high performance and a very demanding architecture because the communication between the boards must achieve speeds similar to the speed between the FPGA on the same circuit.

Using the level 2 architectures, the level 3 and level 4 architectures (distributed computation systems) can be easily attained. For these architectures, the number of FPGA circuits exceeds 100 and the computation power is huge, taking into account that a FPGA circuit is equivalent to 10-100 processors.

3. HARDWARE IMPLEMENTATION PARAMETERS

Every hardware implementation has two main parameters: *operation speed* and *occupied resources* (number of CLB used). An FPGA contains tenths of thousands of building blocks known as Configurable Logic Blocks (CLB) along with configurable interconnects between these blocks (Figure 3).

Because cryptographic algorithms process data blocks, the operation speed depends on *throughput* and *latency*.

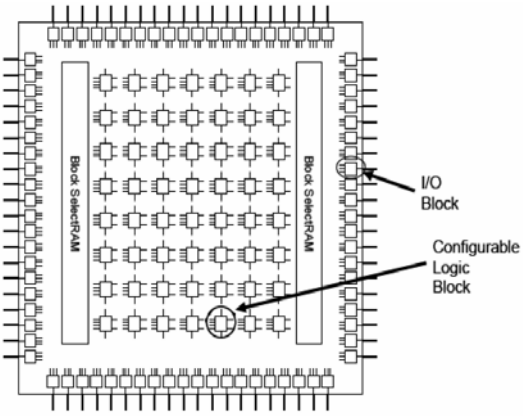

Figure 3.Generic FPGA architecture

$$\text{Throughput} = \frac{\text{Proccessed bits}}{\text{Time unit}} \quad (1)$$

(usually Mbps or Gbps).

The design engineers use the parallel and pipeline mechanisms in hardware design for increasing the operation speed. Parallelism means that multiple processing units can be used simultaneously for processing data (Figure 4).

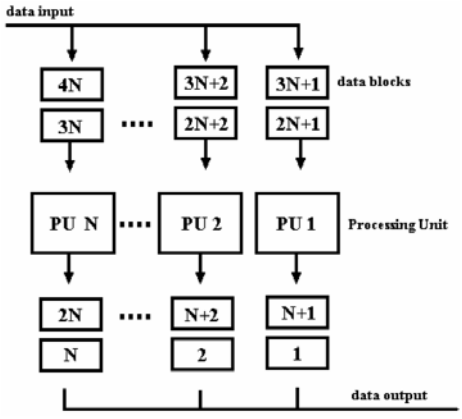

Figure 4.Multiple parallel processing units

The latency is usually defined as the necessary time to process a block of data. The pipeline mechanism means that inside the processing unit, "n" instructions are processed sequentially, meaning that "n" data blocks can be processed simultaneously, but each in different stages (Figure 5).

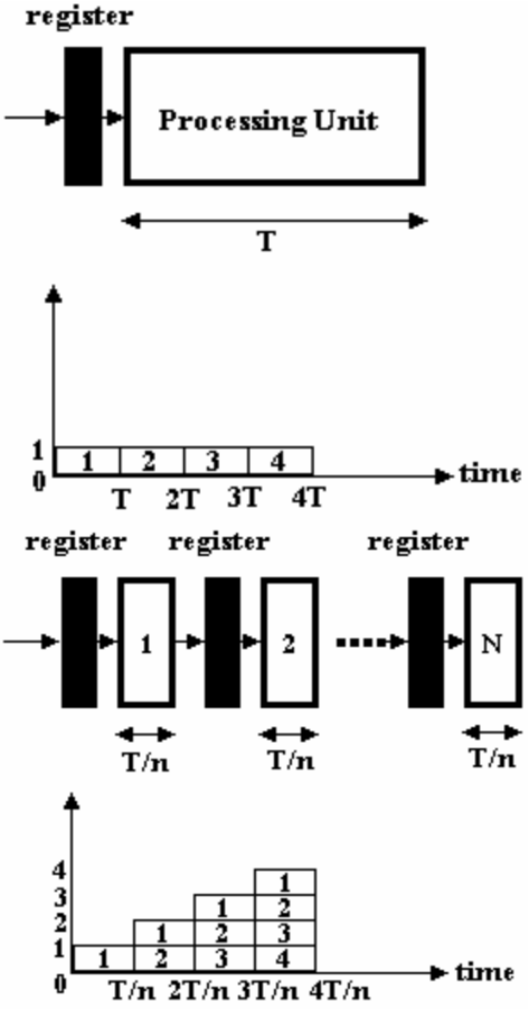

Figure5.Pipeline implementation

In the pipeline implementation the performance parameters are: latency and processing rate.

For the original circuit (Figure 5):

$$Latency = T; \quad (2)$$

$$\text{Proces sing\_rate} = Block\_length/T \quad (3)$$

For the pipelined circuit, the same performance parameters are:

$$Latency = T + n * \tau; \quad (4)$$

$$\text{Proces sing\_rate} = \frac{N * n * Block\_length}{(N + n - 1) * Latency} \quad (5)$$

where N is the number of data blocks that need to be processed.

In conclusion, each of the two techniques for increasing the processing rate: parallel and pipeline, has its advantages and disadvantages (Figure 6), one viable solution being a combination between these two.

	Parallel technique	Pipeline technique
Development difficulty	Easy	Complex (especially for a large number of stages)
The processing speed - gain	Proportional to the number of processing units	- proportional to the number of stages for a small number of stages - drops for a large number of stages
Resources	Proportional to the number of processing units	Depends on the specific circuit - small for balanced structures - large for unbalanced structures

Figure 6.Parallel and pipeline techniques.

We can easily see that the processing rate is proportional to the number of stages, but not in a lineal matter. For a small number of stages, the processing rate is n times greater than in the original implementation, but if we increase the number of stages, the processing rate slows its growth. Also, depending on the specific circuit implementation, the pipeline mechanism can be very demanding from the resources point of view.

4. PLATFORM DESCRIPTION

The selected hardware configuration for the development platform is shown in Figure 8. The initial configuration had one personal computer (PC) and two FPGA circuit boards (Figure 7) connected through a fast interface (PCI, PCI-X, USB, Ethernet etc.).

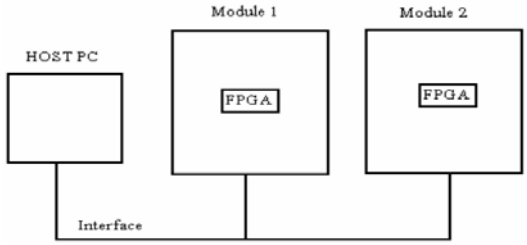

Figure 7.Initial hardware configuration

For scalability reasons and because we wanted to broach level 3 parallelism (multiple computers), we added more FPGA circuit boards and one more PC (Figure 8).

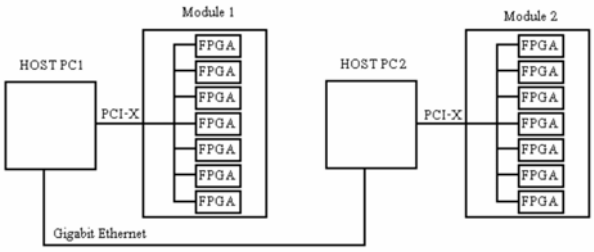

Figure 8.Final hardware configuration

The final configuration has a Gigabit Ethernet network with 2 hosts PC and 2 PCI-X backplane boards with 7 FPGA circuit boards each.

The PCI-X backplane board

For this platform, the PicoComputing EC7BP (Figure 9.) board was chosen, with the following features:

- accommodates 7 ExpressCard/34 boards or 4 ExpressCard/54 boards;
- holds up to 7 Virtex-5 LX50 cards;
- Windows and Linux compatible;
- has the maximum PCI-X board dimensions(length, height);

Figure 9.EC7BP PCI Express Backplane

The FPGA board

- The FPGA board chosen for this platform is E-16 LX50 PicoComputing board (Figure 10):

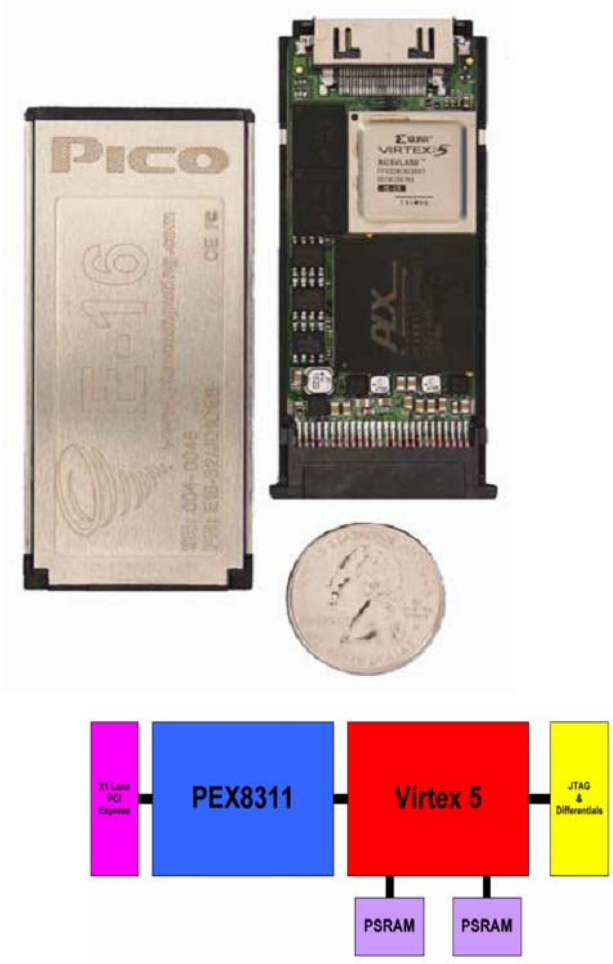

Figure 10.E-16 LX50 PicoComputing board and architecture

The board have the following characteristics:

- ExpressCard/34 (75 mm × 34 mm × 5mm);
- has a FPGA Virtex-5 LX50 (XC5VLx50), with:
- 48 DSP48E slices;
- 46,080 logic cells;
- 28,800 CLB flip flops;
- 1,728 kbits Block RAM.
- PLX PEX8311 PCI Express Bridge;
- 32 MB PSRAM;
- 18 Single-ended or 9 LVDS lines;
- internal JTAG for debugging;
- stainless steel case;

temperature range: from 0° to 70°C.

5. CONCLUSIONS

The parallel and pipeline hardware mechanisms implemented using this development platform, were used for a brute force attack over DES algorithm.

DES is probably one of the best known cryptographic algorithms, and has been widely used since its introduction in 1976 (and is still used today despite the fact that he doesn't offer a sufficient level of security). DES is the most popular symmetric-key algorithm. It was standardized in 1977 and expired in 1998 [3]. DES algorithm is a block cipher, which means that during the encryption process, the plaintext is broken into fixed length blocks and each block is encrypted at the same time. The processing rate achieved by this platform is 19.6 billion keys/s. This development platform attained a computing power equivalent to almost 10000 Pentium4@3GHz personal computers. This comparison highlights the colossal power calculation which can be developed by Virtex-5 FPGA circuits.

6. FUTURE WORK

Some improvements for this paper which have been discussed could be applied in a future work. The chosen implementation allowed us to achieve our goal (DES brute force attack for 40 bits key length), and to exceed it (DES brute force attack for 44 bits key length). Forasmuch

DES brute force attack for 44 bits key length is part of the linear cryptanalysis DES attack for 56 bits key length [4], in the future, the application can be improved by implementing attack of linear cryptanalysis on 56 bits (one block is 64 bits and the key is 64 bits wide (but only 56 bits are used). Also because the FPGA circuits is reconfigurable and have a scalable architecture, the application can be improved by implementing the brute force attack on other algorithms (e.g., MD4), and in other types of cryptanalytic attacks (e.g. password breaking, dictionary type attacks, etc.).

Modern applications of DES cover a wide variety of applications, such as secure internet (SSL), electronic financial transactions, remote access servers, cable modems, secure video surveillance and encrypted data storage.

By encrypting three times successively, we get an adequate level of security, even for sensitive data.

Despite the fact that DES is considered un-secure, there is a way to enhance it.

This method is called Triple DES. The major drawback of Triple DES is the speed which is much lower than other modern algorithm like AES.

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NEW INFORMATION TECHNOLOGY SUPPORT FOR FOREIGNER MISSION IN THE CZECH ARMED FORCES

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Abstract: *The paper deals with development and implementation of new presentation layer in the Czech command and control system. This new presentation layer uses 3D visualization and is currently deployed in the Afghanistan mission.*

Keywords: *command and control, visualization, terrain database.*

1. INTRODUCTION

The Czech Armed forces have been deployed to Afghanistan since 2006 (Enduring freedom operation). Information technology support of this mission was mainly done by foreign countries that have already installed their hardware devices and software application as well there (C2, C3 systems). The new Czech battalion that was deployed in spring of this year will use the Czech proprietary command and control system called Ground Force Tactical Command and Control System (GFTCCS) for the first time in foreign mission. Together with the standard GTCCS there was deployed a new 3D visualization system that should help the commander to better understand the terrain and terrain features in the area of planned operation.

In 2007, The Defense department of the Czech Republic accepted a new research project called:" Virtual reality devices in ground forces tactical command and control system (GFTCCS)". The project concentrates on increasing commander situational awareness at a tactical and operational level in three dimensional (3D) terrain visualization. This project is based on integration of virtual reality devices into command and control process.

The main project goal was a demonstration of a new presentation layer of GFTCCS with virtual reality devices. A global architecture of GFTCCS was designed in 1999 and its presentation abilities were obsolete. The commander could get information about battlefield in 2 dimensions (2D) only. The terrain spatial data were available but they were not used to visualize the battlefield in 3D. Communication between the commander and GFTCCS was supported only by a mouse or keyboard. A resolution of visualized battlefield was given by output devices abilities - CRT or LCD monitors. The old presentation layer offers common features of Geographic Information Systems (GIS) such as zoom in, zoom out or movement of actual position over a map.

The main ability of GFTCCS is to show a position of friendly forces as it can be seen on the picture bellow.

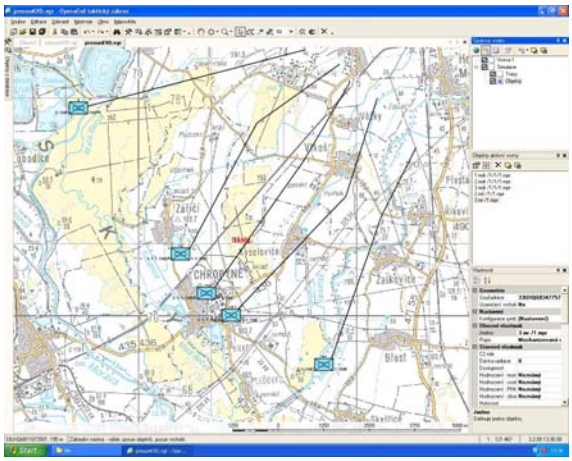

Fig. 1 Old presentation layer of GFTCCS

The new presentation layer comes out from experience with virtual reality devices in the modeling and simulation world. This new presentation layer was tested by commanders and the visualization part was positively accepted. There was a request to have this new presentation layer in the following Afghanistan mission, but there was a problem to prepare the whole virtual reality solution in that short time so a desktop version that runs on a standard military laptop computer was derived. This version utilizes the 3d terrain visualization part of a new presentation layer.

2. TERRAIN DATABASE GENERATION

The terrain database is an essential part of the visualization. The main problem was to find a data source of digital terrain data for the Logar province. We used a digital terrain data from the Multinational Geospatial Co-production Program.

The Multinational Geospatial Co-production Program (MGCP) is a coalition of nations participating in production of global high-resolution vector geospatial data [1]. All MGCP data co-producers will populate the International Geospatial Warehouse (IGW) for storage, exchange and use of geospatial information. The IGW will be established and maintained by the United States National Geospatial-Intelligence Agency (NGA).The MGCP is scheduled through December 31, 2011.

Since its inception in November 2003, MGCP has been working toward bolstering international cooperative production and coordination of high-resolution digital vector data in high-interest regions where inadequate data currently exists. The project is the evolution of the 10-year, global Vector Map Level 1 (VMAP1) effort that began in 1993.

MGCP's main purpose is to produce (in cooperation with all the participating nations) a 1:50K or 1:100K density spatial database which covers the whole World. The basic unit (area) of the project is 1° 1° degree cell. In the first 5 years the goal is to map the areas which are of interest – the so called hot spots – from the aspect of military mapping and defense purposes (these territories are also called: "hot spots"). During the production of VMap Level 1 the mostly used data source was the 1:250K JOG (Joint Operations Graphic) maps. At the planning of MGCP it was declared, that in contrary with VMap project the MGCP's primary data source must be Remotely Sensed Imagery with high resolution.

The participating nations are responsible for acquisition these images from commercial agencies. At the beginning of the project NGA planned to support participating nations by providing images bought from commercial agencies in large amounts to reach good prices, but this is just an opportunity for the participating nations and will surely not solve their responsibility for primary data sources. Besides Remotely Sensed Imagery Legacy Topographic Maps (basically military topomaps) are used during data extraction. Auxiliary Databases are used in MGCP database, such as AAFIF (Automated Airfield Facility Information File), DVOF (Digital Vertical Obstruction File), GeoNames (geographical database owned by NGA, which contains over eight million geographical names).2 Data produced under MGCP are uploaded to the IGW (International Geospatial Warehouse).

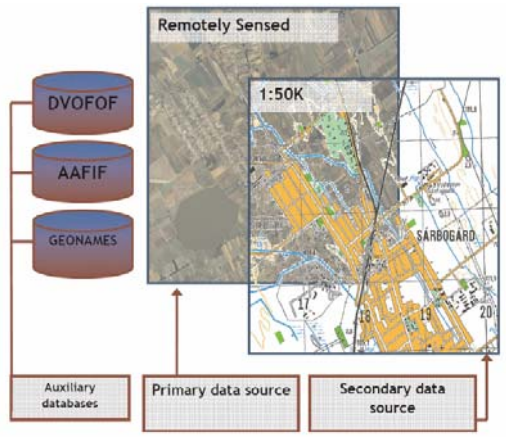

Fig. 2 MGCP map sources

The terrain database generation process is a key process for data preparation of Modeling and Simulation (M&S) applications. Traditional M&S applications use dedicated terrain databases that are human controlled and take lots of time to prepare. On the contrary, the M&S applications integrated into operation and tactical systems need to automatically generate the required data at short notice. This raises the requirement to develop a mechanism to generate terrain databases using the standard digital maps.

In our situation we needed to develop a simple system capable of generating full 3D terrain database from MGCP data sources in order to expand the functionality of GFTCCS.

The terrain generating system must combine aerial photos or satellite images with vector map data and grid terrain model. The system must deal with different resolution of the data sources and also with low resolution of the satellite images. The missed details must be reconstructed from the vector data sources and the resulting database must be optimized for used image generators.

Special algorithms are then used for adding high-detailed topographic lines and contours – such as roads, railways, rivers and lakes to low-resolution satellite or aerial image to look visually correct.

The terrain database can handle full 3D objects such as power lines, trees, bushes, fences and buildings according to the real topographic object database. All objects have correct dimensions and positions.

Fig. 3 Topographic objects in 3D

The resulting database is in WGS-84 coordinate system so it is fully compatible with navigation systems such are GPS and military paper maps. Also the resulting terrain database correlates with digital maps used in GFTCCS.

3. APPLICATION

The Logar3D application is targeted to support planning processes in Afghanistan mission. Commanders can use the 3D visualization of Logar province to get better understanding of the geographical environment in the planned mission area. The terrain database correlates with the digital maps used in Czech Ground Forces Tactical Command and Control System.

The application starts with the 2d vector maps of Logar province, the user can pan the map; zoom in and out to select the starting position of the 3D visualization. The user can also type the exact position in geographical (latitude, longitude) or UTM (paper map coordinates) format.

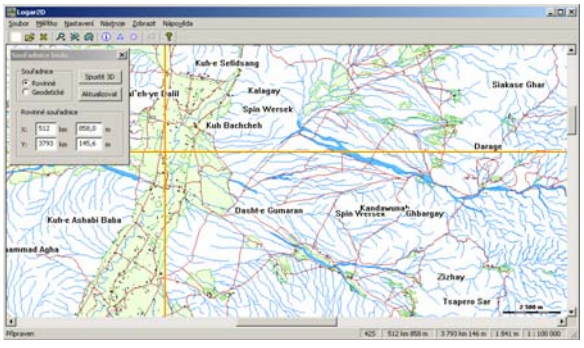

Fig. 4 Selecting starting point

After the user select its position the 3D view is loaded. User can fly over the 3D terrain using arrows keys and look around using mouse. Its position in geodetic and UTM coordinates and terrain altitude is displayed. Also there is a compass rose that shows user's orientation. The user can anytime jump to specific location by typing the geodetic coordinates.

Fig. 5 3D view

The standard satellite terrain texture can be switched to military map and back by pressing a function key, so the commander can compare paper map with displayed terrain.

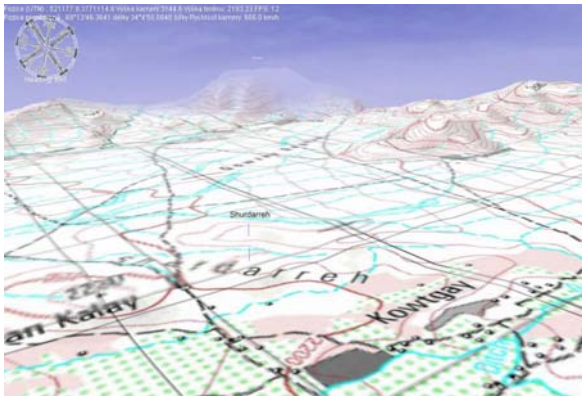

Fig. 6 3D view with standard map

4. CONCLUSION

The Logar3D application has been deployed in Afghanistan mission. This application is also installed in training facilities to prepare the commanders that will be assigned to the Afghanistan mission in next rotations.

The deployment of this application will also bring a valuable feedback that will be used in future development of the application. There is a plan that this new presentation layer will be seamlessly integrated into the whole GFTCCS system.

Currently there is a full 3D projection system in test that will wrap this presentation layer into a complete visualization part of GFTCCS system.

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HARDWARE AND SOFTWARE PLATFORM FOR TESTING, ANALYSIS AND TRAFFIC OPTIMIZATION USED IN IP COMMUNICATION NETWORKS

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Abstract: *The telecommunications industry is undergoing important changes. Incumbent operators have already moved away from the model of the past century, where voice between fixed terminals was the core of the business. Technological shifts, social changes, competition and new regulations have persuaded fixed-line operators to redefine their enterprise around converged multiservice networks.*

Keywords: *traffic, optimization, Trend MultiPro, Spirent TestCenter, PG3A, TLA5202B.*

1. INTRODUCTION

The dispersion degree measuring of the various resources allocated from IP communications networks offers concrete opportunities for the party existence those portions of networks where required traffic values exceed the capacity of processing and transport network of those portions and the other areas where the loading degree of resources not exceeding modest values of the installed networks capacity in many cases. The analysis of measurement results will be able to determine the choice of methods to optimization traffic in these networks to be reflected in reducing the costs of operations.

Continuous innovations in wireless technologies have produced a significant social change. Now personal telephony is based on a combination of mobility and privacy.

It is no secret that wireless providers have stolen a share of the revenues from fixed-line operators and are even suggesting that all traditional and new services can be delivered with wireless technologies.

But the biggest threat to the traditional voice business are ISPs and smart pieces of freeware using inexpensive VoIP calls, which can reduce revenues to a minimum.

Unfortunately alternative businesses, such as data services based on DSL, have quickly become a commodity difficult to differentiate from the competition and maintain profitability.

New regulations have also allowed cable and competitive operators to grab a slice of the conventional market.

Fixed-line providers are responding to these threats by bundling multiple services into a commercial package that includes a combination of: IPTV, VoD, PSTN, VoIP, messaging, broadband and mobile access, multiplayer gaming and other entertainment applications.

Everything is bundled into a single package that also includes the line rental.

This is often known as Triple or Quadruple Play; a bundle of video, audio, data and, eventually, mobile services, designed to reduce churn while building customer loyalty.

This article was realized through research contract No. 11-029/2007 of CNMP

2. PLATFORM DESCRIPTION

The achieving of the hardware and software platform must enables the measurements on the instantaneous and average values by the various resources allocated for traffic network.

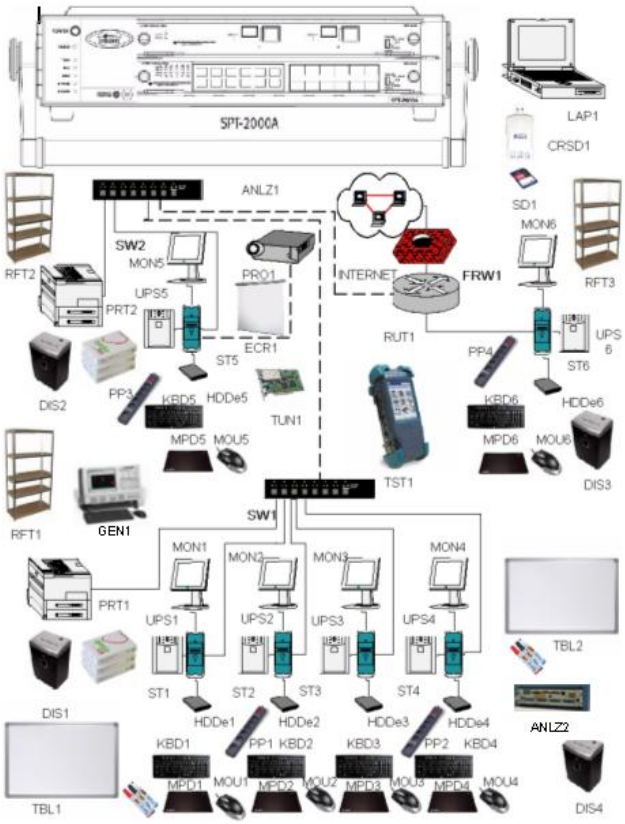

Fig. 1.Hardware and software platform for testing, analysis and traffic optimization used in IP communication networks

Legend:
ST1 ... ST6 – Work station 1 ... 6;
LAP1 - Laptop 1;
SW1, SW2 - Switch 1, 2;
RUT1 - Router 1;
PRT1, PRT2 - Printer 1, 2;
MON1 ... MON6 - Monitor 1 ... 6;
UPS1 ... UPS6 - UPS 1 ... 6;
KBD1 ... KBD6 - Keyboard 1 ... 6;
MOU1 ... MOU6 - Mouse 1 ... 6;
MPD1 ... MPD6 - MousePad 1 ... 6;
PP1 ... PP4 – Drains with multiple protections 1 ... 4;
DIS1, DIS2, DIS3, DIS4 – Documents destroyer 1 ... 4;
TBL1, TBL2 – Magnetic tablee 1, 2;
PRO1 – Projection apparatus 1;
ECR1 – Projection screen 1;
CRSD1 - Card Reader/Writer 1;
SD1 – SD Memory Card 1;
RFT1 ... RFT3 – Metallic Rack 1 ... 3;
TUN1 - Tv-Tuner 1;
ANLZ1 - Generator, tester and traffic analyzor Spirent SPT-2000A 1;
TST1 - Generator, tester and traffic analyzor Trend MultiPro 1.
GEN1 - Digital pattern generator module PG3A
ANLZ2- Logic analyzer Tektronix TLA5202B

The platform has been formed from a computers network skeleton and has been made by a finite devices hardware, software packages, network equipment, traffic generators and analysers and traffic testing equipment. This platform support is focused on the existent diversity of technologies underlying the communication and the need for convergence of the services offered to the clients [1].

At this time, we witness an undergoing analysis regarding the opportunity of steering the services supported by communication networks towards convergence. An example in this view is the soon to come implementation of a unified mobile digital telecommunications platform at national scale. Inside it, all services users, regardless of the structure they belong to, must be able to access any of the network resources, based on a prior authorization and using the national common infrastructure [2].

3. TEST

The generating of the test IP packets, the measuring traffic on the Ethernet type ports of network components will be achieved through the use of testing equipment: Trend MultiPro, Spirent TestCenter SPT-2000A, PG3A Series Digital Pattern Generators and Logic analyzer Tektronix TLA5202B.

Trend MultiPro Copper:

Is a 30 MHz tester to qualify and troubleshoot copper pairs for wideband technologies such as VDSL2 and ADSL2+.

Fig. 2.Trend MultiPro configuration

Bundling video and voice over IP, with the existing data and voice services, is more than just a strategy. It is, in many cases, a must to keep data service companies in the residential market business. This is an important point, because supporting these new applications requires migrating the existing infrastructures towards a new converged network based on IP, xDSL, Carrier Ethernet and, often, FTT and NG SDH. These converged networks offer important benefits, and can increase the average revenue per user (ARPU), but it is also essential to make sure that they deliver optimum performance. It is very difficult to differentiate between competing bundled services. Therefore, it is now even more important to test your network to ensure that any issues that may affect the customers' Quality of Experience (QoE) or the availability of the services, are addressed. The tester ensures correct end-to-end operation of converged networks by testing the service performance as it is experienced by the customer. However, very comprehensive and detailed testing is also available, making this a versatile a tool that adapts to the needs and skills of all users.

Spirent TestCenter SPT-2000A:

Is a system of hardware and software components that enables customers to reduce testing costs by accelerating functional and performance testing. Service providers, network equipment manufacturers and large enterprises use Spirent TestCenter solutions to evaluate devices and network configurations in development, QA, and production environments.

The PG3A Series Digital Pattern Generators:

Are general purpose and powerful tools for both engineering and production. The pattern generators can be used for peripheral/ASIC emulation and stimulation, setup/hold verification, production test, small-scale ATE, and general digital stimulus.

Fig. 3. PG3A Series Digital Pattern Generators

Logic analyzer Tektronix TLA5000B:

The affordable TLA5000B Series logic analyzers make high-speed timing resolution, fast state acquisition, long record length, and sophisticated triggering available to any digital designer who needs to identify initialization failures, operation crashes and intermittent operation.

Fig. 4. Tektronix TLA5000B logic analyzer

For first-time as well as experienced logic analyzer users, the TLA5000B Series is ideal for single-bus timing and state analysis.

An intuitive user interface, familiar Windows-based desktop and OpenChoice® networking and analysis features make the TLA5000B Series logic analyzers easy to network into your design environment.

When coupled with a Tektronix Logic Analyzer and/or a Tektronix Digital Oscilloscope, always a complete test system is realized.

4. APPLICATIONS

With Trend MultiPro you can perform the following tasks, and more:

Channel Zap Testing:

The device uses channel zap tests to validate the IGMP performance of customer premises equipment, to ensure there is minimum delay when the viewer changes channels.

Troubleshooting the Local Loop:

Trend MultiPro can perform an ADSL2+ sync test to check and evaluate the performance of the copper-based local loop. Possible issues in the local loop include: a misconfigured DSLAM or user modem/router, faulty copper, crosstalk and external radio interference. The copper link between the central office and the customer premises may also be too long.

QoE Testing:

The IPTV service can be checked automatically by performing a Quality of Experience (QoE) test. This test summarizes the different sources of degradation and gives a simple Pass/Fail result.

Determining Up/Down Bit Rates:

During synchronization and training, the subscriber modem/router and the DSLAM agree the upstream/downstream bit rates in the local loop. The actual transmission rates can be less, due to congestion in the network or in the remote system. Trend MultiPro obtains information on the real end-to-end transmission rate calls, so that continuous traffic flow can be generated and the average bit rate measured over a specified time.

Testing End-to-End Connectivity:

The end-to-end connectivity or Ping test can be used to check if two network devices can communicate with each other or not. It can also be used to collect basic performance statistics; the measured round trip delay and the number of times the remote server fails to reply.

Verifying SIP Signalling:

The Session Initiation Protocol (SIP) is an application-layer protocol used to establish, modify and tear down calls between users in VoIP applications and can check the SIP protocol operation and make/receive VoIP calls.

TS Structure Analysis:

The Video Player test is used to locate image-related problems in the IPTV service.

Video signals are transported in networks using Transport Streams (TS). Trend MultiPro analyses the complete structure of the TS and measures the bandwidth, jitter, as well as any other events that may be occurring.

IPTV Service Testing:

You can check that the IPTV services are working as expected by using the Video player test to preview the video signal on Trend MultiPro's true-colour touchscreen. You can also listen directly to the audio signal via the built-in speaker or optional headphones.

Internet Service Testing:

By browsing the web, Trend MultiPro automatically checks that the Internet access or Data services are working as expected.

This is usually the first test to perform when installing and maintaining data access networks. The operation of communication services can be tested from almost anywhere: customer premises, central office or street cabinets.

With Spirent TestCenter SPT-2000A you can perform the following tasks, and more:

HyperMetrics™ CV 2/8-PORT 10 Gigabit Ethernet Test Module:

The HyperMetrics 2- and 8-port 10GbE test modules combine Spirent TestCenter's network emulation and application traffic with its industry-leading Layer 2-3 traffic generation and analysis. Ideal for functional, performance and conformance testing of service provider and enterprise networks.

HyperMetrics™ CM 4/12-port Gigabit Ethernet Test Module:

The HyperMetrics 4- and 12-port Gigabit Ethernet test modules are the highest performance Layer 2-7 test solution available on a single module. The modules support line rate Layer 2-3 test traffic and Layer 4-7 traffic over 10/100/1000 Mbps Copper or Gigabit Ethernet SFP interfaces.

HyperMetrics™ AP Module High Performance Avalanche Layer 4-7 Test Solution:

The HyperMetrics AP (Application Performance) 8-port 1GbE and 2-port 10GbE test modules combine Spirent TestCenter's network emulation and traffic generation with line rate Avalanche application traffic. These modules deliver the highest performance Layer 4-7, security and vulnerability assessment test solution in the industry.

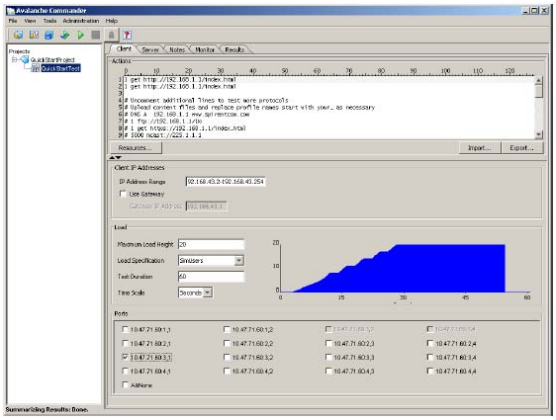

Fig. 3. Configuring the client
in Avalanche Commander

EdenTree Lab Manager Data Sheet:

EdenTree Lab Manager software manages network lab resources, replacing manual patch panels with software-controlled switching infrastructure.

High Performance CPU Module:

High Performance Layer 4-7 test solution IPSec Data Sheet for Avalanche Comprehensive data sheet on Avalanche IPSec offering.

IPSec Data Sheet for Avalanche:

Comprehensive data sheet on Avalanche IPSec offering.

IPTV & Triple Play Best Practices:

Spirent is currently assisting service providers in the deployment of many of the major IPTV solutions in Europe, Asia and North America.

Scalable Application Protocol Emulation Engine (SAPEE) for Avalanche:

With SAPEE you can replay captured protocols across a system or device under test to evaluate overall capacities, error handling, effectiveness of QoS and QoE mechanisms, and other capabilities. SAPEE allows you to inject custom stateful and proprietary protocols into a test alongside other supported protocols and Attack traffic.

Spirent ScriptMaster Data Sheet:

Why wait to start testing? Spirent supplies you with a large library of scripts written by our in-house experts. Spirent ScriptMaster scripts may be executed from the GUI or from the command line.

The parameter files may be edited manually or modified through the supplied Spirent ScriptMaster GUI.

Spirent ScriptMaster:

Spirent ScriptMaster offers maximum flexibility for automated network testing with turnkey, solution-oriented test suites that operate in a platform independent framework. Scriptmaster is a key element in Spirent Test Case Factory, the new industry standard designed for labor-saving network testing.

Spirent TestCenter Conformance Application and Test Suites:

Enables customers to lower development costs and improve product interoperability by identifying correct protocol operation earlier in the development cycle.

Spirent TestCenter 10 Gigabit Ethernet Test Modules:

Provides highly scalable line-speed testing of switches and routers.

Spirent TestCenter DHCP Base Package:

Helps service providers and network equipment manufacturers validate subscriber scalability in an unmatched port density solution.

Spirent TestCenter Enhanced Capture and Decode Base Package A:

Enhances the standard capture and decode capabilities of Spirent TestCenter.

Spirent TestCenter EOAM Base Package:

Data sheet for the Spirent TestCenter EOAM (IEEE 802.1ag & ITU-T Y.1731) Base Package.

Spirent TestCenter Extreme Automation:

Extreme Automation is an integral component of Spirent TestCenter, enabling test engineers to meet their objectives-achieving more complete test coverage and more consistent results with fewer people, who are not required to be programming experts.

Spirent TestCenter High Density 10 Gigabit Ethernet Test Modules:

High-density functional and performance 10GigE tester for LAN and WAN protocols.

Spirent TestCenter IGMP/MLD Host IP Multicast Base Package:

Helps quickly evaluate and troubleshoot host-to-router multicast behavior and the performance of networks and networking devices. Also includes the emulation of multicast registration protocols including IGMPv1/v2/v3 and MLDv1/v2.

Spirent TestCenter IPTV Test Package:

Service providers and cable providers need to test IPTV quality of experience, STB scalability and network performance.

Spirent's IPTV Test Package can help understand these points.

Spirent TestCenter L2TPv3-DEPI Base Package:

The L2TPv3-DEPI package is a Spirent TestCenter System component that enables equipment manufacturers and test consortiums to develop tests that can quickly evaluate and troubleshoot the functionality of any Modular Cable Modem Termination System (M-CMTS) or Edge Quadrature Amplitude Modulation (EQAM) device.

Spirent TestCenter Layer 4-7 Test Solution:

The Layer 4-7 testing solution can quickly identify potential points of failure by stress-testing the infrastructure.

Spirent TestCenter Link Aggregation Control Protocol Base Package:

Provides LACP protocol emulation for functional and interoperability testing of router and switch implementations.

Spirent TestCenter Link OAM (802.3ah) Emulation Base Package A:

The Link OAM Base Package allows emulation of Link OAM devices for functional and system testing of implementations based on IEEE 802.3ah.

Spirent TestCenter MPLS/LDP/RSVP-TE Base Package:

Enables network equipment manufacturers, service providers, and large enterprises to quickly evaluate and troubleshoot MPLS-enabled functionality, performance, and scalability of any routing enabled device or network for common applications such as traffic engineering and VPNs.

Spirent TestCenter Multicast Routing Base Package:

Helps service providers, large enterprises and network equipment manufacturers quickly evaluate and troubleshoot multicast routing

protocol and forwarding behavior and performance in devices and networks.

Spirent TestCenter Multiple Spanning Tree Base Package:

The Multiple Spanning Tree base package provides the emulation of Multiple Spanning Tree (MST) Protocol as defined by IEEE Standard 802.1s-2002 and 802.1q-2003.

Spirent TestCenter PPPoX Base Package:

This integrated component of the Spirent TestCenter simplifies large-scale test configurations to identify issues involving equipment selection, setting competitive service level agreements and planning growth with confidence.

Spirent TestCenter Packet Generator and Analyzer Base Package:

Helps network equipment manufacturers, service providers and large enterprises quickly evaluate and troubleshoot the data plane functionality and scalability of switching and routing devices and networks.

Spirent TestCenter RFC-2544 with VLAN Network Device Benchmark Test Package:

An essential tool enabling network testers to measure the performance of Layer 2 and Layer 3 switches and the networks on which they will be deployed.

Spirent TestCenter RFC-2889 with VLAN Switching Benchmark Test Package:

An essential tool enabling network testers to measure the performance of Layer 2 switches and the networks on which they will be deployed.

Spirent TestCenter Series 1000 and Series 2000 GigE Test Modules:

These modules suit customers that are looking for cost effective, high density Layer 2/Layer 3 scalability with basic routing capabilities.

Spirent TestCenter SIP/RTP/RTCP Datasheet:

Data sheet for Spirent TestCenter BPK-1060A SIP/RTP/RTCP Base Package.

Spirent TestCenter SPT-2000A, SPT-5000A & SPT-9000A Chassis:

Performs comparative analysis of network equipment to determine the suitability of a specific application prior to its deployment.

Spirent TestCenter STP/RSTP Base Package:

This package emulates the Spanning Tree Protocol (STP) and Rapid Spanning Tree Protocol (RSTP).

Spirent TestCenter Unicast Routing Base Package - BGP Protocol:

The Unicast Routing Base Package is a Spirent TestCenter component that enables network equipment manufacturers, service providers and large enterprises to quickly evaluate and troubleshoot routing functionality, performance and scalability of any routing device or network.

Spirent TestCenter Unicast Routing Base Package - IS-IS Protocol:

Spirent TestCenter's Unicast Routing Base Package supports IS-IS for IPv4 and IPv6 routing, and integrates them with BGP, OSPF and RIP to emulated real-world network topologies.

Spirent TestCenter Unicast Routing Base Package - OSPF Protocol:

Spirent TestCenter's Unicast Routing Base Package supports both versions of OSPF and integrates them with BGP, IS-IS and RIP to emulated real-world network topologies.

Spirent TestCenter Unicast Routing Base Package - RIP Protocol:

Spirent TestCenter's Unicast Routing Base Package supports RIP for IPv4 and IPv6 routing, and integrates them with BGP, OSPF and IS-IS to emulate real-world network topologies.

Spirent TestCenter Unicast Routing Base Package:

Enable network equipment manufacturers, service providers and enterprises to quickly evaluate and troubleshoot RIP, OSPF, IS-IS, and BGP routing functionality and performance of any routing-enabled device or network.

Spirent Video Test System (VTS):

Responds to the urgent need of determining IPTV video quality in real time and under different network conditions.

5. RESULTS

The results of the traffic measurements have been carried out with traffic testing equipment and have been stored with the help of devices for storage in order to be used as support for modeling the traffic on the network analyzed.

Relevance of the results is used in the objectives of the 4th Program - Partnerships in priority domains, coordinated by the National Center for the Programs Management (CNMP), 2007 [3], [4], [5] *(*see the first page footnote).*

6. FUTURE WORK

The issues to traffic optimization in IP communications networks must be unified and the need ongoing adaptation of services in order to obtain their convergence.

The aspects pertaining to technological diversity and differences in administrative procedures are taken into consideration in order to establish the most efficient way to optimize centralized access to the said resources.

The methods used will have to take account of his footsteps taken so far in this way and the remaining steps required to harmonize and adding the rest components included, after a multi criterion patterns of replication, which would lead to a solution to the convergence services as more uniform.

In the wake of this analysis, administrative and technical procedures will be established, in order to allow the telecommunication networks managers to cooperate in view to achieve logistical support at up to government level.

The most relevant technical aspects to be considered are those related to the diversity of underlying technologies for these networks.

7. CONCLUSIONS

The platform is provided and the possibility of connecting with other networks.

The results will be able to serves the development of methods for traffic optimization and other communications networks with diversity and technological convergence services.

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ONTOLOGY DEVELOPMENT TO SUPPORT COMMAND AND CONTROL SYSTEM

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Abstract: *One of the current projects solved in the Czech Armed Forces is aimed at knowledge system design and its usage in defense resort. The first part of this project is focused on ontology design and implementation to support command and control system (for both air and ground forces). After ontology design the implementation phase will follow. The C2 core can be supported by ontology to get needed information for decision making process. Based on the existing taxonomy, ontology and the whole knowledge system can be implemented. This system is able to discover a new and hidden relation between C2 domain topics. The article deals with the whole process and aspects of ontology C2 and knowledge system design.*

Key words: *command and control system, Network Enabled Capability, ontology, taxonomy.*
MSC 2010*: 68T35.*

1. INTRODUCTION

One of the current projects solved in the Czech Armed Forces is aimed at knowledge system design and its usage in defense resort. Its code name is "MENTAL". This project started in 2009 and should finish in 2011. The main output of this project is design of knowledge system prototype to revel possible usage in Network Enabled Capability (NEC) implementation. The NEC concept is complicated to manage due the fact of its spreading over the majority of military discipline. Knowledge system should help with the whole management process of NEC implementation. First part of this project is focused on ontology design and implementation to support Czech command and control system with respect of air and ground forces. The Czech C2 system used by ground forces is called Ground Force Tactical Command and Control System (GFTCCS). The figure n. 1 shows the main parts of knowledge system from the data sources processing point of view.

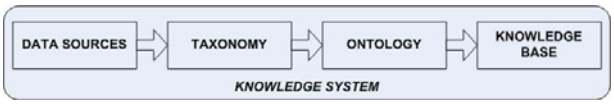

Fig. 1 Old presentation layer of GFTCCS

All available data from the NEC domain must be collected and divided into two groups. The first on is the data sources in Czech language and the second on is in English. Next step is to create taxonomy. Taxonomy contains main topics of the problem domain – NEC and the only relation between them that is enabled is hierarchy. Then the ontology must be prepared. Ontology contains the main topics from the NEC domain and association between them. Ontology is high level view at the

problem domain. The details of particular part of NEC are solved in individual knowledge bases. Knowledge base is the main tool to support the decision making process.

Ontology language creates the core of all designed knowledge systems. Ontology language defines exact interpretation of individual topics that are supported by a knowledge system. It creates the universal language of problem domain and offers the way how to save knowledge. Ontology can be created by ontology modeling languages or Topics Maps [1]. Ontology languages, like Ontology Web language (OWL) [2] are used for formal specification of problem domain based on Extensible Markup Language (XML). OWL can be computerized and it can automatically discover hidden consequences in problem domain. Topic Maps offer the alternative way how to interpret knowledge. It is aimed to humane understanding. Topic Maps concept is based on constructs followed:

- Subject – a part of real world described by topics.
- Topic – subject that is represented in computer.
- Instance – an inner attribute of topic that are saved in this topic (outer attribute is connected through the http protocol).
- Association – relation between topics.

2. KNOWLEDGE SYSTEM ARCHITECTURE

Architecture of command and control knowledge system is based on ATOM [3] and TOVEK tools [4]. The lowest part contains information resources that are the most important for ontology development (laws, resort restriction, etc.). The part above is analytic workplace that is design to analyze unstructured data to be able to enrich core ontology. Analytic workspace is also used for creating categories. These categories are then used for better information structure. Ontology is the core of knowledge system and can be divided into separated parts that contain specialized ontology aimed on appropriate subject. The fusion centre is capable of categorize the unstructured data from available sources that were added into knowledge system after first ontology built prototype. The upper layer is a portal for knowledge driven access of information. Users can use the knowledge system based on the appropriate role. Role can be: End User, Ontology Builder, Analytic, Portal Administrator. Figure 2 shows the main part of knowledge system architecture.

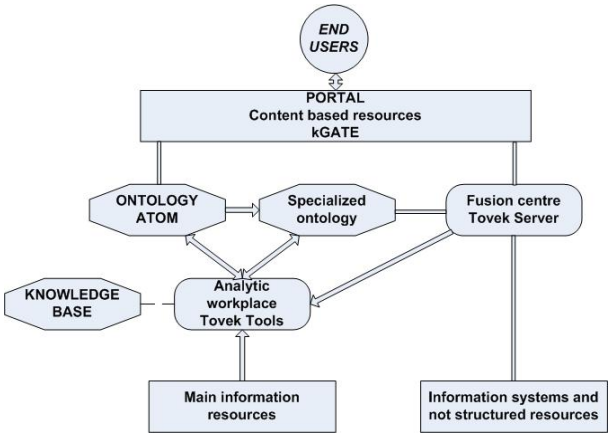

Fig. 2 C2 Knowledge system architecture

NEC ontology of the whole knowledge system is composed of two main specialized ontology's: security and C2. The next part of the article deals with the only C2 ontology.

3. DATA SOURCES

Main data sources from C2 domain was divided into Czech and English parts. The Czech part contains the most important military standards, recommendations, regulations and standard procedures that have relation between C2 and NEC domain. The main documents are: GFTCCS Characteristic – 2008, Regulation for GFTCCS using- 2009, Modernized conception of GFTCCS- 2008, NEC Conception- 2006 and NEC Strategy – 2007.

The English part contains the most important NATO documents with relation to C2 system and NEC concept. These are: NNEC Feasibility Study – 2005, Network Centric Warfare - 2005 and NATO Architecture Framework – 2007.

4. TAXONOMY

The documents mentioned above were used for first prototype of C2 taxonomy. This taxonomy was created by C2 domain experts, without any SW support. Next step was based on TOVEK Index Manager and TOVEK Harvester usage. Index Manager saved all documents related to the C2 domain and created the glossary. After that, Harvester was used to create the list of topics that are contained in the indexed documents. These topics are scored according to their incidences and relations to other topics. The second taxonomy prototype took into account the scored list of topics with respect of the C2 domain expert knowledge.

Taxonomy depicts the hierarchy relation between selected topics in C2 domain. C2 Taxonomy was implemented in FreeMind toll. The picture bellow shows the one part of the top level C2 taxonomy.

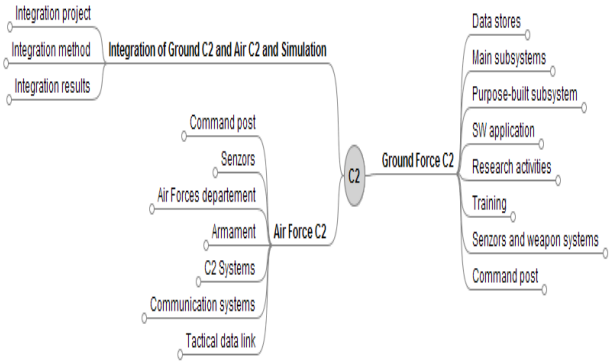

Fig. 3 C2 taxonomy at the top level in FreeMind tool

5. C2 ONTOLOGY

Ontology defines a correct and exact interpretation of individual themes inside the research area. C2 ontology was created by Topic Maps method. In the ontology design phase the SW tools must be used. TOVEK Company was selected as a suitable provider. The ontology design is based on taxonomy implementation, thus the C2 taxonomy was used as enabler of C2 ontology. The main subjects in taxonomy must be loaded as topics into C2 ontology. This can be done automatically by export from MS excel file. This file must also contain the hierarchy between the topics and its definitions. The table bellow shows one part of this taxonomy file.

Table 1 C2 Taxonomy file

H	Subject	
1	C2IS	Command and Control System
2	GFTCCS	Ground Force Tactical Command and Control System
3	Data store	Used for data storing in GFTCCS
4	SpDB	Force and device database in GFTCCS - special
4	STDB	Force and device database in GFTCCS - standard
4	LTDB	Force and device database in GFTCCS - local
4	MTDB	Force and device database in GFTCCS - mobile
3	CTDB	Force and device database in GFTCCS - central
3	Main subsystem	Creates the main functionality of GFTCCS
4	ASCC	Automated command and control systém
4	Battle Management Vehicular Information System (BMVIS)	Battle Management Vehicular information System (BMVIS) is a core battalion/brigade and below information system and a key element in the effort to digitize the battlefield
4	SPEC	Specialized information systém

After successful export of C2 taxonomy file, the instances and associations must be created. Figure 4 shows C2 ontology in the top level of abstraction. The centre of this graph is the main topic – GFTCCS and the particular colors means particular association between topics. Each topic in figure 4 contains instances.

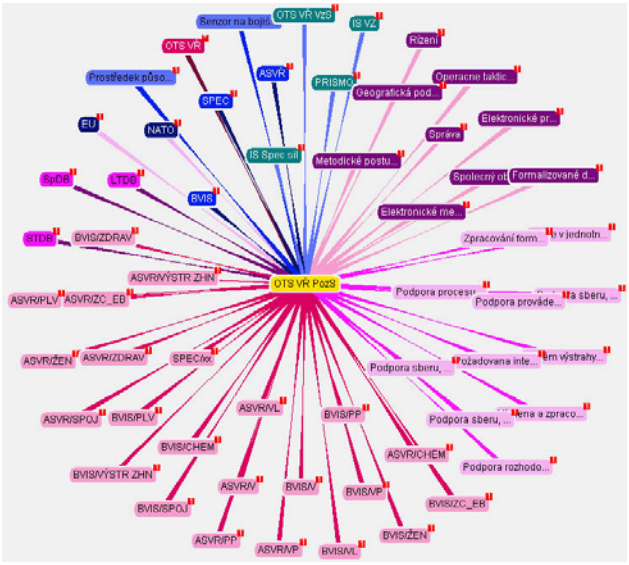

Fig. 4 C2 ontology in the top level of abstraction

6. CONCLUSIONS

C2 ontology can support the intelligence in the sense of:

- Selection of an appropriate level of unit aggregation for particular level of command.
- Minimum combination of information for leading of particular type of operation?
- Order of information importance in particular type of operation?
- Description of the relevant information according to selected operator of C2.

With perspective of these statements, C2 ontology was used in a new presentation layer of GFTCCS that can visualize the battlefield in 3D. This presentation layer creates terrain data model based on available digital map resources. Main tactical information like shape and area of size of a unit and its position must be also solved in 3D respect. The C2 ontology discovered the main supportive tactical data of unit that must be visualized as well in 3D. It is mainly: unit efficiency, velocity of the unit movement and actual fuel and weapon capacity. This data are visualized as bar graphs and express the current state of the measured values in percentages. 100 % of value corresponds with the lower border of a tactical symbol billboard.

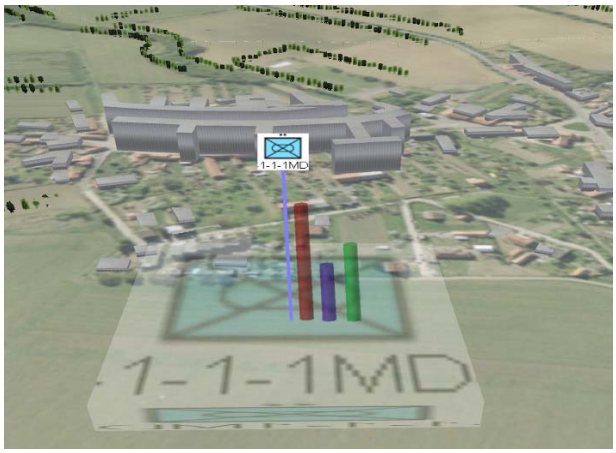

Fig. 5 New presentation layer of GTCCS supported by C2 ontology

Figure 5 shows visualized mechanized squad with the 80% of efficiency, 33% of maximal velocity and 50% of weapon and fuel capacity.

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COMPUTER APPLICATION FOR TRACKING DATA STORAGE DEVICES USING RFID TECHNOLOGY

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Abstract:

In many organizations it's important to protect the classified information saved on hard disks, memory flashes or other storage devices.

The scope of the application was to track the data storage devices belonging to an enterprise when carried in or out of the building by the employees.

The actual detection is made by a RFID reader. RFID (Radio Frequency Identification) is an automatic identification technology that uses radio frequency signals to identify tagged items. A typical RFID system consists of transponders (tags), readers and antennas. The tags are placed on the data storage devices. The reader communicates with the tags through antennas and transfers the data to the computer.

A database correlates the data on the tag with the name and the security clearance of the employee. The application provides logs about all the devices that have passed through and generates a warning if an unauthorized event happens.

Key words: *Computer science, Software, Radio Frequency Identification*
MSC Primary 68N01; Secondary 78A99.

1. INTRODUCTION

In many organizations it's important to protect the sensitive information stored on hard disks, memory flashes, etc. The loss or unauthorized access to this type of information can adversely affect the privacy of an individual, trade secrets of a business or even the security of a nation depending on the level of sensitivity and nature of the information.

The sensitive information to which access is restricted by low or regulation to particular classes of persons is called "classified information". A formal security clearance is required to handle classified documents or access classified data. There are several levels of sensitivity, with differing clearance requirements. This sort of hierarchical system of secrecy is used by virtually every national government.

Some corporation and non-government organization also assign sensitive information to multiple levels of protection, from a desire to protect trade secrets or access to personal information.

The scope of the application was to track the data storage devices belonging to an organization when carried in or out of the building by the employees.

The device who makes the actual detection is a Motorola XR Series RFID Reader. (Fig. 1)

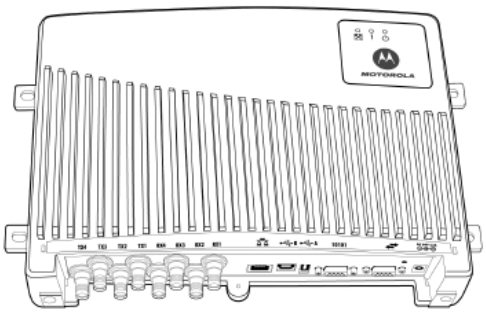

Fig. 1 Motorola XR Series RFID Reader

RFID stands for Radio Frequency Identification. RFID is an advanced automatic identification (Auto ID) technology that uses radio frequency signals to identify tagged items.

An RFID tag contains a circuit that can store data.

A typical RFID system (Fig.2) consists of transponders (called tags), readers, and antennas.

To read a tag the reader sends out radio frequency waves (using attached antennas). This RF field powers and charges the tags, which are tuned to receive radio waves. The tags use this power to modulate the carrier signal. The reader interprets the modulated signal and converts the data to a format for computer storage. The application described in this paper translates this data into an understandable format.

The **tags** contain embedded chips that store unique information. Available in various shapes and sizes, tags, often called transponders, receive and responds to data requests. Tags require power to send data, and are available with two power options:

- Active Tags: are typically powered by light weight batteries and have limited life.
- Passive Tags: are powered by the RF field generated by the RFID reader. Passive tags are lighter, and less expensive, than active tags.

Because of the enumerated advantages, the passive tags were selected to be attached to the data storage devices containing sensitive information.

Antennas attached to the reader are used to transmit and receive radio frequency signals. A *read point* is the RF range of an antenna.

Readers communicate with the tags and transfer the data to a host computer. Readers also provide features such as filtering, CRC check and tag writing

2. MANAGING THE READER

At the physical layer, the XR reader can support an Ethernet interface for command and data communication with the reader. The RS232 serial interface can be used to configure basic communication parameters such as TCP/IP address and viewing system logs etc. In addition to TCP/IP socket interface, byte stream and LLRP communication protocols are also supported. An HTTP over TCP/IP interface is also available to provide a Web-based Administrator Console (using HTML), and a service interface allowing machine to machine interaction (using XML). The default ports are:

- port 3000, for the byte stream socket interface
- port 5084, for LLRP
- port 80, for HTTP requests

The *Administrator Console* (Fig. 3) provided by the reader's built in software, can be accessed by users from the host computer using a web browser. We will use the console to configure the reader for our needs.

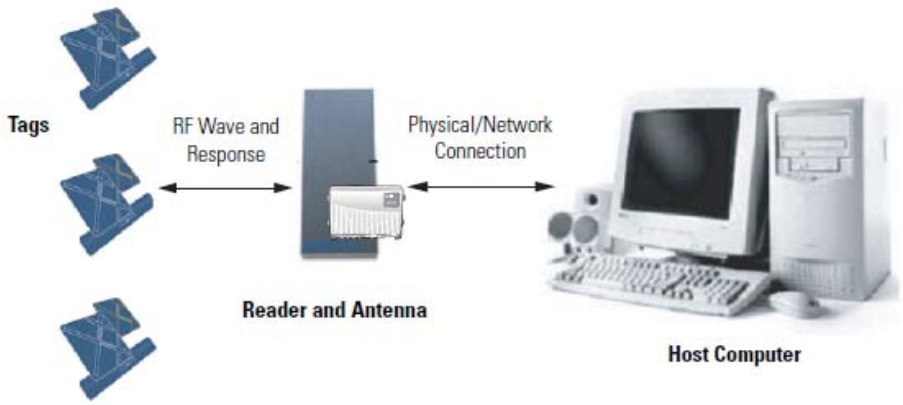

Fig. 2 A typical RFID system

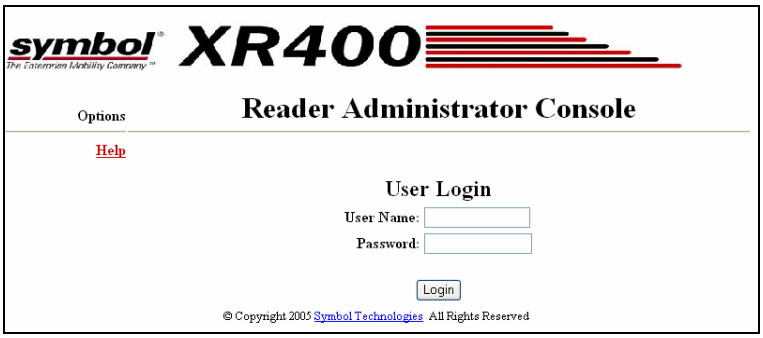

Fig. 3 Administrator Console
Login page

From the Administrator Console we can set the scan frequency, view information about the reader and the read points (antennas), import tag list (push tag information into the reader), write data to tags, "kill" tags (disable read and write operation, rendering the tag useless for any future operations), create "read point zones"(virtual groups of antennas), etc.

An important thing to do is select the Event Notification options. The reader provides notification when selected event occur. The events that concern our application are the **Visibility Events**. There are three types of visibility events:

- **New Tag Event** – event generated when a new tag (not known by the reader) appears for the first time.
- **Tag Not visible Event** – event generated when a visible tag disappears from all read points. The event reports where the tag was located when last visible to the system.
- **Visibility Changed Event** – A general event generated when the visibility of a tag changes. If the *Tag Not Visible Event* is enabled, a previously visible tag that becomes invisible to any read points generates the more specific *Tag Not Visible Event*. Likewise, a *New Tag Event* occurs for the first visibility change when applicable.

For our task, the reader should be set to generate only the general Visibility Changed Event.

3. WRITING THE APPLICATION

The application will receive and interpret the event information sent by the reader to the host computer. To achieve this we need to know the type of data that a tag can contain. There are four fields of information available on the tag:

- RFID tag ID value
- optional user-assigned ID and threshold rule
- current RFID tag state
- read point list

Each RFID tag has a unique HTTP/XML-based protocol ID, encoded in the hexadecimal raw format.

A read point list is a comma-delimited list of read point IDs indicating at which read point(s) the RFID tag is currently visible. The read point ID is the internally-generated unique identifier for a read point (antenna). The read point map indicates the association of the read point ID to the read point's name and other attributes.

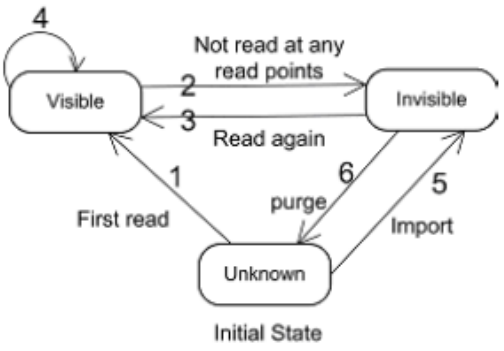

Fig. 3 RFID state transitions

When a tag moves in and out of reading range of an antenna, the RFID tag state changes accordingly. Fig. 3 shows different RFID state in a device and the state transitions.

The RFID tag state transition generates a **tag event**. Each tag has an associated Timestamp that records the time of the last state transition that can generate a tag event.

The possible transitions are (Fig. 3):

- **transition 1**: After the first read operation, the tag changes to and remains in a visible state as it can be read throw any of the read points, generating a *New Tag Event* if enabled, or a more general *Visibility Changed Event*.
- **transition 2**: When no read points can read the tag, the tag changes to an invisible state, generating a *Tag Not Visible Event* if enabled, or a more general *Visibility Changed Event*.
- **transition 3**: If a read point re-reads a known but not currently visible tag, the tag changes to visible state again, generating a *Visibility Changed Event*.
- **transition 4**: A different set of read points can read a visible tag in a different read cycle. The state remains visible, but a *Visibility Changed Event* is generated.
- **transition 5**: When an import tag list pushes tag information into a device the system recognizes the tags, but they are not visible to any read points. This transition does not generate any tag event.
- **transition 6**: When a purge tag list or a soft reboot cycle removes a tag, its information disappears from the device. It starts its state transition as if from the initial state.

Byte stream protocol is used to command the reader. The protocol is supported over a TCP/IP socket connection. The default TCT/IP port for byte stream is 3000.

The general communication sequence of the byte stream protocol is represented in Fig. 4. The reader is always waiting in passive mode for this protocol, the communication being initiated by the host system.

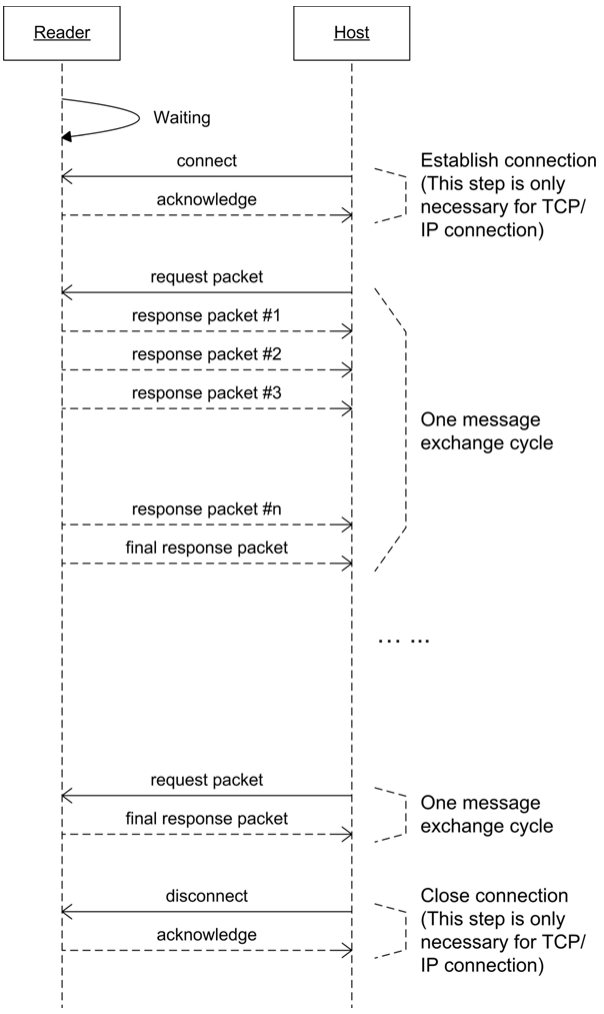

Fig. 4 General byte stream protocol communication sequence

At the end of each packet is positioned a 16 bit Cyclic Redundancy Check (CRC). The documentation for the reader contains a C++ algorithm that can be used to calculate the CRC for the commands sent by the programmer

The application will use the following commands of the byte stream protocol:

- Login Command
- Set Autonomous Mode

The Login Command is the first command sent to the reader. It's issued after a TCP connection to the byte-stream port is successfully established. The reader sends back an acknowledge response, like described in Fig. 4.

The Set Autonomous Mode command it's used to turn autonomous (pooling) mode on and to tell the reader to send events as they are detected. Once the autonomous mode is set, the reader continuously reads tags and reports the results to the host. Remember that the reader was configured from the Administrator Console to generate only the Visibility Changed Event.

The events data will be reported in the form of an XML included in the packet sent by the reader. An example of an XML transmission has the following form:

```
<?xml version='1.0'?>
<Matrics>
<EventGroup>
<TagList>
<Tag raw ='123456781234567887654321'
PC='3000' time='45ffb64e' RPL='1'/>
<Tag
raw='333333333333333333339696'/>
</TagList>
</EventGroup>
</Matrics>
```

The above XML signifies that two tags with the ID values presented in the *Tag raw* fields are visible at the reader point number 1 (value assigned to the antenna from the Administrator Console) at the time specified. The time is a hexadecimal value representing the number of seconds since the Epoch (Jan. 1, 1970, also known as the Unix Time).

So the XML provides the information about the time and place where the specified tag attached to a HDD for example was detected. On the host computer I created a database that correlates the ID of the tag with other important information, like:

- the type of the correspondent data storage device (HDD, memory flash, DVD, etc.),
- the capacity
- the security clearance requested for transporting the device
- the interval of time when the transport of the device outside of the organization's building it's permitted

By using this database the application can record all the "tagged" devices that pass throw a gate and it can generate a warning message or sound if an unauthorized exit is detected.

The pseudo-code of the application looks like this:

1. Connect to the reader
2. Send "Login" Command
3. Test the CRC of the reader response
   If correct, continue
   Else go to 1
4. Send "Set Autonomous Mode" command
5. Test the CRC of the reader response
   IF correct, continue
   Else go to 4
6. Wait messages from the reader
7. when message receive, extract the XML
8. show and store information from the XML correlated with data from the database
   IF unauthorized event,
   Show warning message
   Go to 6

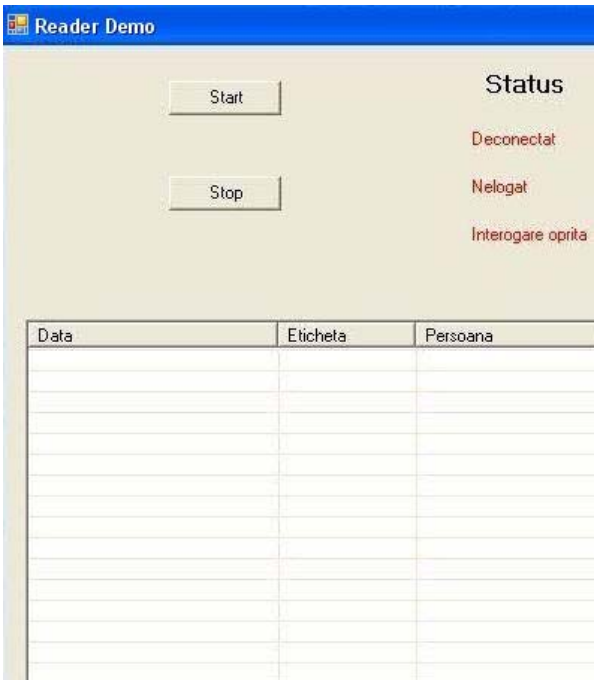

Fig. 4 Part of the application's main window

The application has a main window with a panel for displaying information, two buttons for "Start" and "Stop" and some labels for displaying the status (Connected /

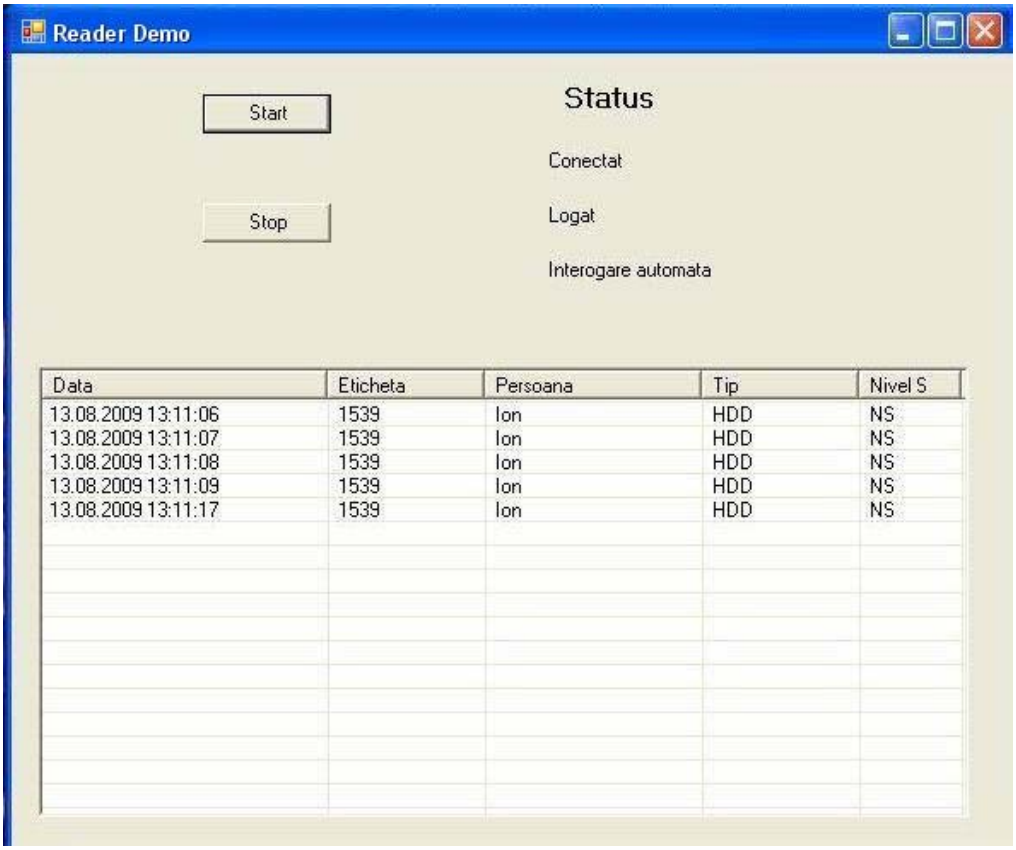

Fig. 5 The Application in running mode

Disconnected, Logged / Not logged, etc.) like you can see in Fig. 4. In Fig. 5 we see the application running while a tagged HDD is moved in front of the antenna.

4. Conclusions

RFID technology can be successfully applied to tracking data storage devices containing sensitive information.

If the programmer has some knowledge of C++ language and XML file manipulation, the documentation for the XR Series RFID Reader provides sufficient information for writing an application that retrieves data from the RFID tags.

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SPECIFIC PROPERTIES OF CYBERBETIC SYSTEMS IN SPECIAL TECHNIQUE

ASSUMED AVERAGE OF THE FACULTY OF SPECIAL TECHNIQUE ALEXANDER DUBCEK UNIVERSITY OF TRENCIN ON THE SPECIAL TECHNOLOGY DEVELOPMENT ROUTING

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Abstract
Cybernetic systems are important part of special technique in all areas – from monitoring situation to execution operations.
Special technique is required to have high reliability and that is why special technique needs specific processes of quality assurance. The article contains ways of university education of cybernetic systems for needs of usage of special technique.
The introduction contains description of individuality of cybernetic systems for special technique. The next part includes examples of solutions of cybernetic systems for special technique. The last part contains solved problems of testing, modeling and simulating these systems.
In the article are present tendency resorts of activities of the Faculty of special technology Alexander Dubček University of Trenčín for science, expertly and education activities tendency. The resorts outgoing of orientation and heading of Slovak republic in the alliance groups and partners responsibilities, in ambit which is presumption of a development, production and pursuit the special technology. In the chapter are formulated departures of intended focus of activity of faculty with practical application of the resorts and present approach examples.

Keywords
Cybernetics systems, Special technology, Quality assurance, Modeling and simulating methods.
Special technology, special technology user and operator, development and production, crisis situation, state defence requisites, supply chasses, standardization, codification and state verification of the product quality and services for the defence purpose.

1 INTRODUCTION

Assumed special technology development goes out of needs of the operation by practical onset of the special technology into working and of the specifications of the criterions, which are set on the attributes and qualities of this technology. In the Slovak Republic conditions, this needs and criterions go out of the conditions, which are presented by personators and officials of the rezorts, in ambit which is this technology engaged. One of the main users and operators of special technology are AF SR. Slovak republic ministry of defence in the document „Militarization strategy“ [1], [11], [12], [13] prepares objective model about ambitions of SR in the sphere of the militarization, cooperation with industry in the research and technology sphere, by constructing own operative abilities. SR access to the strategic vision development for the militarization sphere reflects trends in the NATO and EU

in the knot on the planned reformation of the planning and realization reform of the militarization in the NATO. Slovak republic membership in the Euro-Atlantic and European structures, responsibilities and privileges, which are founded of this membership and acquired experience require to actualize the main approaches of Ministry of defence of SR to the defence abilities development, and so to the militarization, how one of the main part of this process too. Creation process of Militarization strategy was successful conclude by its predicting at Minister of defence advisory board and subsequently Minister of defence of SR confirmation than program proclamation working out of the Slovak republic governments for yers 2007 till 2010 for the conditions of defence department (22.11.2007). Doc. Ing. Stanislav Szabo,PhD.,national director for the militarization of AF SR [2] characterize the main factors determinate military sphere :

- The SR membership in the euroatlantic and europe structures and with it coupled responsibilities exigent adequate participation of Slovak republic in the operative NATO and EU/EDA projects, designates primary collaboration territorium and product process orientaction of weaponry acquisition and military technology and requires creation of compatibile militarization system
- Armed forces militarization present public sources exerting on the providing armed forces mision fullfilling, so have to be realizing transparently, disposeal,and adressly with effort to expended sorces return through householder inovation programs with international project export support, offset programs and another compensation tools.
- The defence industry like state defence system element, propping on the defence research and defence technology development, is minimal independence condition in the weaponry and military technology sphere.
- Limited defence rezort capacity, like primery subscriber for the defence industry, designates orientation on the international cooperation projects with achievement objective not only according living cycle price, quality and time ambit of the delivery, but also equivalent interoperability and level of the project standardization stability and in the verification preparatory phase solution of the identified viciousness.
- Rational access to the defence ability development in the weaponry and military technology sphere expects consistently utilise the science knowledge and with equivalent method interest in science- research base.

2 DELIMITATIONS HEADING OF THE SPECIAL TECHNOLOGY FROM THE ACTUAL REFERENCE VIEW

Concept special technology, determinate by literture and within the frame its terminology, for example [3], [11], [12], [13] is in present conception characterize not only of possible user and operator view, for example AF SR, Interior Department, etc., but from the view construction specifity, predetermination, singleness, operation in the special, unconventional, for example extreme conditions, from the specifity of the manufacturing systems and technologies view. Away overlaped determination on the guns, explosives, and amunition, means of delivery of weapons and guns accessories, balistic technology, dial sights, technology and material which sumarizated into material classes [4].

From the topicality characteristic view of the concept special technology is liquet, that this problem will be in the future claim proper attention. We suppose, that within the frame of this concept will be specific technology:

- Technology and material designed for

usage in the crisis situations.

- Technology and material for state defence requisites. It is noteworthy that concept material classes is in the conditions of the AF SR not topical. From the number of material classes 6 transforming into 27, late into 10, is in present time actual the concept „Supplying classes“ and those is 5 (1.foodstuff and feed,2. weaponry and spare parts inclusive software,3. fuelling,4. constructive and common material,5. ammunition).
- Products and services for purpose deliminate by unified standardization and codification of the aliance ingremio legis about defence standardization, codification, and state quality verification of the products and services for the defence purposes. They are codoficate by special code list „Delivery classification H2“, this is treated within the frame of the NATO aliance [5].
- Technology and material designed for using in the accident situations and statuses.
- Technology and material designed for using in the nonstandard conditions, for example in the extreme conditions.
- Technology and material designed for specific, single production and production systems
- Technology and material related with assumption and research for space industry.

We don`t suppose and either ambit of this article don`t allows complex determination of this concept „Special technology“ actual for present time. Progress direction of the determination hinted Doc.Ing.Stanislav Szabo,PhD., national director for the militarization AF SR: „Militarization sphere don`t touch only armed forces of SR, but outgrow his political, social-oconomic and technologic impact defence department acivity. Si it is conveinent this ties to formalize by higher than deparment document processed in close contact mainly with the Department of Agriculture of SR, Interior Department of SR, Military defence industry association of SR“. From this strategy accrue the document: „Development and defence competences strategy of SR at the weaponry and military technology sphere“, with objective of „national“ formulation of development and strategy not only armed forces competences at the weaponry and military technology sphere, but also dearly and obligate formulate „national“ access to the defence research, defence industry and their development within the frame euroatlantic and europe structures. The document harmonization with the long-time planenable concretize priorites of the militarization and create long-time orientation not only to the research, develop and production subjects[2]. Example of this access is provision preparing of the system and complex solution process automatization of the army command and control or troops engaged within the frame crisis managment into operations and actions“.

Within the frame of the Aliance and its strategic targets is in the main programs set emphasis on [6]:

- Alliance Ground Surveillance- AGS.
- Active Layered Theatre Balistic Missile Defence – ALTBMD.
- Air Comand and Control System – ACCS.
- Airborne Warning and Control System – AWACS.
- Deployable Communication and Information System – DCIS.
- NATO General Communication System – NGCS..

To the strategic vision blocks of the spheres which are related with special technology [6]:

- Fixations on the custom development of the living cycle managment like militarization planning components.
- National abicious definition in the given sphere with ambicious doublestriking of SR in the NATO key projects.

- Access harmonization of SR to the building – up questions of the defence abilities with bearin, to the militarization, research and technologies within the frame of NATO and EU.
- Form definition and SR industry co – operation ambit with partner and allies industry.

3 FACULTY OF SPECIAL TECHNOLOGY BASIS AND DECISIONS IN THE SPECIAL TECHNOLOGY DEVELOPMENT ROUTING

From the special technology development routing view for the state defence needs,we can how basis apply clause characterizing like defence abilitis trends [7], [14], [15], [16]:

- New technologies development and application.
- Effectivity growth and destructive force of asymetric menace, above all active terrorist forces.
- Post – conflicts situations reason.
- Remaining allotment battle conducting in the settled terain and cities .
- High accurate and efficient guns applications on the targets in the area with civil population.
- Human resources saving like priority by operation planning.
- Consecutive robotization of the military action.

Section program bearings defence research and develpment of the technologies in the defence department in the long-time horizont, would fade above on the objectives implicit of the documents of NATO and EU [7]:

- Search comprendium system and target detection within the frame of the operations, realized in the settled area.
- Biologic and toxic chemical substances detection and indication and protection over them, their decontamination.
- Battlefield digitalization and hardware force integration into network- centric warfare.
- Protection and safety of the information systems.
- Observeables decrease and technology camouflage of the military equipment.
- Operations and defence systems modeling and simulation, training technologies development
- Common battelfield operating view creating.
- Nanotechnologies explotation at the military forces.
- Micro – electromechanical systems (MEMS).
- Army outfit advanced systems to the interoperability gaining in the NATO
- Living force protection and balistic protection increment.
- Mobility in the settled areas.
- Force equipment and back up sending to the outland.

Faculty of special technology get in this path in- process and commented document : „Bearing and support reserach conception and defence sphere development to year 2010“ and faculty members share to its commented. Substantial on the document for FST AD U Tn is that faculty is arranged among educational establishments of Slovak Republik, with will be chose ministries and central bodies of the state administration co-operate by defence research and development long-time plan conception and will be debug with the complex security research.

Faculty of special technology get in this path in- process and commented document : „Development strategy of the ZOP SR on the season 2008-2012“ and faculty members share to its commentation. Inherent on this document for FST AD U Tn will be delegate industry needs. Accord document is assume, that AD U Tn will be delegate by responsibilities:

- Systemic integrator of university

preparing of experts for defence industry.

- Studing program inovation of the 2 level university studing oriented into supporting areas of defence industry of SR development

Within the frame of the studing program is to realize assume:

- Expert preparation for the specialization „weaponry systems".
- Expert preparation for the specialization „Ammunition and explosives"
- Expert preparation for the specialization „Wheel and tracked military technology"
- Expert preparation for the specialization „Mechatronic systems of the military technology",
  (controll units and computers, senzoric, regulate, power elektronic and combination electrofluid components and systems, algorithmization components and system activity programming, etc.)
- Export preparing for specialization „Optic and optoelectronic military systems".

Broad ambit of the education is in the present document characterized:

- To inovate current studing programs about production technologies specification , with CAD/CAM products support, apply education of the new materials, compozits for the military technology and nanomaterials for development and military technology production include nanotechnologies for production realization. Append the education of new laboratory methods and modern methods on the materials properties modification.
- Accredit AD U Tn with program preparation for the 3. level of the university study- postgradual study in the science specialization, related with special technology within the frame of the research advancment and defence Technologies development organizating, is in the document characterize objective:Accredit AD U Tn by organizating and coordinating of main effect live research for the defence industry needs.

4 ORIENTATION OF THE FACULTY OF SPECIAL TECHNOLOGY IN ACTIVITIES RELATED WITH SPECIAL TECHNOLOGY DEVELOPMENT

From requirements, which are marked in the previous chapters, related with Faculty of special
technology activity, we can assert in the activity object are included assumed spheres of faculty
parts on the research, development and education in the work sphere with special technology.
Considering to studing specification of studing subjects cathegorization is term „special
technology" classified within the frame of terminology „Special machine technology".
Present activities interrelated with:

- Education related with constructive problem, operation and special technology production.
- Grant project solving and projects for experience at the spheres:
  - Interaction missile and material with usage assumption for safety issues.
  - Sappers and logistic operation provision.
  - Ways of agregate placing of the armoured fighting vehicle (AFV).
  - Reason intention of mobile repair and diagnostic equipments.
  - Sort reliability sampled from special technology.
  - Dynamic properties of sho – firer parts of the guns and possibilities of their influences.

- Simulation of activities and actions with simulator construction assumption.
- Cybernetic systems of special technology.

Assumed tendency of FST activities will be in the future go out from the requirements of special technology users in the proposal, development, production, operation and logistic support background pertinent to Slovakia routing within the frame of alliance groups and partners objective fulfilling. Orientation will route to the sphere and content filling related with this activity subjects:

- Determination and actualization of the special technology term, special technology categorization, education programs solution within the frame of this determination.
- Access to the standardization, codification and state verification of quality of the products and services for defence purpose [5].
- Solution of crisis, accident and defence situation from the onset view of the special technology predestined to the life and attributes saving, life possibilities renovation and environment (harmfulness, and contamination of terrain and scene research, energy distribution and production, production and distributing drinking and supply water, field health and sanitarian requirements), hit area and terrain trimness, command by crisis and accident situation requirements and etc.[8].
- Crisis, accident and defence situations solving from the logistic support view.
- Nanotechnologies utilization for requirements related with special technology its production and operating.
- Mobile repair, diagnostic and service equipments with the condition those field conditions onset [9], [14], [15], [16].
- Field position containerization and concept of its securing.
- Character and definition of so – called extreme conditions, abilities and concepts their simulation, technology parameters impact of special technology
- Etc.

Some of present gaining achievements illustrate on the sufficient assumes on this activity. For example is in the cooperation phase preparing the research case of the equipment technology of forest fire slacking and inaccessible terrain fires[10], field diagnostic and repair Instruments solution, shied mechanical working decisions, the simulation technology parts, which simulated special technology activity.

So we can to observe, that the special technology problem, questions and objectives, which depends with its development, construction, production and operation are parts of activity charge of the Faculty of special technology. It is essential, that conception questions and ideas were early presented by member of faculty so, that sufficient area was created for them realization.

5 AN EXAMPLE OF APPLICATION OF AUTOMATED AND ROBOT-AIDED SYSTEMS IN SPECIAL TECHNIQUE

We will describe automated and robot-aided systems in its basic term in accordance with an exerted approach of an engineering cybernetics – fig. 5.1.

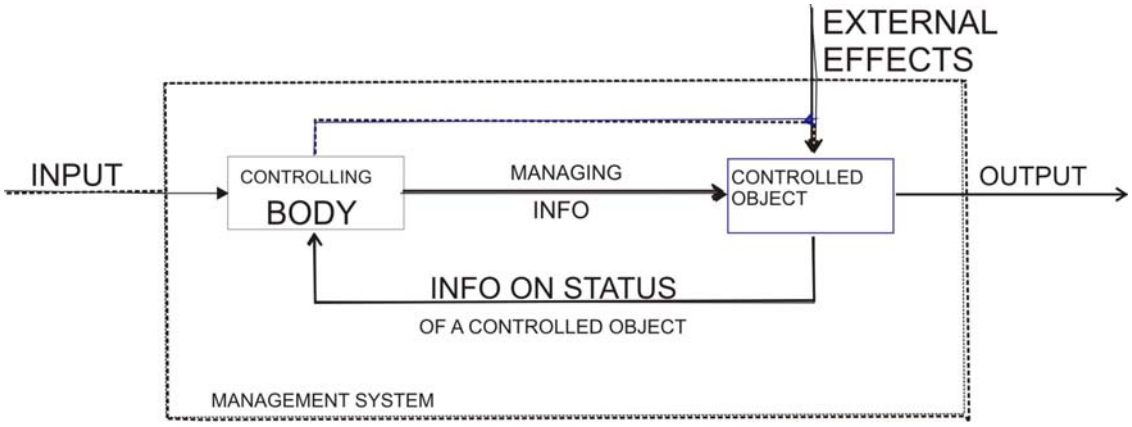

Fig. 5.1. Block diagram of a basic term of automated and robot-aided systems in special technique

Generally it is always needed to separate a scanning part of subsystems from assessing ones, controlling and executing subsystems, so a scanning incentive is transferred to a signal and this one is transmitted through a transmission channel to be processed in other subsystems of special technique, fig. 5.2.

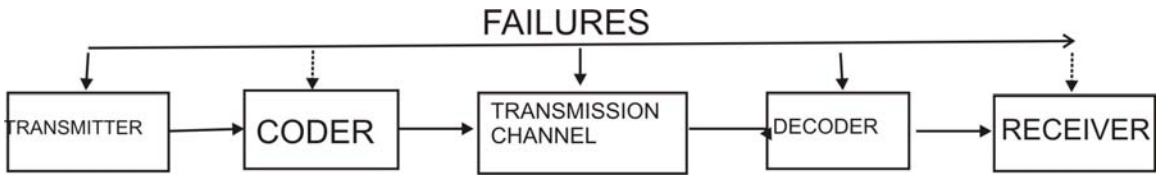

Fig.5.2. Block diagram of a signal transfer between subsystems

Then for example, special technique aiming to monitor chemical and fire situation can be solved in arrangement in accordance with fig. 5.3.

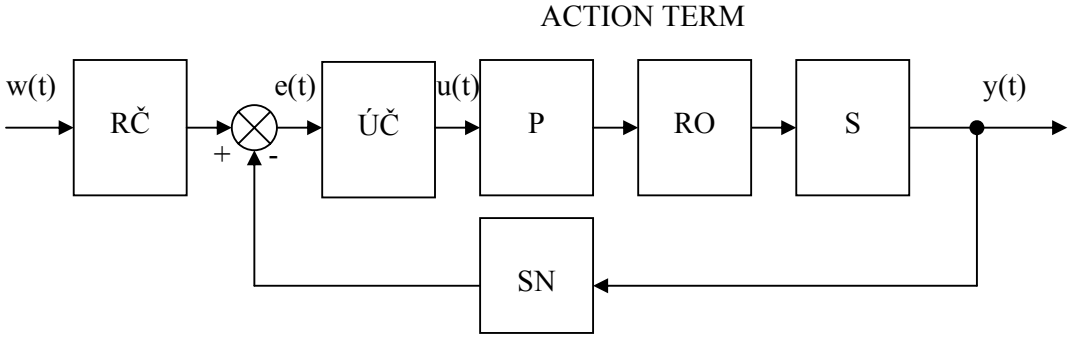

Fig. 5.3. Block diagram of a closed control circuit of a special technique position mechanism

where RČ is control item, RO is controlling body,
ÚČ is central item, S is system,
P is drive, SN is scanner.

Symbols of block designation is defined in line with terms used in special technique are, for example tank and artillery technique.

For such arrangement of a control circuit the model of a resultant transmission function is given by relation:

$$F(p) = F_{RČ}(p).\cdot\frac{F_{ÚČ}(p).F_P(p).F_{RO}(p).F_S(p)}{1+F_{ÚČ}(p).F_P(p).F_{RO}(p).F_S(p).F_{SN}(p)} \quad (5.1)$$

where $F_{RČ}(p)$, $F_{ÚČ}(p)$, $F_P(p)$, $F_{RO}(p)$, $F_S(p)$, $F_{SN}(p)$ are display transmission by particular blocks by fig. 4.3.

Instantiation of scheme to monitor and to declare a fire alert is in the picture 5.4.

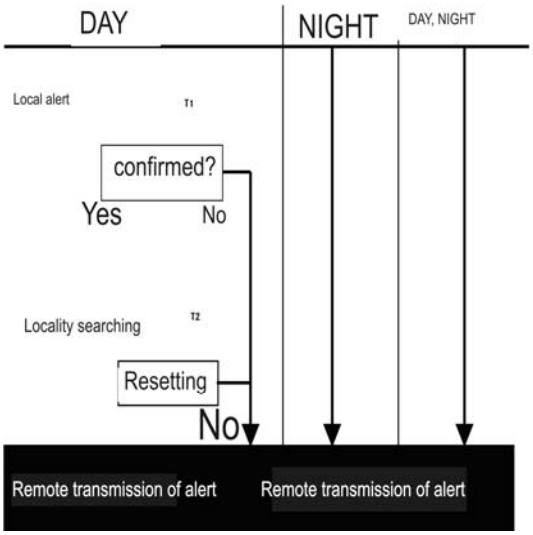

Fig. 5.4. Real monitoring of object through EPS

Additional approach to an application of automated and robot-aided systems in special technique is an application of optical and optoelectronic principle in detecting a display and state of a detected chemical agent. A starting point is formed by a theory of rise, diffusion and detection of electromagnetic radiation, which is comprehensively described through Maxwell equations [12]. Their solution brings us to a discussion on correlations:

$$\mathbf{E}, \mathbf{H} = \mathbf{f}(\varepsilon, \mu, \blacktriangledown, t), \quad (5.2)$$

Where: **E** … is a vector of electric field intensity,

H … is a vector of magnetic field intensity,

ε …is an electric permittivity, defining electric features of medium,

μ … is a magnetic susceptibility, defining magnetic features of medium

▼… vector nabla defines the changes of positions in space ... $\blacktriangledown = \left(\frac{\delta}{\delta x}, \frac{\delta}{\delta y}, \frac{\delta}{\delta z}\right)$.

Thence is obvious, that generation, diffusion and detection of parameters of electromagnetic field relate also with properties of the substance, in which it has been created, with medium, in which it has been diffused and where it has been detected.

An application of chemical photometry is one of possibilities how to detect a chemical agent in the medium. During absorption of radiation of a certain quantized E energy, the molecular or an atomic system passes from a basic state into an exited status. The following applies for particular energetic changes:

$$h\frac{c}{\lambda} = \Delta E = \Delta E_E + \Delta E_K + \Delta E_R, \quad (5.3)$$

Where h ... is Planck's constant

c ... is speed of light

λ ... is a wave length of an emitter of electromagnetic oscillation.

E ... quantum of absorption of electromagnetic radiation,

Whereby the following applies:

$\Delta E_E > \Delta E_K > \Delta E_R$.

Note: In gases and liquids the individual molecules are under reciprocal force actions resulting in energy line spectrum blurred by an existence of additional energy states.

Base of a spectral photometry is Lambert – Beer's law:

$$\Phi = \Phi_0 e^{-\varepsilon cb}, \quad (5.4)$$

Where Φ ...is a radiation flux getting out in a substance being measured or compared

Φ_0 ...is a radiation flux entering into a measuring or a comparing substance

ε ... is a molar absorption factor

c ... is a substance concentration

d ... is length of a substance being measured.

In a technical practice a modified relation is used:

$$E(\lambda) = \varepsilon(\lambda)dc \quad (5.5)$$

Where E (λ) ... is absorbance

ε (λ) ... is a molar decadic absorption factor.

It is obvious from the above mentioned, that an electromagnetic radiation passing through a substance being measured is affected by featured of the measured substance, to the extent that we are able quantitatively define the features for example an intensity of an entering electromagnetic radiation or other of its quantitative feature and to evaluate an electromagnetic radiation leaving from a measured substance, based on comparison of these values we can define a substance being measured. Measuring chain must consist of a source of electromagnetic radiation, or a modulation of such radiation and a routing of radiation through a medium enabling the radiation to pass through a measured substance, from an evaluating and a measuring element. There are several approaches in current practice in establishing chains, being a base of measuring and diagnostic device of chemical agents.

Perspective in usage of automation and control chains in a particular practice of special technique is a solution of a new light armored vehicle of Slovak production and its variants [11]. From a point of view of a current practice there is a need to send a vehicle into the environment, terrain with a possible contamination with dangerous chemical agents or with mine fields. It seems as suitable to solve an integral system of targeting of dangerous objects and based on it to block a further movement of the vehicle. Chemical and engineer version of a light armored vehicle with a high maneuverability, mobility at short as well as long tracks, able to pass through a heavy terrain, with wading and floating capabilities, serviceable in lower visibility.

6 CONCLUSIONS

International science conference „SPECIAL TECHNOLOGY 2008“ is organized by Faculty of special technology of Alexander Dubcek University in Trencin. In cooperation with Faculty of military Technologies of Defence University in Brno it is a forum for opinion Exchange about correct routing of science and realized work of personnel, cooperation in this or collateral areas. It is assumed, that after knowledge evaluation and classification, presented within the frame of this conference, an orientation of science and technical routing of the activity and FST activity will be modificated in line with these findings. Works assumed in the areas related with special technology are relatively deep and it is apparent, that faculty will find its application place there.

Faculty of special technique of Trenčín University pays an attention to this mater; it organizes an international scientific conference on these topics ICMT – ŠPECIÁLNA TECHNIKA 2010 in Bratislava. There are expectations that after evaluation and classification of knowledge, presented during the conference, the orientation of scientific and professional routing of activities and functioning of the Special Technique Faculty will be modified in line with these conclusions. Working conditions in areas related with special technique are relatively large and it is obvious, that the faculty will find its application.

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SATELLITE COMMUNICATION

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Abstract: *This paper deals with comparison of laser and radio frequency systems for satellite communication. After the study of nowadays researches it seems to be useful this system´s comparison for future application and it is source of the next inquiry. It is focused on laser / RF satellite communication, advantages and disadvantages of these systems. It is briefly mentioned the systems´ communication equations and shortly analysis of these equation. The optical communication systems become more and more attractive as the interest in high-capacity and long-distance space links grows. Advancer in laser communication system architectures and optical components technology make such high capacity links feasible. Research opportunities in this area include development of laser beam acquisition, tracking and pointing techniques and algorithms, development of computer aided analysis link budget for the free space channel, systems engineering (analysis and design) of optical transmission development of high efficiency flight qualifiable solid-state lasers, fast fine-pointing mirrors high update rate acquisition and tracking cameras and very low-noise high-quantum efficiency receiver. But there are still problems by transmitting throught the atmosphere and it seems to be a future in hybrid systems – combination of laser and RF satellite communication systems.*

Key words: *Satellite systems, RF, laser, communication, signal transmission, space channel, range loss, signal transfer loss.*

1. INTRODUCTION

It come up the project of of three month stage at Laboratoire E³I²-EA3876 (Extraction et Exploitation de l'Information en Environnements Incertains). After comprehensive the present state of problem solution in literature available was determined the theme of the project. The theme Comparison of Satellite Communication Systems was established on the basis of free space in this field of research.

The nowadays research of inter-satellite communication is centred on hybrid ordering laser and microwave systems. The laser inter-satellite communication is predicted on real GEO satellites.

The optical space communications are a key building block for wide-area space data networks. A crosslink, or communication between two satellites, may be needed to solve certain requirements of satellite communication architecture. Laser cross links will be enable the transfer of data between satellites at rates compatible with ground fibre networks. [1] This is an exciting era for space laser communications. Not only is information transfer driving the requirements to higher data rates, but laser crosslink technology explosions, global development activity, and increased hardware/design maturity are all contributing to interest in space laser communication [2]. A crosslink, or communication between two satellites, may be needed to solve certain requirements of satellite communication architecture. Integration ease issues include compactness of terminals, elimination of complex frequency planning and authorization, and RF interference issues.

2. SATELLITE CROSSLINKS

Early systems looked at very high-data-rate applications. This was natural so as to leapfrog the more established radio frequency (RF) technology.

Laser communication needed a niche of its own and high data rates appeared to fit that niche nicely. After all, a strong RF communication contingent was going to have to be convinced that lasers could indeed transfer information as efficiently as the older, more established RF technology with which they were so comfortable. And laser communications couldn't be a threat W the security of the current RF systems if it was going to have a chance of' being accepted. Hence, a data rate of one gigabit per second was set as a requirement for the first systems.

A crosslink, or communication link between two satellites, may be needed to solve certain requirements of satellite communications architecture. One example is political; the desire to avoid reliance on a ground station located on foreign soil. Another is the need to transmit data from an information-gathering platform that is located on the other side of the Earth from the user. The data may be perishable, that is, it is needed in nearly real time for maximum usefulness, or may be so voluminous that placing sufficient data storage capability onboard the satellite is not practical. Yet still another reason may be a need to avoid multiple up and down links, which add complexity, potential unavailability, and communication data quality loss to the overall data transfer. Additionally, needs may arise for short-range cross links internetting small terminals in large constellations [3]. As indicated previously, laser communications offers the user a number of unique advantages over radio frequency (RF) systems, including size, weight, power, and integration ease on the spacecraft. Integration ease issues include compactness of terminals, elimination of complex frequency planning and authorization, and RF interference issues.

Three of the main design drivers of a crosslink are data rate, range, and link symmetry. Once these three requirements are astablished, the design can proceed with some degree of certainty. For convenience in describing the missions and technologies, this section is divided into categories that include lower data rates at long range, high data rates at long range, and short-range links. Although all crosslinks are duplex, symmetric and asymmetric links may be implemented using slightly different hardware implementations. An example of an asymmetric link is the gathering of large quantities of data by a platform and the transfer of that data at high data rates to a user. The return link direction sends data at much lower data rates for command and control of the data gathering platform.

3. LASER AND RF COMPARISON

Unlike terrestrial cellular networks, in a mobile-satellite network, transmissions are constrained by available power. As illustrated in the previous chapter, the mobile-satellite channel provides a challenging environment in which to operate. Consequently, efficient coding and modulation techniques need to be employed in order to achieve a system margin above the minimum needed to guarantee a particular Quality of Service (QoS) [10].

3.1 RF Link Analyses

A link budget analysis forms the cornerstone of the system design. Link budgets are performed in order to analyse the critical factors in the transmission chain and to optimise the performance characteristics, such as transmission power, bit rate and so on, in order to ensure that a given target quality of service can be achieved.

Basic relation is connection in space and polarisation of wave, which are adapted.

One factor that has hindered realistic trades in the past is the lack of understanding of laser communication systems. Communications system designers have historically specified radio frequency (RF) systems since this has been, until recently, the only mature technology available. Individuals in the traditionally RF communications community need to understand the differences between laser and RF communications in order to conduct realistic trade studies.

There are significant differences between RF and laser communication systems, and much of it results directly from the several orders of magnitude difference in wavelength. This difference is most noticeable in antenna size and beam divergence. Extremely high frequency (EHF) systems (e.g., 60 GHz, with over three orders of magnitude longer wavelength than the near infrared laser communication wavelengths), require antenna sizes measured in feet versus

inches for laser communication. Similarly beam divergences are measured in fractions of degrees versus micro radians for laser communications [4].

High-data-rate RF up/down links require large apertures and/or high-power transmitters at both the satellite and the user terminals. High-data-rate optical up/down links to the ground offer limited availability at any one location due to low cloud penetration ability. Using optical up/down links to a relay aircraft flying above the cloud deck (typically 20,000 to 35,000 ft) allows for aperture sizes of less than 6 in while: using long life, low-power solid-state lasers. RF links between the, aircraft and ground or sea-based terminals are then able to use relatively small apertures and low-power solid-state transmitters due to the greatly reduced range. This RF operation is conventional, easily implemented, and well understood. This type of operational scenario is most cost- effective when the aircraft used is a type of command and control aircraft that is normally present in the area of conflict or when the aircraft has other high-data-rate generating or receiving missions. The data-rate range mentioned previously is the same as that supported by the North American *synchronous optical network* (SONET) standard. Obviously, existing military communication units will not be capable of the higher data rates, but by using the *asynchronous transfer mode* (ATM) capability of the SONET architecture, lower data rate communications can be multiplexed into and out of this high-speed communications trunk. This multiplexing/demultiplexing process would occur at either the relay aircraft, the mobile ground terminal, or the fixed ground terminals These then would act as gateways in a global architectural pan.

4. LASER SATELLITE COMMUNICATIONS

Laser cross links will be enable the transfer of data between satellites at rates compatible with ground fiber networks. This is an exciting era for space laser communications. Not only is information transfer driving the requirements to higher data rates, but laser crosslink technology explosions, global development activity, and increased hardware/design maturity are all contributing to interest in space laser communication [13]. A crosslink, or communication between two satellites, may be needed to solve certain requirements of satellite communication architecture. Laser communications offers the user a number of unique advantages over radio frequency (RF) systems, including size, weight, power and integration ease on the spacecraft. Integration ease issues include compactness of terminals, elimination of complex frequency planning and authorization, and RF interference issues [14].

4.1 Inter-satellite Communication Systems

The optical communication systems become more and more attractive as the interest in high-capacity and long-distance space links grows. Advancer in laser communication system architectures and optical components technology make such high capacity links feasible. The laser communication equation (LCE) is a basic resort of LICS's (Laser Inter-satellite Communication System) analysis. Based on the background and receiver noise and the type of signal modulation which is to be detected, a required signal is generated [15]. The ratio of received signal to required signal is the system link margin. Identifying these gains and losses requires intimate knowledge of the system design, including both the internal constraints and design choices and knowledge of the external factors, including range, data rate, and required signal criteria. These parameters are of single-way data transfer for three independent links – acquisition, tracking and data transfer.

4.2 Signal Transmission Between Satellite and Ground

These applications, for the most part, are extensions of crosslinks since they represent the beginning or end of data flow that involves a crosslink. An example of this is where a data gathering LEO transmits the data to a GEO, which in turn transmits it to another GEO. The data must then be returned to the user on the ground for analysis. In addition, the ground has control of the spacecraft and issues commands via uplink.

As mentioned earlier, as data rates increase into the multigigabit per second regime, RF communications technology is having difficulty coping with a number of problems. First, the high

data rates force the spacecraft/ground terminal builder to use larger antennas (smaller beam divergence) and/or greater power in the transmitter to contend with the high-data-rate link demands. Another problem is frequency congestion, which is as serious as the demand for larger hardware and more power. The larger antenna/more power automatically implies larger spacecraft with larger power systems [22]. The ground antennas are already large. As power increases, the side lobes become very energetic and the intercept problem intensifies. Also, the RF uplink receiver can be jammed more readily than the downlink receiver, so this is another problem, particularly for a foreign ground station. Laser communications provides users with a viable solution for their high-data-rate congestion and security concerns. The laser communications solution works well also with the global military on the move scenario as will be discussed.

4.3 Submarine laser communication

Submarines currently must surface to communicate. They must at least come to a depth that permits them to trail a wire enabling use of RF signals for comnumica- tion, the most common being *very low frequency* (VLF), which is rapidly attenu- ated by sea water. Radio frequencies do not penetrate seawater to any depth excepting *extremely low frequencies* (ELF) where data rate is but a few bits per second. There are two types of antennas used with VLF, the floating wire type and the loop antenna. The loop may be carried on a retractable mast on the submarine's sail or it may be towed behind the submarine on a cable that also carries the received signal down to the submarine. There must be about 100m of floating wire at the surface; therefore, the deeper the submarine wishes to be, the more wire must be streamed. The wire must be lined up with the (great circle) azimuth to the transmitting station. The use of a mast-mounted loop antenna requires the submarine to be very near to the surface. With the mast extended and the loop just below the surface, the submarine is vulnerable to detection and might even collide with a surface ship. The near surfacing, of course, exposes the submarine to detection, which implies sub loss to a sub captain. The ballistic missile submarine fleet depends on stealth for survival and the original concept for SLC involved only the transmission of nuclear control orders to the force. Surfacing has been equated with detection and loss ever since World War II and this is not likely to change. The onshore transmission facilities are not expected to survive more than a few minutes in the event of a nuclear surprise attack.

The thought of two-way communications with a sub is appealing to fleet commanders since they can receive reports from the submarine and direct the submarine's actions. The submarine captain, on the other hand, cannot afford to compromise his or her position so he or she is very reluctant to implement two-way communications.

5. CONCLUSION

Following the parametric correlations computer analyses, basic parameters premises were calculated. These premises serve as input data for effective decisions concerning optimal technological implementation of LICS application. Analysis and optimization supported by computer programme allow making cost-effective decision in designing individual parameters in laser inter-satellite communication system.

The differences between laser and RF communications arise from the very large difference in the wavelengths. RF wavelengths are thousands of times longer than those at optical frequencies. There are not only differences between wave length, but also lower weight, lower power, smaller antenna size etc.

The equation was implemented in MATLAB programme for illustration of differences between these systems. Furthure this systems´simulations are good for analysis and optimization of the satellite communication systems.

But in these days there are the requirements for the data rate and the channel capacity with the minimal losses. One of the best way as a solution of the event of these requirements and the comparison of different systems for satellite communications seems to be the combination of the systems. The laser inter-satellite communication with RF communication thought the atmosphere channel. The atmosphere is an imperfect medium for transmission of laser communications signals. It is not homogeneous and further, it is dynamic in its behaviour. The communication with laser utilisation is possible only by the time of well atmospheric conditions.

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SECURING THE FLOODING ALGORITHM ON GENERAL NETWORKS

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***Abstract*:** *Routing messages in a network is an essential component of Internet communication, as each packet in the Internet must be passed quickly through each network (or autonomous system) that it must traverse to go from its source to its destination. The most methods currently deployed in the Internet for routing messages in a network are designed to forward packets along shortest paths. The algorithms for routing messages are not secure, because they can be compromised by routers that did not follow the respective algorithms correctly. In this paper we describe a new approach to securing the setup and flooding stages of routing algorithms. After a preliminary setup that involves distributing a set of secret keys equal that total no more than the number of routers, our method uses a public-key infrastructure and cryptographic hashing of messages to achieve security. This method can secure several routing algorithms for networks where a single bad router can affect an entire network.*

***Key words*:** *network, router, protocol, algorithm, security.*
***MSC 2010**: 68M12.*

1. INTRODUCTION

The need for communication has always been the driving force behind the invention of technologies whichis bringing the people closer day by day. The telecommunication industry began with a wired connection and then the recent advancement in different technologies has made it possible to communicate using wireless technologies. Invention of computer, software, hardware, micro chips has changed the whole concept of communication. Today we see a blend of wired and wireless communication network using heterogeneous technologies.

Routing messages in a network is an essential component of Internet communication, as each packet in the Internet must be passed quickly through each network (or autonomous system) that it must traverse to go from its source to its destination. It should come as no surprise, then, that most methods currently deployed in the Internet for routing in a network are designed to forward packets along shortest paths. Indeed, current interior routing protocols, such as OSPF, RIP, and IEGP, are based on this premise, as are many exterior routing protocols, such as BGP and EGP.

The algorithms that form the basis of these protocols are not secure, however, and have even been compromised by routers that did not follow the respective protocols correctly. Fortunately, all network malfunctions resulting from faulty routers have to date been shown to be the result of misconfigured routers, not malicious attacks. Nevertheless, these failures show the feasibility of malicious router attacks, for they demonstrate that compromising a single router can undermine the performance of an entire network.

In this paper we describe a new approach to securing the setup and flooding stages of routing algorithms. After a preliminary setup that involves distributing a set of secret keys equal that total no more than the number of routers, our method uses simple cryptographic hashing of messages (HMACs) to achieve security.

2. FLOODING

We begin by discussing the flooding protocol and a low-cost way of making it more secure. Our method involves the use message-authenficating scheme using cryptographic hashing.

2.1. THE NETWORK FRAMEWORK AND THE FLOODING ALGORITHM

Let $G = (V;E)$ be a network whose vertices in V are routers and whose edges in E are direct connections between routers. We assume that the routers have some convenient addressing mechanism that allows us without loss of generality to assume that the routers are numbered 1 to n. Furthermore, we assume that G is biconnected, that is, that it would take at least two routers to fail in order to disconnect the network.

The flooding algorithm is initiated by some router s creating a message M that it wishes to send to every other router in G. The typical way the flooding algorithm is implemented is that s incrementally assigns sequence numbers to the messages it sends. So that if the previous message that s sent had sequence number j, then the message M is sent with sequence number $j + 1$ and an identification of the message source, that is, as the message $(s; j +1;M)$. Likewise, every router x in G maintains a table S_x that stores the largest sequence number encountered so far from each possible source router in G. Thus, any time a router x receives a message $(s; j + 1;M)$ from an adjacent router y, the router x first checks if $S_x [s] < j +1$. If so, then x assigns $S_x[s] = j +1$ and x sends the message $(s; j +1;M)$ to all of its adjacent routers, except for y. If the test fails, however, then x assumes it has handled this message before and it discards the message.

If all routers perform their respective tasks correctly, then the flooding algorithm will send the message M to all the nodes in G. Indeed, if the communication steps are synchronized and done in parallel, then the message M propagates out from s is a breadth-first fashion.

If the security of one or more routers is compromised, however, then the flooding algorithm can be successfully attacked. For example, a router t could spoof the router s and send its own message $(s; j + 1;M'')$. If this router reaches a router x before the correct message, then x will propagate this imposter message and throw away the correct one when it finally arrives. Likewise, a corrupted router can modify the message itself, the source identification, and/or the sequence number of the full message in transit. Each such modification has its own obvious bad effects on the network.

2.2. SECURING THE FLOODING ALGORITHM ON GENERAL NETWORKS

On possible way of avoiding the possible failures that compromised or misconfigured routers can inflict on the flooding algorithm is to take advantage of a public-key infrastructure defined for the routers. In this case, we would have s digitally sign every flooding message it transmits, and have every router authenticate a message before sending it on. Unfortunately, this approach is computationally expensive

Our scheme is based on a light-weight strategy. The initial setup for our scheme involves the use of a public-key infrastructure, but the day-to-day operation of our strategy takes advantage of much faster cryptographic methodologies. Specifically, we define for each router x the set $N(x)$, which contains the vertices (routers) in G that are neighbors of x (which does not include the vertex x itself). That is, $N(x) = \{y : (x, y) \in E \text{ and } y \neq x\}$. The security of our scheme is derived from a secret key $k(x)$ that is shared by all the vertices in $N(x)$, but not by x itself. This key is created in a setup phase and distributed securely using the public-key infrastructure to all the members of $N(x)$. Note, in addition, that $y \in N(x)$ if and only if $y \in N(y)$.

Now, when s wishes to send the message M as a flooding message to a neighboring router, x, it sends $(s, j+1, M, h(s \mid j+1 \mid M \mid k(x)), 0)$,

where h is a cryptographic hash function that is collision resistant. Any router x adjacent to s in G can immediately verify the authenticity of this message (except for the value of this application of h), for this message is coming to x along the direct connection from s. But nodes at distances greater than 1 from s cannot authenticate this message so easily when it is coming from a router other than s. Fortunately, the propagation protocol will allow for all of these routers to authenticate the message from s, under the assumption that at most one router is compromised during the computation.

Let $(s; j+1; M; h1; h2)$ be the message that is received by a router x on its link from a router y. If $y = s$, then x is directly connected to s, and $h2 = 0$. But in this case x can directly authenticate the message, since it came directly from s. In general, for a router x that just received this message from a neighbor y with $y \neq s$, we inductively assume that $h2$ is the hash value $h(s \mid j+1 \mid M \mid k(y))$. Since x is in $N(y)$, it shares the key $k(y)$ with y's other neighbors; hence, x can authenticate the message from y by using $h2$. This authentication is sufficient to guarantee correctness, assuming no more than one router is corrupted at present, even though x has no way of verifying the value of $h1$.

So to continue the propagation assuming that flooding should continue from x, the router x sends out to each w that is its neighbor the message $(s, j+1, M, h(s \mid j+1 \mid M \mid k(w)), h_1)$. Note that this message is in the correct format for each such w, for $h1$ should be the hash value $h(s \mid j+1 \mid M \mid k(x))$, which w can immediately verify, since it knows $k(x)$. Note further that, just as in the insecure version of the flooding algorithm, the first time a router w receives this message, it can process it, updating the sequence number for s and so on.

2.3. TRADING MESSAGE SIZE FOR HASHING COMPUTATIONS

In some contexts it might be too expensive for a router to perform as many hash computations as it has neighbors. Thus, we might wonder whether it is possible to reduce the number of hashes that an intermediate router needs to do to one. In this subsection we describe how to achieve such a result, albeit at the expense of increasing the size of the message that is sent to propagate the flooding message.

In this case, we change the preprocessing step to that of computing a small-sized coloring of the vertices in G so that no two nodes are assigned the same color. Algorithms for computing or approximating such colorings are known for a wide variety of graphs. For example, a tree can be colored with two colors. Such colorings might prove useful in applying our scheme to multicasting algorithms, since most multicasting communications actually take place in a tree. A planar graph can be colored with four colors, albeit with some difficulty, and coloring a planar graph with five colors is easy. Finally, it is easy to color a graph that has maximum degree d using at most $d+1$ colors by a straightforward greedy algorithm. This last class of graphs is perhaps the most important for general networking applications, as most communications networks bound their degree by a constant.

Let the set of colors used to color G be simply numbered from 1 to c and let us denote with V_i the set of vertices in G that are given color i, for $i = 1; 2; : : : ; c$, with $c \geq 2$. As a preprocessing step, we create a secret key k_i for the color i. We do not share this color with the members of V_i, however. Instead, we share k_i with all the vertices that are *not* assigned color i.

When a router s wishes to flood a message M with a new sequence number $j + 1$, in this new secure scheme, it creates a full message as $(s; j + 1; M; h1; h2; : : : ; hc)$, where each $h_i = h(s \mid j+1 \mid M \mid k_i)$. (As a side note, we observe that the prefix of the bit string being hashed repeatedly by s is the same for all hashes, and its hash value in an iterative hashing function need only be computed once.) There is one problem for s to build this message, however. It does not know the value of k_i, where i is the color for s. So, it will set that hash value to 0. Then, s sends this message to each of its neighbors. Suppose now that a router x receives a message $(s; j + 1; M;$

*h*1*; h*2*; : : : ; hc*) from its neighbor $y \neq s$. In this case *x* can verify the authenticity of the message immediately, since it is coming along the direct link from *s*. Thus, in this case, *x* does not need to perform any hash computations to validate the message. Still, there is one hash entry that is missing in this message (and is currently set to zero): namely, $h_i = 0$, where *i* is the color of *s*. In this case, the router *x* computes $h_{j_i} = h(s \mid j+1 \mid M \mid k_j)$, since it must necessarily share the value of k_j, by the definition of a vertex coloring. The router *x* then sends out the (revised) message (*s; j* + 1*;M; h*1*; h*2*; : : : ; hc*).

Suppose then that a router *x* receives a message (*s; j* + 1*;M; h*1*; h*2*; : : : ; hc*) from its neighbor $y \neq s$. In this case we can inductively assume that each of the h_i values is defined. Moreover, *x* can verify this message by testing if $h_i = h(s \mid j+1 \mid M \mid k_i)$, where *i* is the color for *y*. If this test succeeds, then *x* accepts the message as valid and sends it on to all of its neighbors except *y*. In this case, the message is authenticated, since *y* could not manufacture the value of *hi*.

If the graph *G* is biconnected, then even if one router fails to send a message to its neighbors, the flood will still be completed. Even without biconnectivity, if a router modifies the contents of *M*, the identity of *s*, or the value of *j*+1, this alteration will be discovered in one hop. Nevertheless, we cannot immediately implicate a router *x* if its neighbor *y* discovers an invalid h_i value, where *i* is the color of *x*. The reason is that another router, *w*, earlier in the flooding could have simply modified this h_i value, without changing *s*, *j* + 1, or *M*. Such a modification will of course be discovered by *y*, but *y* cannot know which previous router performed such a modification. Thus, we can detect modifications to content in one hop, but we cannot necessarily detect modifications to h_i values in one hop. Even so, if there is at most one corrupted router in *G*, then we will discover a message modification if it occurs.

3. SETUP FOR DISTANCE-VECTOR ROUTING

Another important routing setup algorithm is the distance-vector algorithm, which is the basis of the well-known RIP protocol. Protocol RIP calculates the distance up to the destination of a package and allows routers to update their routing tables every 30 seconds. Rip lead the way used for data transmission based on the concept of distance-vector. When a packet crosses a router, considering that went with a hop, and the number of hops passed a package to reach the destination is counted in a hop count. For example, a road that has hop count (number of hop-RI) equal to 4, means that a package has gone through 4 routers to reach destination. Because there are many roads that can get a package from source to destination path with the fewest-hop is selected by router. As with the link-state algorithm, the setup for distance-vector algorithm creates for each router *x* in *G* a vector, D_x, of distances from *x* to all other routers, and a vector C_x, which indicates which link to follow from *x* to traverse a shortest path to a given router. Rather than compute these tables all at once, however, the distance vector algorithm produces them in a series of rounds.

3.1. REVIEWING THE DISTANCE-VECTOR ALGORITHM

Initially, each router sets $D_x[y]$ equal to the weight, $w(x; y)$, of the link from *x* to *y*, if there is such a link. If there is no such link, then *x* sets $D_x[y] = +\infty$. In each round each router *x* sends its distance vector to each of its neighbors. Then each router *x* updates its tables by performing the following computation:

for each router *y* adjacent to *x* **do**
  for each other router *w* **do**
    if $D_x[w] > w(x; y) + D_y[w]$ **then**
    {It is faster to first go to *y* on the way to *w*}
    Set $D_x[w] = w(x; y) + D_y[w]$
    Set $C_x[w] = y$
    endif
  endfor
endfor

If we examine closely the computation that is performed at a router *x*, it can be modeled as

that of computing the minimum of a collection of values that are sent to x from adjacent routers (that is, the $w(x; y)+D_y[w]$ values), plus some comparisons, arithmetic, and assignments. Thus, to secure the distance-vector algorithm, the essential computation is that of verifying that the router x has correctly computed this minimum value.

3.2. SECURING THE SETUP FOR THE DISTANCE-VECTOR ALGORITHM

Since the main algorithmic portion in testing the correctness of a round of the distance-vector algorithm involves validating the computation of a minimum of a collection of values, let us focus 7 more specifically on this problem. Suppose, then, that we have a node x that is adjacent to a collection of nodes $y_0, y_1, : : :, y_{d-1}$, and each node y_i sends to x a value a_i. The task x is to perform is to compute

$$m = \min_{i = 0,1,...,d-1} \{a_i\}$$

in a way that all the y_i's are assured that the computation was done correctly. As in the previous sections, we will assume that at most one router will be corrupted during the computation (but we have to prevent and/or detect any fallout from this corruption). In this case, the router that we consider as possibly corrupted is x itself. The neighbors of x must be able therefore to verify every computation that x is to perform. To aid in this verification, we assume a preprocessing step has shared a key $k(x)$ with all d of the neighbors of x, that is, the members of $N(x)$, but is not known by x.

The algorithm that x will use to compute m is the trivial minimum-finding algorithm, where x iteratively computes all the pre_x minimum values

$$m_j = \min_{i = 0,1,...,j} \{a_i\}$$

for $j = 0; : : : ; d-1$. Thus, the output from this algorithm is simply $m = m_{d-1}$. The secure version of this algorithm proceeds in four communication rounds:

1. Each router y_i sends its value a_i to x, as $A_i = (a_i, h(a_i \mid k(x)))$, for $i = 0; 1; : : : ; d - 1$.
2. The router x computes the m_i values and sends the message $\left(m_{i-1}, m_i, A_{i-1 \bmod d}, A_{i+1 \bmod d}\right)$ to each y_i. The validity of $A_{i-1 \bmod d}$ *and* $A_{i+1 \bmod d}$ is checked by each such y_i using the secret key $k(x)$. Likewise, each y_i checks that $m_i = \min\{m_{i-1}, a_i\}$.
3. If the check succeeds, each router y_i sends its verification of this computation to x as $B_i = ("yes", i, m_i, h("yes" \mid m_i \mid i \mid k(x)))$. (For added security y_i can seed this otherwise short message with a random number.)
4. The router x sends the message $(B_{i-1 \bmod d}, B_{i+1 \bmod d})$ to each y_i. Each such y_i checks the validity of these messages and that they all indicated "yes" as their answer to the check on x's computation. This completes the computation.

4. CONCLUSIONS

In essence, the above algorithm is checking each step of x's iterative computation of the m_i's. But rather than do this checking sequentially, which would take $O(d)$ rounds, we do this check in parallel, in $O(1)$ rounds.

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HARDWARE IMPLEMENTATIONS OF BLOCK CIPHERS IN FPGA CIRCUITS

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Abstract. *Software implementation of cryptographic algorithms has several advantages: short development cycle, cheap development tools, flexibility and portability, though it offers a limited physical security (especially in key storing) and low processing speed. On the other hand, hardware implementations offer strong physical protection and high processing speed and even if they have several disadvantages, overall hardware implementation is the best and the most common solution.*

Keywords: *hardware implementation, block ciphers, Virtex, DES, FPGA (Field Programmable Gate Array), Xilinx FPGAs*

1. INTRODUCTON

The development of technology and the modern requirements for security (flexibility, reduced life time for algorithms) lead to the use of FPGA (Field Programmable Gate Array) circuits in cryptographic applications, as a new, promising alternative for hardware implementations of algorithms.

The applications of FPGA can be found in the domains of evolvable and biologically – inspired hardware, network processors, real-time systems, rapid ASIC prototyping, digital signal processing, interactive multimedia, machine vision, computer graphics, robotics, embedded applications, beside cryptography. In general, FPGA tend to be an excellent choice when dealing with algorithms that can benefit from the high parallelism offered by the FPGA fine-grained architecture. FPGA are used for reconfigurable computing when the main goal is to obtain high performance at a reasonable cost out of hardware implemented algorithms.

The paper describes two mechanisms of FPGA circuits (parallel and pipeline structures) applied in the hardware implementation of block ciphers.

2. HARDWARE MPLEMENTATION OF BLOCK CIPHERS

General Structure of a Block Cipher

Block ciphers are based on well understood mathematical problems and make extensive use of non-linear functions and linear modular algebra. Most block ciphers exhibit a highly regular structure: same building blocks are applied a predetermined number of times. Encryption and decryption only differ in the order (ascending or descending) that the sub-keys are used.

Implementation of block ciphers mainly uses bit level operations and table look-ups. The bit level operations include standard combinational logic operations (such as XOR, AND, OR etc.), substitutions, logical shifts and permutation. These operations can be nicely mapped to the structure of FPGA devices. In addition, there are

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built-in dedicated resources like memory modules which can be used as a Look Up Tables (LUTs) to speedup the substitution operation, which is one of the key transformation of modern block ciphers.

As shown in Figure 1 there are three main processes in block ciphers: encryption, decryption and key schedule. For the encryption process, the input is *plaintext* and the output is *cipher text.* For the decryption process, cipher text becomes the input and the resultant output is the original plaintext. A number of rounds are performed for encryption/decryption on a single block. Each round uses a round key which is derived from the cipher key through a process called *key scheduling.*

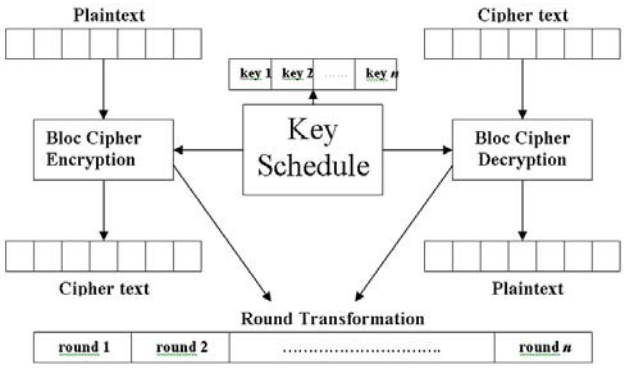

Figure1.General structure of a block cipher

Block cipher encryption

Many modern block ciphers are Fiestel ciphers. Fiestel ciphers divide input block into two halves. Those two halves are processed through n number of rounds. In the final round, the two output halves are combined to produce a single cipher text block. All rounds have similar structure. Each round uses a round key, which is derived from the previous round key. The round key for the first round is derived from the user master key. In general all the round keys are different from each other and from the cipher key.

The block ciphers, partially or completely employ a Fiestel structure (Figure 2). The round operations normally include some non-linear transformations like substitution and permutation making the algorithm stronger against cryptanalytic attacks.

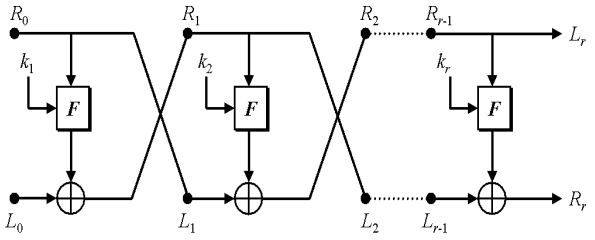

Figure 2.Generic Fiestel structure

Block cipher decryption

As it was early mentioned, one of the main characteristics of a Fiestel is the usage of a similar structure for encryption and decryption processed. The difference lies in the order that the round keys are applied. For decryption, round keys are used in reverse order as that of encryption.

Key schedule

The round keys are derived from the user key through a process called key scheduling. Block ciphers define several transformations for deriving the round keys to be utilized during the encryption and decryption processes. For some of them, round keys for decryption are derived using reverse transformation. Alternatively, keys derived for encryption can be simply used during decryption process in reverse order.

Useful properties for implementing block ciphers

Hardware implementations are intrinsically more physically secure: key access and algorithm modification is considerable harder. The properties of symmetric ciphers that can be easily mapped in hardware are: bit-wise operations, substitutions, permutations, shift and rotate.

Bit-wise operations

Most of the block ciphers include bit-level operations like AND, XOR and OR, which can be efficiently implemented and executed in FPGA. Indeed, those operations utilize a relatively modest amount of hardware resources. The primitive logic units in most of the FPGA are based on 4-input/1-output configuration. This useful feature of FPGA allow to build 2, 3 or 4 input Boolean function using the same hardware resources (Figure 3).

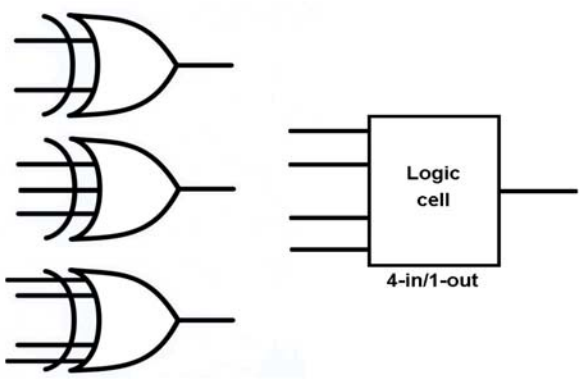

Figure 3.FPGA logic cell

Substitution

Substitution is the most common operation in symmetric block ciphers which adds maximum non-linearity to the algorithm. It is usually constructed as a look-up table referred to as substitution box (S-box). The strength of DES algorithm heavily depends on the security robustness of its S-boxes. AES S-box is used in both encryption and decryption and also in its key schedule algorithm.

Formally, an S-box can be defined as a mapping of n input to m output bits. When n = m the mapping is reversible and therefore it is said to be bijective.

FPGA devices offer various solutions for the implementation of substitution operation:

- the primitive logic unit in FPGA can be configured into memory mode. A 4-in/1-out LUT provides 16 * 1 memory. A large number of LUTs can be combined into a big memory. This might be seen as a fast approach because the S-box pre-computed values can be stored, thus saving valuable computational time for S-box manipulation.
- The value for S-boxes in some block ciphers can also be calculated. In this case, if the target device does not contain enough memory, then one can use combinational logic to implement S-boxes. That could be rather slow due to large routing overheads in FPGA.
- Some FPGA devices contain built-in memory modules. Those are fast access memories which do not make use of primitive logic units but they are integrated within FPGA. The pre-computed values for S-boxes can be stored in those dedicated modules. That could be faster as compared to store S-box values in primitive logic units configured into memory mode.

Permutation

Permutation is a common block cipher primitive. Fortunately, there is no cost associated with this operation since it does not make use of FPGA logic resources. It is just rewiring and the bits are rearranged in the required order.

Shift & rotate

Shift is simpler than the permutation operation. Shift operation is normally performed by extracting some particular bit/byte values from a larger register.

Most block ciphers use the rotation operation. It is very similar to the shift operation.

For a 4 bit buffer, shifting left $a_0a_1a_2a_3$ by 1 bit becomes $a_1a_2a_30$, whereas rotating left by 1 bit produces $a_1a_2a_3a_0$.

3. IMPLEMENTATION STRATEGIES

Iterative design strategy

Block ciphers are naturally iterative, that is, *n* iterations of the same transformations, normally called *rounds*, are made for a single encryption/decryption. An iterative design strategy is a simple approach which implements the cipher algorithm by executing *n* iterations of its rounds.

Therefore, *n* clock cycles are consumed for encrypting/decrypting a single block, as shown in Figure 4. Obviously, this is an economical approach in terms of required hardware area. But it slows cipher speed which is *n* times slower for a single encryption. Such architectures would be useful for those applications where available hardware resources are limited and speed is not a critical factor.

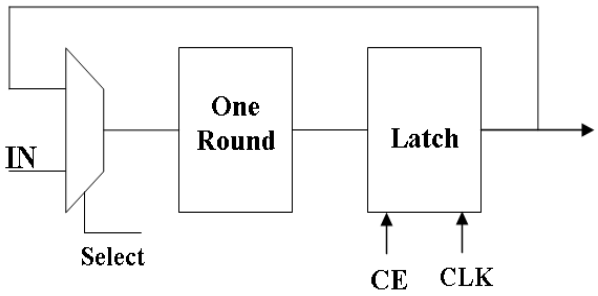

Figure 4.Iterative Design

Unrolled design strategy

Unrolled designed is the simplest extension of iterative design strategy and it uses several rounds as a combinational circuit. In the most cases, the number of unrolled rounds is a divider of total number of rounds and in extreme cases all rounds can be unrolled, eliminating the use of a multiplexer and the reaction loop (Figure 5 and Figure 6).

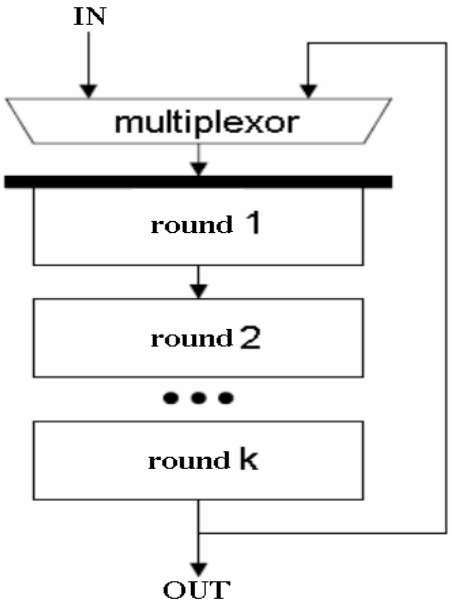

Figure 5.Partial loop-unrolling

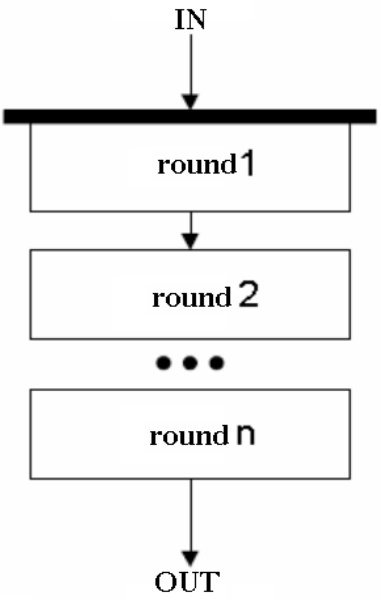

Figure 6.Total loop-unrolling

Pipeline design strategy

In a pipeline design, all the *n* rounds of the algorithm are unrolled and registers are provided between two consecutive rounds as shown in Figure 7.

All the intermediate registers are triggered at the same clock by shifting data to the next stage

at the rising/falling edge of the clock. Once all the pipeline stages are filled, the output blocks starts appearing at each successive clock cycle.

This is a fast solution which increases the hardware cost to approximately *n* times as compared to an iterative design.

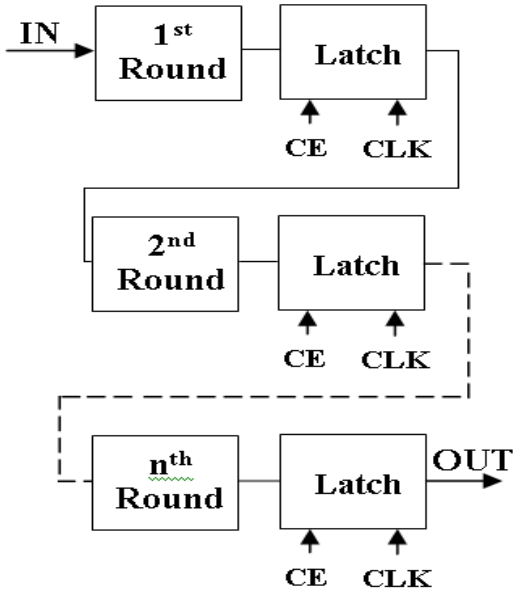

Figure 7.Pipeline design

4. IMPLEMENTATION RESULTS

For this paper we chose to implement the most well known block cipher: DES algorithm. The FPGA used is Virtex-4 LX25 (about 25.000 logic cells).

In Table 1 we listed twelve different implementation strategies, the number of occupied resources and the maximum clock used for DES encryption/decryption.

The results are as we expected, the maximum clock was obtained for a DES pipeline 16 rounds implementation.

Also the maximum number of instances of DES pipeline is 4 occupying 99 percent of resources.

5. CONCLUSIONS

From the implementation results we can conclude that the implementation with the highest frequency is the total-unrolled pipeline one (16 rounds). The throughput in this case is:

$$Throughput = 64(bits) * 242(MHz) = 15.4Gbps$$

Implementation type	Nr. of LUTs		Nr. of REGs		Maximum CLK (MHz)	Nr of SLICEs	
	Nr	Area	Nr	Area		Nr	Area
DES iterative design	2,030	9%	807	3%	175.116	1,312	12%
DES unrolled 2 rounds	2,037	9%	805	3%	132.100	1,322	12%
DES unrolled 4 rounds	2,752	12%	830	3%	83.899	1,711	15%
DES unrolled 8 rounds	4,364	20%	874	4%	48.217	2,618	24%
DES unrolled 16 rounds	5,153	23%	801	3%	25.985	2,955	27%
DES pipeline 16 rounds	5,546	25%	1,714	7%	242.615	3,445	32%
2xDES iterative design	3,387	15%	1,152	5%	175.116	2,034	18%
2xDES unrolled 2 rounds	3,403	15%	1,148	5%	132.100	2,051	19%
2xDES unrolled 4 rounds	4,769	22%	1,296	6%	83.899	2,910	27%
2xDES unrolled 8 rounds	7,167	33%	1,298	6%	48.217	4,166	38%
2xDES pipeline 16 rounds	10,526	48%	2,930	13%	242.615	6,271	58%
4xDES pipeline 16 rounds	**19,520**	**90%**	**5,083**	**23%**	**242.615**	**10,75**	**99%**

Table 1.DES implementation results

This means that with 4 instances of this DES implementation in a single Virtex-4 LX25 FPGA, the total throughput is over 60Gbps.

This is the undeniable proof that using FPGA we can achieve very high processing speeds, unparalleled to software implementation.

6. FUTURE WORK

Some improvements for this paper which have been discussed could be applied in a future work.

The chosen implementation allowed us to achieve our goal (DES brute force attack for 40 bits key length), and to exceed it (DES brute force attack for 44 bits key length).

Forasmuch DES brute force attack for 44 bits key length is part of the linear cryptanalysis DES attack for 56 bits key length [4], in the future, the application can be improved by implementing attack of linear cryptanalysis on 56 bits (one block is 64 bits and the key is 64 bits wide (but only 56 bits are used).

Also because the FPGA circuits is reconfigurable and have a scalable architecture, the application can be improved by implementing the brute force attack on other algorithms (e.g., MD4), and in other types of cryptanalytic attacks (e.g. password breaking, dictionary type attacks, etc.).

Modern applications of DES cover a wide variety of applications, such as secure internet

(SSL), electronic financial transactions, remote access servers, cable modems, secure video surveillance and encrypted data storage.

Despite the fact that DES is considered un-secure, there is a way to enhance it. By encrypting three times successively, we get an adequate level of security, even for sensitive data.

This method is called Triple DES. The major drawback of Triple DES is the speed which is much lower than other modern algorithm like AES.

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SECURITY OF THE CRIPTOGRAPHIC SYSTEMS BASED FPGA

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Abstract

The paper presents the advantages of reconfigurable hardware (FPGA) in cryptographic applications and some security shortcomings of FPGA in the cryptographic systems.

In cryptographic applications there are Software and Hardware implementations for the security fuctions..

The advantages of software implementations include ease of use, ease of upgrade, portability, low development costs, low unit prices and flexibility. On the down side, a software implementation offers moderate speed, high power consumption compared to custom hardware, and only limited physical security, especially with respect to key storage.

ASIC implementations show lower price per unit, can reach high speeds, and can have low power dissipation. Furthermore hardware implementations of cryptographic algorithms are more secure because they cannot as easily be read or modified by an outside attacker as software implementations.

Reconfigurable hardware devices, such as Field Programmable Gate Arrays (FPGAs), seem to combine the advantages of SW and HW implementations.

Keywords: cryptography, FPGA, security, attacks, reconfigurable hardware, physical

1. ADVANTAGES OF FPGAS FOR CRYPTOGRAPHIC APPLICATIONS

Algorithm Mobility:
This term refers to the switching of cryptographic algorithms during operation of the targeted application. Whereas algorithm mobility is costly with traditional hardware, FPGAs can be reprogrammed on-the-fly.

Architecture Efficiency:
In certain cases a hardware architecture can be much more efficient if it is designed for a specific set of parameters. FPGAs allow this type of design and optimization with specific parameter set.

Algorithm Modification:
There are applications which require modification of standardized cryptographic algorithms, e.g., by using proprietary S-boxes or permutations. Such modifications are easily made with FPGA circuits.

Throughput:
Although typically slower than ASIC implementations, FPGA implementations have the potential of running substantially faster than software implementations.

Cost Efficiency:
There are two cost factors that have to be taken into consideration, when analyzing the cost efficiency of FPGAs: cost of development and unit prices.

2. SECURITY SHORTCOMINGS OF FPGAS

The most common threat against an implementation of cryptographic algorithm is to learn a confidential cryptographic key, that is, either a symmetric key or the private key of an asymmetric algorithm. Given that the algorithms applied are publicly known in most commercial applications, knowledge of the key enables the attacker to decrypt future (assuming the attack has not been detected and countermeasures have not been taken) and, often more harming, past communication which had been encrypted.

Another threat is the one-to-one copy, or "cloning", of a cryptographic algorithm *together* with its key. In some cases it can be enough to run the cloned application in decryption mode to decipher past and future communication. In other cases, execution of a certain cryptographic operation with a presumingly secret key is in most applications the sole criteria which authenticates a communication party. An attacker who can perform the same function can masquerade as the attacked communication party. Yet another threat is given in applications where the cryptographic algorithms are proprietary. Even though such an approach is not wide-spread, it is standard practice in applications such as pay-TV and in government communication. In such scenarios it is already interesting for an attacker to reverse-engineer the encryption algorithm itself. The associated key might later be recovered by other methods (e.g., bribery or classical cryptanalysis.)

The discussion above assumes mostly that an attacker has physical access to the encryption device.

Black Box Attack

The classical method to reverse engineer a chip is the so called Black Box attack.
The attacker inputs all possible combinations, while saving the corresponding outputs.
The intruder is then able to extract the inner logic of the FPGA, with the help of the Karnaugh map or algorithms that simplify the resulting tables.
This attack is only feasible if a small FPGA with explicit inputs and outputs is attacked and a lot of processor power is available. The reverse engineering effort grows and it will become less feasible as the size and complexity of the FPGA increases and with the usage of state machines, LFSRs (Linear Feedback Shift Registers), integrated storage, and so on [Dip].

Readback Attack

This feature allows to read a configuration out of the FPGA for easy debugging.
The idea of the attack is to read the configuration of the FPGA through the JTAG or programming interface in order to obtain secret information (e.g. keys).

Attack of the Bitstreams

In order to get the design of proprietary algorithms or the secret keys, one has to reverseengineer
the bitstream. The condition to launch the attack is that the attacker has to be in possession of the (unencrypted) bitstream.

Physical Attack

The aim of a physical attack is to investigate the chip design in order to get information about proprietary algorithms or to determine the secret keys by probing points inside the chip. Hence, this attack targets parts of the FPGA, which are not available through the normal I/O pins. This can potentially be achieved through visual inspections and by using tools such as optical microscopes and mechanical probes. However, FPGAs are becoming so complex that only with advanced methods, such as Focused Ion Beam (FIB) systems, one can launch such an attack. To our knowledge, there are no countermeasures to protect FPGAs against this form of physical threat. In the following, we will try to analyze the effort needed to physically attack FPGAs

manufactured with different underlying technologies.

SRAM FPGAs:
Due to the similarities in structure of the SRAM memory cell and the internal structure of the SRAM FPGA, it is most likely that the attacks can be employed in this setting.
Contrary to common wisdom, the SRAM memory cells do not entirely loose the contents when power is cut.
The reason for these effects are rooted in the physical properties of semiconductors. The physical changes are caused mainly by three effects: electromigration, hot carriers, and ionic contamination.

Most publications agree that device can be altered, if
- threshold voltage has changed by 100mV or
- there is a 10% change in transconductance, voltage or current.

One can find attacks against SRAM memory cells using the access points provided by the manufactures.

One of the widely used methods to analyze SRAM cells and it is based on the analysis of the current usage. The idea is to execute a set of test vectors until a given location is reached, at which point the device current is measured.

Another possibilities for the attack are also to use the scan path that the IC manufacturers insert for test purposes or techniques like bond pad probing .
When it becomes necessary to use access points that are not provided by the manufacturer, the layers of the chip have to be removed.

Mechanical probing with tungsten wire with a radius of 0*;* 1 ¡ 0*;* 2¹*m* is the traditional way to discover the needed information. These probes provide gigahertz bandwidth with 100*fF* capacitance and 1*M*- resistance. Due to the complex structure and the multi layer production of chips the mechanical testing is not sufficient enough.

Focused Ion Beam workstations can expose buried conductors and deposit new probe points. The functionality is similar to an electron microscope and one can inspect structures down to 5nm. Electron-beam tester (EBT) is another measurement method. An EBT is a special electron microscope that is able to speed primary electrons up to 2.5 kV at 5nA. EBT measures the energy and amount of secondary electrons that are reflected.
Resulting from the above discussion of attacks against SRAM memory cells, it seems likely that a physical attack against SRAM FPGAs can be launched successfully, assuming that the described techniques can be transfered. However, the physical attacks are quite costly and having the structure and the size of state-of-the-art FPGA in mind, the attack will probably only be possible for large organizations, for example intelligence services.

Antifuse FPGAs:
The basic structure of an AF node is a thin insulating layer (smaller than 1 μm^2) between conductors that are programmed by applying a voltage. After applying the voltage, the insulator becomes a low-resistance conductor and there exists a connection (diameter about 100nm) between the conductors.

Side Channel Attacks
Any physical implementation of a cryptographic system might provide a *side channel* that leaks unwanted information. Examples for side channels include in particular: power consumption, timing behavior, and electromagnet radiation.
FPGA implementations are also vulnerable to these attacks.

3. COUNTERMEASURES

This section shortly summarizes possible countermeasures that can be provided to minimize the effects of the attacks mentioned in the previous section.

Preventing the Black Box Attack: The Black Box Attack is not a real threat nowadays, due to the complexity of the designs and the size of

stateof- the-art FPGAs. Furthermore, the nature of cryptographic algorithms prevents the attack as well. Cryptographic algorithms can be segmented in two groups: symmetric-key and public-key algorithms. Symmetric key algorithms can be further divided into stream and block ciphers. Todays stream ciphers output a bit stream, with a period length of 128 bits .

Block ciphers, like AES, are designed with a block length of 128 bits and a minimum key length of 128 bits. Minimum length in the case of public-key algorithms is 160 bits for elliptic curve cryptosystems and 1024 bits for discrete logarithm and RSA-based systems. It is widely believed that it is infeasible to perform a brute force attack and search a space with 280 possibilities.

Hence, implementations of this algorithms can not be attacked with the black box approach.

Preventing the Cloning of SRAM FPGAs: There are many suggestions to prevent the cloning of SRAM FPGAs, mainly motivated by the desire to prevent reverse engineering of general, i.e., non-cryptographic, FPGA designs.

One solution would be to check the serial number before executing the design and delete the circuit if it is not correct. This approach is not practical because of the following reasons:

- The whole chip, including the serial number can be easily copied;
- Every board would need a different configuration;

A more realistic solution would be to have the nonvolatile memory and the FPGA in one chip or to combine both parts by covering them with epoxy.

This reflects also the trend in chip manufacturing to have different components combined, e.g., the FPSLIC from Atmel. However, it has to be guaranteed that an attacker is not able to separate the parts.

Encryption of the configuration file is the most effective and practical countermeasure against the cloning of SRAM FPGAs.

There are several methods that propose different scenarios related to the encryption of the configuration file:

- a partial encryption of the bitstream;

-how to load the file into the FPGA: some FPGA platforms have a key stored in the FPGA in order to be able to encrypt the configuration file before transmitting it to the chip. The problem was that every FPGA had the same key on board. This implies that if an attacker has one key he can get the secret information from all FPGAs.

- to power the whole SRAM FPGA with a battery, which would make transmission of the configuration file after a power loss unnecessary.

Hence, a combination of encryption and battery power provides a possible solution.

Preventing the Physical Attack: To prevent physical attacks, one has to make sure that the retention effects of the cells are as small as possible, so that an attacker can not detect the status of the cells. Already after storing a value in a SRAM memory cell for 100–500 seconds, the access time and operation voltage will change. Furthermore, the recovery process is heavily dependant on the temperature.

The solution would be to invert the data stored periodically or to move the data around in memory.

Cryptographic applications cause also longterm retention effects in SRAM memory cells by repeatedly feeding data through the same circuit. One example is specialized hardware that always uses the same circuits to feed the secret key. Neutralization of this effect can be achieved by applying an opposite current or by inserting dummy cycles into the circuit.

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ABOUT INFORMATION SECURITY

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***Abstract**: According to one common view, information security comes down to technical measures. Given better access control policy models, formal proofs of cryptographic protocols, approved firewalls, better ways of detecting intrusions and malicious code, and better tools for system evaluation and assurance, the problems can be solved.*
In this note, I put forward a contrary view: information insecurity is at least as much due to perverse incentives. Many of the problems can be explained more clearly and convincingly using the language of microeconomics: network externalities, asymmetric information, moral hazard, adverse selection, liability dumping and the tragedy of the commons.

***Keywords**: economics, computer, cryptography, key, information, security*

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1. INTRODUCTION

In a survey of fraud against auto teller machines [4], it was found that patterns of fraud depended on who was liable for them. In the USA, if a customer disputed a transaction, the onus was on the bank to prove that the customer was mistaken or lying; this gave North American banks a motive to protect their systems properly. But in the European countries, the burden of proof lay on the customer: the bank was right unless the customer could prove it wrong. Since this was almost impossible, the banks in these countries became careless. Eventually, epidemics of fraud demolished their complacency. North American banks, meanwhile, suffered much less fraud; although they actually spent less money on security than their European counterparts, they spent it more effectively [4]. There are many other examples. Medical payment systems that are paid for by insurers rather than by hospitals fail to protect patient privacy whenever this conflicts with the insurer's wish to collect information about its clients. Digital signature laws transfer the risk of forged signatures from the bank that relies on the signature (and that built the system) to the person alleged to have made the signature. Common Criteria evaluations are not made by the relying party, as Orange Book evaluations were, but by a commercial facility paid by the vendor. In general, where the party who is in a position to protect a system is not the party who would suffer the results of security failure, then problems may be expected. A different kind of incentive failure surfaced in early 2000, with distributed denial of service attacks against a number of high-profile web sites. These exploit a number of subverted machines to launch a large coordinated packet flood at a target. Since many of them flood the victim at the same time, the traffic is more than the target can cope with, and because it comes from many different sources, it can be very difficult to stop [7]. Varian pointed out that this was also a case of incentive failure [20]. While individual computer users might be happy to spend 100€

on anti-virus software to protect them against attack, they are unlikely to spend even 1€ on software to prevent their machines being used to attack Amazon or Microsoft. This is an example of what economists refer to as the "Tragedy of the Commons" [15]. If a hundred peasants graze their sheep on the village common, then whenever another sheep is added its owner gets almost the full benefit - while the other ninety-nine suffer only a small decline in the quality of the grazing. So they aren't motivated to object, but rather to add another sheep of their own and get as much of the grazing as they can. The result is a dustbowl; and the solution is regulatory rather than technical. A typical tenth-century Saxon village had community mechanisms to deal with this problem; the world of computer security still doesn't. Varian's proposal is that the costs of distributed denial-of-service attacks should fall on the operators of the networks from which the flooding traffic originates; they can then exert pressure on their users to install suitable defensive software, or, for that matter, supply it themselves as part of the subscription package.

These observations prompted us to look for other ways in which economics and computer security interact.

2. NETWORK EXTERNALITIES

Economists have devoted much effort to the study of networks such as those operated by phone companies, airlines and credit card companies. The more people use a typical network, the more valuable it becomes. The more people use the phone system - or the Internet - more people there are to talk to and so the more useful it is to each user. This is sometimes referred to as *Metcalfe's law*, and is not limited to communication systems. The more merchants take credit cards, the more useful they are to customers, and so the more customers will buy them; and the more customers have them, the more merchants will want to accept them. So while that networks can grow very slowly at first - credit cards took almost two decades to take off - once positive feedback gets established, they can grow very rapidly. The telegraph, the telephone, the fax machine and most recently the Internet have all followed this model. As well as these physical networks, the same principles apply to virtual networks, such as the community of users of mass market software architecture. When software developers started to believe that the PC would outsell the Mac, they started developing their products for the PC first, and for the Mac only later (if at all). This effect was reinforced by the fact that the PC was easier for developers to work with. The growing volume of software available for the PC but not the Mac made customers more likely to buy a PC than a Mac, and the resulting positive feedback squeezed the Mac out of most markets. A similar effect made Microsoft Word the dominant word processor. A good introduction to network economics is by Shapiro and Varian [17]. For our present purposes, there are three particularly important features of information technology markets.

First, the value of a product to a user depends on how many other users adopt it.

Second, technology often has high fixed costs and low marginal costs. The first copy of a chip or a software package may cost millions, but subsequent copies may cost very little to manufacture. This isn't unique to information markets; it's also seen in business sectors such as airlines and hotels. In all such sectors, pure price competition will tend to drive revenues steadily down towards the marginal cost of production (which in the case of information is zero). So businesses need ways of selling on value rather than on cost.

Third, there are often large costs to users from switching technologies, which leads to lock-in. Such markets may remain very profitable, even where (incompatible) competitors are very cheap to produce. In fact, one of the main results of network economic theory is that the net present value of the customer base should equal the total costs of their switching their business to a competitor [19].

All three of these effects tend to lead to "winner takes all" market structures with dominant firms. So it is extremely important to get into markets quickly.

Once in, a vendor will try to appeal to complementary suppliers, as with the software vendors whose band-wagon effect carried Microsoft to victory over Apple. In fact, successful networks tend to appeal to complementary suppliers even more than to users: the potential creators of"killer apps" need to be courted. Once the customers have a substantial investment in complementary assets, they will be locked in. There are a number of complexities and controversies. [14]. But the above simplified discussion will take us far enough for now. These network effects have significant consequences for the security engineer, and consequences that are often misunderstood or misattributed. Consultants often explain that the reason a design broke for which they were responsible was that the circumstances were impossible: "the client didn't want a secure system, but just the most security I could fit on his product in one week on a budget of 10,000€". It is important to realize that this is not just management stupidity. The huge first-mover advantages that can arise in economic systems with strong positive feedback are the origin of the so-called „Microsoft philosophy" of "we'll ship it on Tuesday and get it right by version 3". Although sometimes attributed by cynics to a personal moral failing on the part of Bill Gates, this is perfectly rational behavior in many markets where network economics apply.

Another common complaint is that software platforms are shipped with little or no security support, as with Windows 95/98; and even where access control mechanisms are supplied, as with Windows NT/2000, they are easy for application developers to bypass. In fact, the access controls in Windows NT/2000 are often irrelevant, as most applications either run with administrator privilege, or, equivalently, require dangerously powerful operating system services to be enabled. This is also explained simply from the viewpoint of network economics: mandatory security would subtract value, as it would make life more difficult for the application developers. Indeed, Odlyzko observes that much of the lack of user-friendliness of both Microsoft software and the Internet is due to the fact that both Microsoft and the Internet achieved success by appealing to developers. The support costs that Microsoft dumps on users - and in fact even the cost of the time wasted waiting for PCs to boot up and shut down - greatly exceed its turnover. [16]

Network owners and builders will also appeal to the developers of the next generation of applications by arranging for the bulk of the support costs to fall on users rather than developers, even if this makes effective security administration impractical. One reason for the current appeal of public key cryptography may be that it can simplify development - even at the cost of placing an unreasonable administrative burden on users who are neither able nor willing to undertake it. [9] The technical way to try to fix this problem is to make security administration more "user-friendly" or "plug-and-play"; many attempts in this direction have met with mixed success. The more subtle approach is to try to construct an authentication system whose operators benefit from network effects; this is what Microsoft Passport does, and we'll discuss it further below. In passing, it is worth mentioning that (thanks to distributed denial of service attacks) the economic aspects of security failure are starting to get noticed by government. A recent EU proposal recommends action by governments in response to market imperfections, where market prices do not accurately reflect the costs and benefits of improve med network security. [11] However, this is only the beginning of the story.

3. COMPETITIVE APPLICATIONS AND CORPORATE WARFARE

Network economics has many other effects on security engineering. Rather than using a standard, well analyzed and tested architecture, companies often go for a proprietary obscure one - to increase customer lock-in and increase the investment that competitors have to make to create compatible products. Where possible, they will use patented algorithms as a means of imposing licensing conditions on manufacturers. For example, the DVD Content Scrambling System was used as a means of insisting that manufacturers of compatible equipment signed up to a whole list of copyright protection

measures. [5] This may have come under severe pressure, as it could prevent the Linux operating system from running on next-generation PCs; but efforts to foist non-open standards continue in many applications from SDMI and CPRM to completely proprietary systems such as games consoles. A very common objective is differentiated pricing. This is usually critical to firms that price a product or service not to its cost but to its value to the customer. This is familiar from the world of air travel: you can spend 200€ to fly the Atlantic in coach class, 2000€ in business class or 5000€ in first. Some commentators are surprised by the size of this gap; yet a French economist, Jules Dupuit, had already written in 1849:

"It is not because of the few thousand francs which would have to be spent to put a roof over the third-class carriage or to upholster the third-class seats that some company or other has open carriages with wooden benches . . . What the company is trying to do is prevent the passengers who can pay the second-class fare from traveling third class; it hits the poor, not because it wants to hurt them, but to frighten the rich . . . [10]"

This is an also common business model in the software and online services sectors. A basic program or service may be available free; a much better one for a subscription; and a"Gold" service at a ridiculous price. In many cases, the program is the same except that some features are disabled for the budget user. Many cryptographic and other technical protection mechanisms have as their real function the maintenance of this differential.

Another business strategy is to manipulate switching costs. Incumbents try to increase the cost of switching, whether by indirect methods such as controlling marketing channels and building industries of complementary suppliers, or, increasingly, by direct methods such as making systems incompatible and hard to reverse engineer. Meanwhile competitors try to do the reverse: they look for ways to reuse the base of complementary products and services, and to reverse engineer whatever protection the incumbent builds in. This extends to the control of complementary vendors, sometimes using technical mechanisms. Sometime, security mechanisms have both product differentiation and higher switching costs as goals. An example which may become politicized is "accessory control". According to one company that sells authentication chips into the automotive market, some printer companies have begun to embed cryptographic authentication protocols in laser printers to ensure that genuine toner cartridges are used. If a competitor's cartridge is loaded instead, the printer will quietly downgrade from 1200 dpi to 300 dpi. In mobile phones, much of the profit is made on batteries, and authentication can be used to spot competitors' products so they can be drained more quickly. [3] Another example comes from Microsoft Passport. This is a system whose ostensible purpose is single sign on: a Passport user doesn't have to think up separate passwords for each participating web site, with all the attendant hassle and risk. Instead, sites that use Passport share a central authentication server run by Microsoft to which users log on. They use web redirection to connect their Passport-carrying visitors to this server; authentication requests and responses are passed back and forth by the user's browser in encrypted cookies. But the real functions of Passport are somewhat more subtle. [18] First, by patching itself into all the web transactions of participating sites, Microsoft can collect a huge amount of data about online shopping habits and enable participants to swap it. If every site can exchange data with every other site, then the value of the network to each participating web site grows with the number of sites, and there is a strong network externality. So one such network may come to dominate, and Microsoft hopes to own it. Second, the authentication protocols used between the merchant servers and the Passport server are proprietary variants of Kerberos, so the web server must use Microsoft software rather than Apache or Netscape (this has supposedly been "fixed" with the latest release, but participating sites still cannot use their own authentication server, and so remain in various ways at Microsoft's mercy). So Passport isn't so much a security product, as a play for control of both the web server and purchasing information markets. It comes bundled with services such as Hotmail, is

already used by 40 million people, and does 400 authentications per second on average.

Its known flaws include that Microsoft keeps all the users' credit card details, creating a huge target; various possible middleperson attacks; and that you can be impersonated by someone who steals your cookie file. (Passport has a "logout" facility that's supposed to delete the cookies for a particular merchant, so you can use a shared PC with less risk, but this feature didn't work properly for Netscape users when it was first deployed. [13]) The constant struggles to entrench or undermine monopolies and to segment and control markets determine many of the environmental conditions that make the security engineer's work harder. They make it likely that, over time, government interference in information security standards will be motivated by broader competition issues, as well as by narrow issues of the effectiveness of infosec product markets (and law enforcement access to data). As information attack and defense become ever more important tools of national policy, what broader effects might they have?

4. INFORMATION WARFARE - OFFENSE AND DEFENSE

One of the most important aspects of a new technology package is whether it favors offense or defense in warfare. The balance has repeatedly swung back and forth, with the machine gun giving an advantage to the defense in World War 1, and the tank handing it back to the offense by World War 2. The difficulties of developing secure systems using a penetrate-and-patch methodology have been known to the security community since at least the Anderson report in the early 1970s [2]; however, a new insight on this can be gained by using an essentially economic argument, that enables us to deal with vulnerabilities in a quantitative way. [6] To simplify matters, let us suppose a large, complex product such as Windows 2000 has 1,000,000 bugs, each with an MTBF of 1,000,000,000 hours. Suppose that Paddy works for the Irish Republican Army, and his job is to break into the British Army's computer to get the list of informers in Belfast; while Brian is the army assurance guy whose job is to stop Paddy. So he must learn of the bugs before Paddy does. Paddy has a day job so he can only do 1000 hours of testing a year. Brian has full Windows source code, dozens of PhDs, control of the commercial evaluation labs, an inside track on CERT, an information sharing deal with other UKUSA member states – and he also runs the government's scheme to send round consultants to critical industries such as power and telecoms to advise them how to protect their systems. Suppose that Brian benefits from 10,000,000 hours a year worth of testing.

After a year, Paddy finds a bug, while Brian has found 100,000. But the probability that Brian has found Paddy's bug is only 10%. After ten years he will find it - but by then Paddy will have found nine more, and it's unlikely that Brian will know of all of them. Worse, Brian's bug reports will have become such a fire hose that Microsoft will have kill filed him. In other words, Paddy has thermodynamics on his side. Even a very moderately resourced attacker can break anything that's at all large and complex. There is nothing that can be done to stop this, so long as there are enough deferent security vulnerabilities to do statistics: different testers find different bugs. The actual statistics are somewhat more complicated, involving lots of exponential sums. [6] There are various ways in which one might hope to escape this statistical trap.

First, although it's reasonable to expect a 35,000,000 line program like Windows 2000 to have 1,000,000 bugs, perhaps only 1% of them are security-critical. This changes the game slightly, but not much; Paddy now needs to recruit 100 volunteers to help him (or, more realistically, swap information in a greenmarket with other subversive elements). Still, the effort required of the attacker is still much less than that needed for effective defense.

Second, there may be a single fix for a large number of the security critical bugs. For example, if half of them are stack overflows, then perhaps these can all be removed by a new compiler.

Third, you can make the security critical part of the system small enough that the bugs can be found. This was understood, in an empirical

way, by the early 1970s. However, the discussion in the above section should have made clear that a minimal TCB is unlikely to be available anytime soon, as it would make applications harder to develop and thus impair the platform vendors' appeal to developers.

So information warfare looks rather like air warfare looked in the 1920s and 1930s. Attack is simply easier than defense. Defending a modern information system could also be likened to defending a large, thinly-populated territory like the nineteenth century Wild West: the men in black hats can strike anywhere, while the men in white hats have to defend everywhere. Another possible relevant analogy is the use of piracy on the high seas as an instrument of state policy by many European powers in the sixteenth and seventeenth centuries. Until the great powers agreed to deny pirates safe haven, piracy was just too easy. The technical bias in favor of attack is made even worse by asymmetric information. Suppose that you head up a U.S. agency with an economic intelligence mission, and a computer scientist working for you has just discovered a beautiful new exploit on Windows 2000. If you report this to Microsoft, you will protect 250 million Americans; if you keep quiet, you will be able to conduct operations against 400 million Europeans and 100 million Japanese. What's more, you will get credit for operations you conduct successfully against foreigners, while the odds are that any operations that they conduct successfully against U.S. targets will remain unknown to your superiors. This further emphasizes the motive for attack rather than defense. Finally - and this appears to be less widely realized - the balance in favor of attack rather than defense is still more pronounced in smaller countries. They have proportionally fewer citizens to defend, and more foreigners to attack. In other words, the increasing politicization of information attack and defense may even be a destabilizing factor in international affairs.

5. DISTINGUISHING GOOD FROM BAD

Since Auguste Kerckhoffs wrote his two seminal papers on security engineering in 1883 [12], people have discussed the dangers of "security-by-obscurity", that is, relying on the attacker's being ignorant of the design of a system. Economics can give us a fresh insight into this. We have already seen that obscure designs are often used deliberately as a means of entrenching monopolies; but why is it that, even in relatively competitive security product markets, the bad products tend to drive out the good? The theory of asymmetric information gives us an explanation of one of the mechanisms. Consider a used car market, on which there are 100 good cars (the "plums"), worth 3000€ each, and 100 rather trouble-some ones (the "lemons"), each of which is worth only 1000€. The vendors know which is which, but the buyers don't. So what will be the equilibrium price of used cars?

If customers start off believing that the probability they will get a plum is equal to the probability they will get a lemon, then the market price will start off at 2000€. However, at that price only lemons will be offered for sale, and once the buyers observe this, the price will drop rapidly to 1000€ with no plums being sold at all. In other words, when buyers don't have as much information about the quality of the products as sellers do, there will be severe downward pressure on both price and quality. Infosec people frequently complain about this in many markets for the products and components we use; the above insight, due to Akerlof [1], explains why it happens.

The problem of bad products driving out good ones can be made even worse when the people evaluating them aren't the people who suffer when they fail. Much has been written on the ways in which corporate performance can be adversely affected when executives have incentives at odds with the welfare of their employer. For example, managers often buy products and services which they know to be suboptimal or even defective, but which are from big name suppliers. This is known to minimize the likelihood of getting fired when things go wrong. Corporate lawyers don't condemn this as fraud, but praise it as "due diligence".

Over the last decade of the twentieth century, many businesses have sought to fix this

problem by extending stock options to ever more employees. However, these incentives don't appear to be enough to ensure prudent practice by security managers. This problem has long been perceived, even if not in precisely these terms, and the usual solution to be proposed is an evaluation system. This can be a private arrangement, such as the equipment tests carried out by insurance industry laboratories for their member companies, or it can be public sector, as with the Orange Book and the Common Criteria. For all its faults, the Orange Book had the virtue that evaluations were carried out by the party who relied on them - the government. The European equivalent, ITSEC, introduced a pernicious innovation – which the evaluation was not paid for by the government but by the vendor seeking an evaluation on its product.

This got carried over into the Common Criteria. This change in the rules provided the critical perverse incentive. It motivated the vendor to shop around for the evaluation contractor who would give his product the easiest ride, whether by asking fewer questions, charging less money, taking the least time, or all of the above. To be fair, the potential for this was realized, and schemes were set up whereby contractors could obtain approval as a CLEF (commercial licensed evaluation facility). The threat that a CLEF might have its license withdrawn was supposed to offset the commercial pressures to cut corners. But in none of the half-dozen or so disputed cases we've been involved in has the Common Criteria approach proved satisfactory. Some examples are documented in the book, *Security Engineering.* [3] The failure modes appear to involve fairly straightforward pandering to customers' wishes, even (indeed especially) where these were in conflict with the interests of the users for whom the evaluation was supposedly being prepared. The lack of sanctions for misbehavior - such as a process whereby evaluation teams can lose their accreditation when they lose their sparkle, or get caught in gross incompetence or dishonesty, is probably a contributory factor.

But there is at least one more significant perverse incentive. From the user's point of view, an evaluation may actually subtract from the value of a product. For example, if you use an unevaluated product to generate digital signatures, and a forged signature turns up which someone tries to use against you, you might reasonably expect to challenge the evidence by persuading a court to order the release of full documentation to your expert witnesses. A Common Criteria certificate might make a court much less ready to order disclosure, and thus could severely prejudice your rights. A cynic might suggest that this is precisely why it's the vendors of products which are designed to transfer liability (such as digital signature smartcards), to satisfy due diligence requirements (such as firewalls) or to impress naive users (such as PC access control products), who are most enthusiastic about the Common Criteria. So an economist is unlikely to place blind faith in a Common Criteria evaluation. Fortunately, the perverse incentives discussed above should limit the uptake of the Criteria to sectors where an official certification, however irrelevant, erroneous or misleading, offers competitive advantage.

6. CONCLUSION

Much has been written on the failure of information security mechanisms to protect end users from privacy violations and fraud. This misses the point. The real driving forces behind security system design usually have nothing to do with such altruistic goals.

They are much more likely to be the desire to grab a monopoly, to charge different prices to different users for essentially the same service, and to dump risk. Often this is perfectly rational. In an ideal world, the removal of perverse economic incentives to create insecure systems would depoliticize most issues. Security engineering would then be a matter of rational risk management rather than risk dumping. But as information security is about power and money - about raising barriers to trade, segmenting markets and differentiating products – the evaluator should not restrict herself to technical tools like cryptanalysis and information flow, but also apply economic tools such as the analysis of asymmetric information

and moral hazard. As fast as one perverse incentive can be removed by regulators, businesses (and governments) are likely to create two more.

In other words, the management of information security is a much deeper and more political problem than is usually realized; solutions are likely to be subtle and partial, while many simplistic technical approaches are bound to fail. The time has come for engineers, economists, lawyers and policymakers to try to forge common approaches.

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ABOUT INFORMATION WARFARE

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***Abstract**: Information warfare, in its largest sense, is simply the use of information to achieve our national objectives. Like diplomacy, economic competition, or the use of military force, information in itself is a key aspect of national power and, more importantly, is becoming an increasingly vital national resource that supports diplomacy, economic competition, and the effective employment of military forces. Information warfare in this sense can be seen as societal-level or nation-to-nation conflict waged, in part, through the worldwide internetted and interconnected means of information and communication.*
What this means is that information warfare, in its most fundamental sense, is the emerging "theater in which future nation-against-nation conflict at the strategic level is most likely to occur. Information warfare is also changing the Way Theater or operational-level combat and everyday military activities are conducted. Finally, information warfare may be the theater in which "operations other than war" are conducted, especially as it may permit the strong country to accomplish some important national security goals without the need for forward-deployed military forces in every corner of the planet. Information warfare, then, may define future warfare or, to put it another way, be the central focus for thinking about conflict in the future.

***Keywords**: Air Force, doctrine, information, strategy, warfare*

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1. INTRODUCTION

We need to state up front that much of what is discussed in this essay on information warfare is unofficial speculation. The Department of Defense calls its current thinking and approach to information warfare "command and control warfare" (C2W). [1] There is little agreement among the services about either information warfare or C2W; and among civilian defense analysts looking at the issues of information warfare, there is even less agreement.

Why, then, should we be thinking about this new and strange idea?

The chief reason, of course, is that while we don't know just what we've got here, all the services agree that information warfare is something important. [2]

Was Desert Storm the first war of third-wave information warfare or the last war of mechanized second-wave industrial warfare? [3]

We're not sure, but a lot of people, including potential rivals, are trying to figure it out. [4]

This article attempts to make some sense of this new idea called information warfare.

We'll look at four sets of ideas:

(1) A definition of information warfare;

(2) How we should start thinking about developing a strategy of information warfare;

(3) Why current Air Force doctrine may be the best framework for developing a doctrine of information warfare.

2. DEFINING INFORMATION WARFARE

Information warfare, in its largest sense, is simply the use of information to achieve our national objectives. Like diplomacy, economic competition, or the use of military force, information in itself is a key aspect of national power and, more importantly, is becoming an increasingly vital national resource that supports diplomacy, economic competition, and the effective employment of military forces. Information warfare in this sense can be seen as societal-level or nation-to-nation conflict waged, in part, through the worldwide internetted and interconnected means of information and communication. [5] What this means is that information warfare, in its most fundamental sense, is the emerging "theater" in which future nation-against-nation conflict at the *strategic* level is most likely to occur. Information warfare is also changing the Way Theater or operational-level combat and everyday military activities are conducted. Finally, information warfare may be the theater in which "operations other than war" are conducted, especially as it may permit the United States to accomplish some important national security goals without the need for forward-deployed military forces in every corner of the planet. Information warfare, then, may define future warfare or, to put it another way, be the central focus for thinking about conflict in the future.

Information warfare, in its essence, is about *ideas and epistemology* - big words meaning that information warfare is about the way humans think and, more important, the way humans make decisions. And although information warfare would be waged largely, but not entirely, through the communication nets of a society or its military, it is fundamentally not about satellites, wires, and computers. It is about influencing human beings and the decisions they make. The greatest single threat faced by the Air Force, and by the services in general, as we begin to think about information warfare is that we will yield to our usual temptation to adopt the new technologies, especially information technologies, as merely force multipliers for the current way we do business. [6] It would be a strategic mistake of historical proportions to focus narrowly on the technologies; force the technologies of information warfare to fit familiar, internally defined models like speed, precision, and lethality; and miss the vision and opportunity for a genuine military revolution. Information warfare is real warfare; it is about using information to create such a mismatch between us and an opponent that, as Sun Tzu would argue, the opponent's *strategy* is defeated before his first forces can be deployed or his first shots fired.

The target of information warfare, then, is the human mind, especially those minds that make the key decisions of war or peace and, from the military perspective, those minds that make the key decisions on if, when, and how to employ the assets and capabilities embedded in their strategic structures. One could argue that certain aspects of the cold war such as Radio Free Europe, Radio Marti, or the US Information Agency were a dress rehearsal for information warfare. One could argue that certain current capabilities in **PSY**chological **OP**erations (PSYOP), public affairs and civil affairs, together with the intelligence agencies, satellite drivers, communications specialists, computer wizards, and the men and women in agencies like the Air Intelligence Agency or the new Joint Information Warfare Center, represent some of the key learning environments in which we'll develop some of the new capabilities for information warfare. [7] And while the concept of information warfare in its computer, electronic warfare, and communications net version is most familiar in military operations involving traditional state-to-state conflict, there are new and dangerous players in "cyberspace" - the battlefield for information warfare. There has been a proliferation of such players - nonstate political actor such as Greenpeace, Amnesty

International, rogue computer hackers like the Legion of Doom, some third world "rebel" who stages a "human rights abuse" for the **C**able **N**ews **N**etwork (CNN), or ideological / religious inspired terrorists with easy access to worldwide computer and communications networks to influence, to exchange information, or to coordinate political action on a global basis. All of this suggests that the military or governments of a traditional nation-state may not be the only serious threat to our security or the driver of our national security politics. [8] Cyberspace may be the new "battle space," but the battle remains the battle for the mind. There must be no confusion of the battle space with the battle.

Let's take a look at this in a context we think we're familiar with: propaganda as an effort to influence national morale and support for the nation's armed forces. The Vietnam War taught us the consequences of winning every battle in the field and losing the information war on the home front. Before the advent of information warfare, propaganda was traditionally targeted through various mass media to influence a mass audience. One key change made possible by the new technologies is the potential for customized propaganda. Those who have received individually targeted political advertising from a company specializing in "niche" marketing research must have had a momentary shudder when they realized that there are private companies who seem to know everything about their buying habits and tastes, whether they support the National Rifle Association or attend Tail hook conventions, and what television shows they watch. Every credit card purchase adds data to someone's resources, and not everybody is selling just soap or politicians. Contemporary public and commercial databases and the constantly expanding number of sources, media, and channels for the transmission of information, essentially available to anyone with a bit of money or skill, have created the opportunity and "target sets" for custom-tailored information warfare attacks on, to take just one example, the families of deployed military personnel. Think about the moral implications of that for a minute. Computer bulletin boards, cellular telephones, video cameras, and fax machines-all of these provide entry points and dissemination nets for customized propaganda assaults by our opponents on military, governmental, economic, key civilian strategic structures, or even the home checking accounts of deployed troops. [9] **OP**erations **SEC**urity (OPSEC) is increasingly a most vital military security issue. However, information warfare should not be confused with or limited to just propaganda, deception, or traditional electronic warfare.

A major new factor in information war is the worldwide info sphere of television and broadcast news. Information warfare at the strategic level is the "battle off the battlefield" to shape the political context of the conflict. It will define the new "battle space." We face an "integrated battlefield," not in the usual sense of having a **G**lobal **P**ositioning **S**ystem (GPS) receiver in every tank or cockpit but in the Clausewitz sense that war is being integrated into the political almost simultaneously with the battle. Many people suspect that the **N**ational **C**ommand **A**uthorities (NCA) are in danger of becoming increasingly "reactive" to a "fictive" universe created by CNN, its various international competitors, or even a terrorist with a video camera. [10] This media-created universe we live in is fictive rather than "fictional" because although what we see on CNN is "true," it is just not the whole, relevant, or contextual truth. Nevertheless, this fictive universe becomes the politically relevant universe in which the government or the armed forces are supposed to "do something." Members of Congress, the national command authorities, and our mothers all watch the "instant news" followed by "instant" second-guessing commentary. This is increasingly the commander's nightmare. First, 15 congressmen are calling the chairman of the Joint Chiefs to ask whether retired admiral so-and-so's critical analysis on "Nightline" of the CINC's ongoing theater air campaign is valid. More importantly, 300 congressmen are also getting 10,000 calls, E-mails, faxes, and even letters from angry families who've just seen the television report

(carefully "leaked" to French television by an unhappy defense contractor and innocently repeated by CNN) that the US military-issue ant malaria pills don't work in Bongo-Bongo. Use your imagination. Somalia gets in the news, and we get into Somalia despite the reality of equally disastrous starvation, disorder, and rapine right next door in Sudan. The truth is that there were no reporters with "sky link" in Sudan because the government of Sudan issued no visas to CNN reporters. We all know the impact of the pictures of the failed raid to capture Mohamed Farah Aidid in Somalia. The potential, then, for governments, militaries, parties in a civil war such as Bosnia, or even religious fanatics to manipulate the multimedia, multisource fictive universe of "the battle off the battlefield" for strategic information dominance should be obvious. [11] The armed services are just beginning to think about how these new technologies of instant communication will change the battle space, and, quite frankly, there are not many good answers yet.

Fictive or fictional operational environments, then, whether mass-targeted or niche-targeted, can be generated, transmitted, distributed, or broadcast by governments or all sorts of players through increasingly diversified networks. The information war potential available to states or other players with access to the universe of internetted communications to use the networks over which banking information is transmitted to suggest that a "hostile" state is about to devalue its currency could easily provoke financial chaos. [12] Direct satellite radio or television broadcasts to selected audiences, analogous to central control of pay-per-view programs, again offers the potential for people in one province or region of a targeted state to discover that the maximum leader has decided to purge soldiers from their clan or tribe from the army. Your own imagination can provide many examples of how the increasingly multisource communications systems offer both the armed forces and the national command authorities countless new possibilities for societal-level information warfare to shape the information battle space to our advantage.

Let us take just one example of how current technologies could be used for strategic-level information warfare. If, say, the capabilities of already well-known Hollywood technologies to simulate reality were added to our arsenal, a genuinely revolutionary new form of warfare would become possible. Today, the techniques of combining live actors with computer-generated video graphics can easily create a "virtual" news conference, summit meeting, or perhaps even a battle that would exist in "effect" though not in physical fact. Stored video images can be recombined or "morphed" endlessly to produce any effect chosen. This moves well beyond traditional military deception, and now, perhaps, "pictures" will be worth a thousand tanks. Imagine the effect of a nationwide broadcast in bandit land of the meeting between the "digitized" maximum leader and a "digitized" Jimmy Carter in which all loyal soldiers are told to cease fighting and return to their homes. The targets of information warfare, remember, are the decisions in the opponent's mind, and the battle space of the human mind is also the zone of illusion.

Let's play with this a bit. Through hitching a ride on an unsuspecting commercial satellite, a fictive simulation is broadcast. This may not be science fiction, and readers of Tom Clancy's latest novel *Debt of Honor* will suspect it's not. Simultaneously, various "info-niches" in the target state are accessed via the net. Some of the targets receive reinforcement for the fictive simulation; others receive slightly misleading variations of the target state's anticipated responses, and the whole of the opponent's military is subject to a massive electronic deception operation. What is happening here?

At the strategic level, this is the paralysis of the adversary's **O**bservation, **O**rientation, **D**ecision, **A**ction (OODA) loop. [13] The opponent's ability to "observe" is either flooded or very slightly and subtly assaulted by contradictory information and data. More importantly, his ability to "orient" is degraded by the assault on the very possibility of

objective reasoning as we replace his "known" universe with our alternative reality. His "decisions" respond increasingly to our fictive or virtual universe, and, most importantly, military "actions" within his strategic structures become increasingly paralyzed as there is no rational relationship of means to ends. What he does is not based on reality because we've changed his reality. This is real war fighting. It would seem, then, that if we can develop a strategic vision and real capability for information warfare, we can bring American strategic power within sight of that elusive "acme of skill" wherein the opponent is subdued without killing as we destroy his ability to form or execute a coherent strategy. How, then, do we think about developing information warfare strategy?

3. DEVELOPING INFORMATION WARFARE STRATEGY

Developing a strategy of information warfare starts with serious, creative, and "color-outside-the-lines" thinking about current information technologies and ways in which these might be turned to strategic purpose to serve the national command authorities and military use. This will involve thinking about information in new ways: What information is needed? What organizational changes would occur in the way we gather, process, distribute, and use information? What information-based operational changes could then happen? [14] The services are starting this new thinking under the label "command and control warfare."[15] This, however, is only the first step, as the "digitized battlefield" fails to revolutionize strategic thinking. Let's illustrate this with a bit of history. As Speaker of the House Newt Gingrich observed, some time before the American Civil War, the Prussian general Helmuth von Moltke was thinking about railroads and telegraphs: *If we used the telegraph to relay mobilization orders quickly and then used railroads to concentrate troops from bases scattered throughout Prussia, we could concentrate the main effort at the key battle location of a campaign. We wouldn't have to mobilize the army, and then concentrate it, and then march it to where we hoped the key battle would occur*. [16]

Good insight. And this, unfortunately, is about where we are when we think of information warfare as only command and control warfare. [17] That is, how does this technology permit tanks, ships, and aircraft to do what they do now a bit better. It was Moltke's next insight, argues Speaker Gingrich that the Joint Staff and the services need to imitate: *But the Prussian army is not organized, nor does it operate in a way that would permit it to respond to telegraphed orders to get on trains and show up somewhere else. That's not how we organize, train, and equip. What I need to do is reform the way to get the information needed to do this, the way we're organized so we can use this information, and figure-out new ways to operate; what I need is a new General Staff system*. [18]

So Count von Moltke realized that before he could make revolutionary use of the new technology, he had to solve the higher-order question of what changes in information, organization, and operations would be needed. This is the challenge we face now. The armed forces have a good idea that information technologies just might be the driver in future warfare, but we haven't yet articulated the strategic vision or identified the higher-order changes we need to make to really make this all come together.

Now, let's add another idea-this time from the Air Force heritage. In some ways, "info-warriors" are like Gen William ("Billy") Mitchell and the pioneer league of airmen. They see the potential. Mitchell's vision of the potential for airpower drove, at great cost to himself but great benefit to the nation, the development of a new form of warfare. Now here's the key point. Once the vision of strategic airpower was presented clearly, once people were able to say, "Yes, I see how this could change warfare," then the technologies followed: "Oh, air bombing-you'll need a bombsight." "Oh, enemy aircraft-we'll need some kind of detection system; let's call it radar." This is the point-the technology is not

just a force multiplier. It is the interaction of strategic vision with new technology that will produce the revolution in military affairs and a new warfare form.

This, then, is the challenge of information warfare. Is there something about information and the information technologies that would permit us to create such a mismatch between what, when, and how we and our opponents observe, orient, decide, and act or such a level of "information dominance" that the opponent is helpless-and not just on the battlefield? Is there a way we could use information, like current theories of airpower, to create an "information campaign" that engages an opponent simultaneously in time, space, and depth across the full range of his strategic structures so that the result is strategic paralysis (he is deaf, dumb, and blind to anything except that which we permit him to hear, say, or see)? [19] Not that we just blind him, but that he sees what we wish him to see without realizing that it's "our" reality, not his. Can we envision that kind of strategic information warfare? And, as was the case with airpower, technology will follow strategic vision. It's OK if we can't insert computer viruses by direct satellite broadcast-today; fry every air defense radar with an electromagnetic burst from a remote **U**nmanned **A**erial **V**ehicle (UAV)-today; transfer all the dictator's Swiss bank accounts to the **I**nternal **R**evenue **S**ervice (IRS)-today; project holographic images, complete with proper electronic signatures, of 15 squadrons coming in from the north when we're coming in the back door-today; or beam the Forrest Gump interview with "El Supremo" into every radio and television in bandit land-today. Develop the strategic theory of information warfare, and the technology will come.

4. INFORMATION WARFARE DOCTRINE

There is, of course, no official information warfare doctrine and the efforts of the various services to describe command and control warfare as the military application of information warfare remain incomplete. For the Air Force to focus almost exclusively on C2W that is defined as the "integration, coordination, and synchronization" of OPSEC, deception, PSYOP, electronic warfare, and physical destruction efforts targeted against the opponent's fielded military forces represents a failure to appreciate either air and space power or to appreciate how airpower doctrine could guide the development of an information warfare campaign. How, then, might we use current Air Force doctrine as presented in **A**ir **F**orce **M**anual (AFM) 1-1, *Basic Aerospace Doctrine of the United States Air Force*, as a template to start thinking about information warfare?

First, assume that information warfare is warfare in the information realm as is air warfare in the air and space realms. As the objective of air warfare is to control the air realm in order to exploit it while protecting friendly forces from enemy actions in the air realm, so the objective of information warfare is to control the "info sphere" in order to exploit it while protecting friendly forces from hostile actions taken via the information realm. Thus, as air control is usually described as counter air, with offensive and defensive counter air, so any strategy and doctrine of information control must address counter information in terms of offensive and defensive counter information. Offensive counter information, like offensive counter air, could be seen as involving information exploitation through psychological operations, deception, electronic warfare, or physical attack and information protection as, again, physical attack, **E**lectronic **W**arfare (EW), and, often overlooked, public and civil affairs. Defensive counter information, like defensive counter air, would include active protection such as physical defense, OPSEC, communications security, computer security, counterintelligence, and, again, public affairs. Passive protection would include standard ideas like hardening sites and physical security.

If control, or dominance, of the information realm is the goal, like air control, it is not an end in itself but the condition to permit the exploitation of information

dominance for, as in air doctrine, strategic attack, interdiction, or close "battlefield" support through C2W attack. Information dominance of both the strategic "battle off the battlefield" and the operational "information battle space" is, like air and space control for traditional surface warfare, the key to strategic effect. The relevance of airpower doctrinal thinking for information warfare now becomes obvious. A review of the history of the airpower debates would show, in part, that those who insisted that airplanes were merely a force multiplier to provide close air support for the "real" effort would never recognize the strategic potential of airpower or support the acquisition of technologies for strategic air missions. As long as information warfare thinking is dominated by a doctrine that argues that the only information warfare mission relevant to the armed forces is command and control warfare and that C2W is merely a force multiplier against the communications and information assets of the fielded enemy forces, the potential for the exploitation of information dominance for strategic information warfare and, again, the identification and acquisition of key technologies will be missed. C2W, like close air support, is a vital military mission. It is, in fact, a central component of information warfare, but, like close air support and other "traditional" battle-oriented missions, not the whole story. The challenge is to use Air Force doctrine as the foundation to envision the "Information Campaign," which, like the "Air Campaign" in the Gulf War, is of strategic significance. What, for example, would "speed, precision, and lethality" be in an "info-strike?"

5. EPILOGUE: DANGER OF NOT DEVELOPING INFORMATION WARFARE STRATEGY

If the world really is moving into a third-wave, information-based era, failure to develop a strategy for both defensive and offensive information warfare could put the United States and the US military into the situation of being on the receiving end of an "Electronic Pearl Harbor." [20] Information is fluid; the advantages we now have, and which were demonstrated in the Gulf War, could be lost because we have very little control over the diffusion of information technology. [21] Second, it's a smaller world, and our potential opponents can observe our technologies and operational innovations and copy ours without them having to invent new ones for themselves. [22] Remember, the biggest center for developing new computer software is not Silicon Valley but Madras, India. What will they sell to whom? Finally, and to return to an earlier point, if the US military approaches information warfare merely as a force multiplier and adapts bits and pieces of technology to just do our current way of warfare a bit better-if we "digitize the battlefield" for an endless rerun of mechanized desert warfare-the real danger will be that someone else will refuse to play the game our way. What if they, like Count von Moltke or General Mitchell, think real hard, purchase the dual-use technologies on the free world market, alter their whole strategic concept, and make the leap to a strategy of information warfare?

We do not yet have a strategy of information warfare, and we have not answered the higher-order questions of how we would reorganize, retrain, and reequip for third-wave warfare. But if any of this has made even some sense, you now know the urgent requirement for developing the vision that produces the strategy. The strategy will identify the technologies, organizational changes, and new concepts of operations. We must really become like von Moltke and Billy Mitchell-"If we could use this to do that, then we could. . . ."

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MOBILE HEALTH CARE SYSTEM
e-Learning Security System Design

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Abstract *The Mobile Health Care (MCHC), the e-learning system, was designed for training IT managers to understand the IT security policies and strategies, applied on real situation of an for-profit provider of primary, acute and emergency care to a rural population in a 50 mile radius. The MCHC e-learning system can be also assumed as an remote control system, used in our material as RCHC e-learning system.*
Key words:

Our task is to move our patient care system into the 21st century so that we continue to provide outstanding care, while maximizing revenue, to the following customers:

Clinic, acute and emergency patients at our central location

Satellite clinics in the surrounding community

Outpatients and chronic care patients being treated at home

Emergency patients in transit by ambulance

This requires secure information transfer between multiple user groups, accessing multiple applications via both wired and mobile devices, connected within the MCHC complex and remotely over the Internet.

The Mobile Health Care was design fist like an e-learning system to provide a better idea for the next step, implementation with the cooperation of the IT and security managers.

Concept of Operation

The patient data systems consist of the following:

a) Patient identification
b) MCHC Patient Healthcare departmental data will be assumed also as RCHC data (remote control health care)
- Treatment history
- Scheduling
- Procedures, tests and results
- Test and implant device communications

c) Health Care Provider treatment plans and payment for treatments.
d) Insurance providers
- Payment authorization (billing is not directly handled by this system)
- Treatment plan and outcome database

Users will access the system through the following methods:

e) Patients
- Remote locations
  - Personal computers
  - Future generation m smart phones, capable of operating via wifi and VOIP.
- Within the MCHC complex
  - Terminals in patient rooms connected client-server over the LAN.

f) MCHC personnel
- Client-server over the LAN
- Client-server over the Internet for outsourced billing coding.

g) Satellite Healthcare providers
- Within the MCHC complex
  - workstations in the treatment and testing areas
  - Future generation smart phones, capable of operating over wifi and VOIP
- Remotely
  - Personal computers
  - Smart phones

h) Insurance providers
- Remotely over the Internet

i) Surgically implanted appliances and portable medical test devices
- Remotely over the Internet
- client-server over the LAN within MCHC complex.

1. Managing Deployed Systems: Employee Security Awareness

Managing mobile systems with the concern about security, involve a risk calculation over the implementation of the e-learning system. The security awareness algorithm over the MCHC e-Learning Security System was design as an audit algorithm after the system is deployed.

The following steps have to be followed for risk score calculations:

- Decide the risk level of each item.

The risk level of the item indicates its relative importance.

- Numerical value assign for the risk level:
  - Very High:4;
  - High:3;
  - Medium:2;
  - Low:1.
- If the response to the item is "Yes", give the "Yes Details". This could take up any of the given three values: "Planned/Just started", "partially completed" and "Fully implemented".
- The final risk score for an item is calculated as follows:

If the response is "NO" then the risk score is determined by the Risk level as follows:

- If risk is "Very High" than the score is 4;
- If risk is "High" then the score is 3;
- If the risk is "Medium" then the score is 2;
- If the risk is "Low" then the risk is 1.

If the response is "Yes" then the risk score is determined by both the risk level and the "Yes Details" as follows:

- If risk is "Very High" than the score is 4* ("Yes Details" weight);
- If risk is "High" then the score is 3* ("Yes Details" weight);
- If the risk is "Medium" then the score is 2 * ("Yes Details" weight);
- If the risk is "Low" then the risk is 1* ("Yes Details" weight);

Where "Yes Details" weights are the followings:

"Planned/Just started": weight 0.5

"Partially completed": weight 0.25

"Fully implemented": weight 0.

"Risk Upper Limit" is the maximum risk posed by an item, is used to calculate the "Percentage Risk Abated (%RA)"

ORGANIZATION: MCHC	**RESPONCE**	**"YES" DETAILS**	**RISK**	**RISK SCORE**	
AWARENESS & TRAINING	YES / NO N/A	-Planned/ Just started -Partially completed - Fully implemented	VERY HIGH HIGH MEDIUM LOW	CALCULATED	RISK UPPER LIMIT
Have a formal, on-going Security training program been implemented?	Yes	Planned/Just started	VERY HIGH	2	4
Have the MCHC CIO implemented a process to measure the Effectiveness of Security Training?	Yes	Partially completed	VERY HIGH	1	4

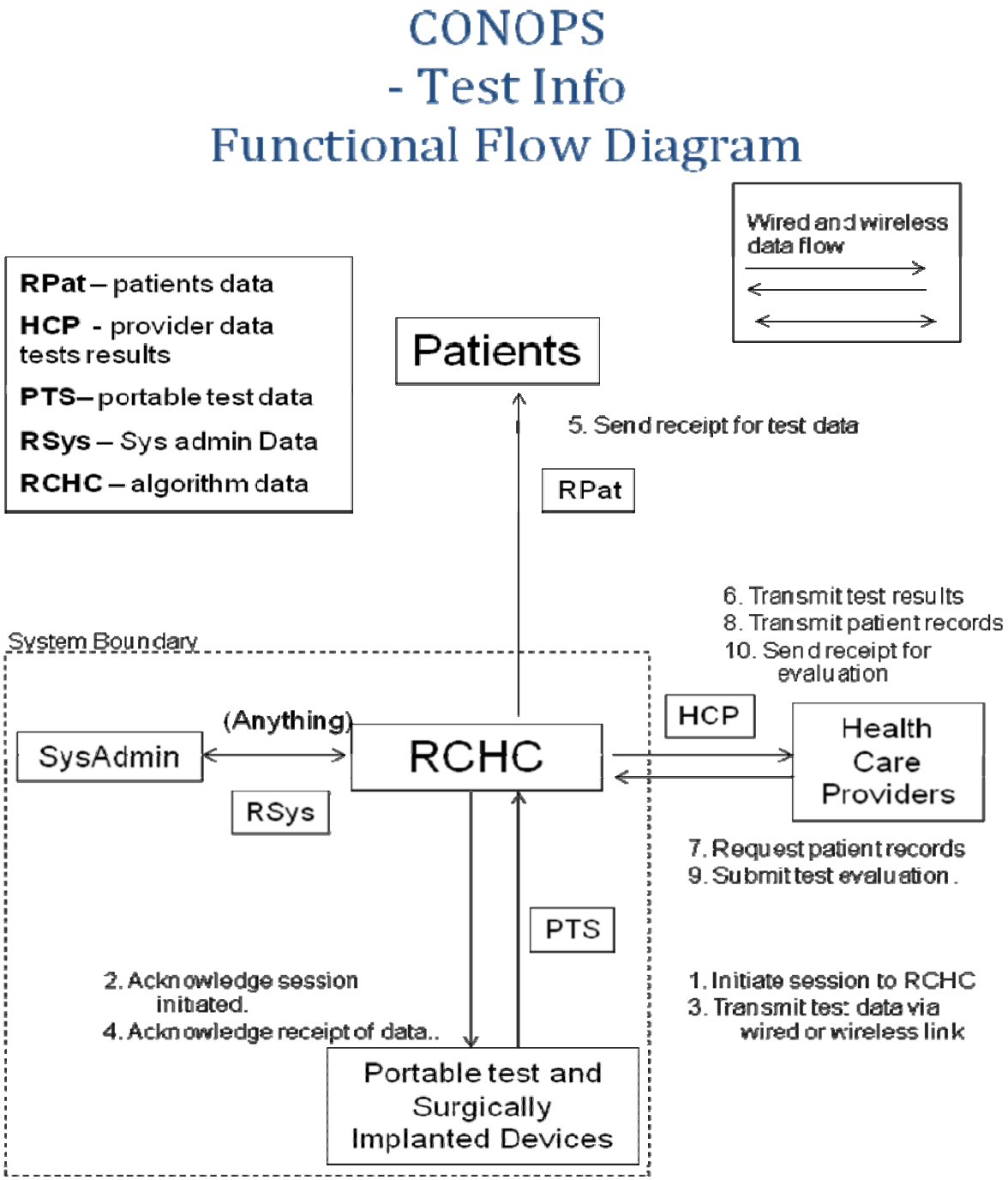
Does the on-going Security Awareness program include instructing user on how to detect and avoid social engineering attacks as well as competitive intelligence probes?	Yes	Fully implemented	VERY HIGH	0	4
Have users been educated on how to report suspected security violations or vulnerabilities?	Yes	Fully implemented	HIGH	0	3
Is there a process to communicate security policy and guideline changes to employees?	Yes	Planned/Just started	MEDIUM	1	2
Is the importance of Information Security visible throughout the organization (meeting, posters)	Yes	Fully implemented	VERY HIGH	0	4
Do the MCHC CIO notify employees that patients sensitive data cannot be loaded on personal PC's?	Yes	Fully implemented	MEDIUM	0	2
Are users of systems containing sensitive information made aware of legal and company obligations associated with the use of the application?	Yes	Planned/Just started	MEDIUM	1	2
Have employees been instructed to challenge strangers or unescorted visitors in MCHC area?	Yes	Fully implemented	VERY HIGH	0	4
Has MCHC issued an Employee Internet Use Monitoring and Filtering Policy?	Yes	Fully implemented	VERY HIGH	0	4
Are there periodic spot-checks of users workspaces to monitor compliance with the information protection program	Yes	Fully implemented	VERY HIGH	0	4
Has MCHC issued the Remote Access Policy for the new patients?	Yes	Fully implemented	HIGH	0	3
Has MCHC issued the Database Password Policy for the new patients?	Yes	Fully implemented	VERY HIGH	0	4
Has MCHC issued an Ethics training for the new employees?	Yes	Fully implemented	HIGH	0	3
Do new contractors receive introductory awareness security training?	NO		VERY HIGH	4	4
Is there a clear desk policy?	NO		MEDIUM	2	2
TOTAL				**15**	**73**

%RA= 1- ∑ (Risk Score) / ∑ (Risk Upper Limit) = 0.19

The security awareness algorithm implementation in an e-Learning system will open the training opportunity for the systems designers and also for the health systems implementation.

The security audit algorithm, over the deployed mobile heath systems, is the last testing step for training the mobile heath care system managers using wireless communication. The security audit algorithm implemented in the e-Learning system is the security risk test for the mobile health system proposed by the manager in training (see annex with system proposal). The security audit algorithm over the Mobil Health wireless system will open the security policies evaluation process. After the e-Learning outcome with regarding the security risk is low, the system will be proposed for the final approvals.

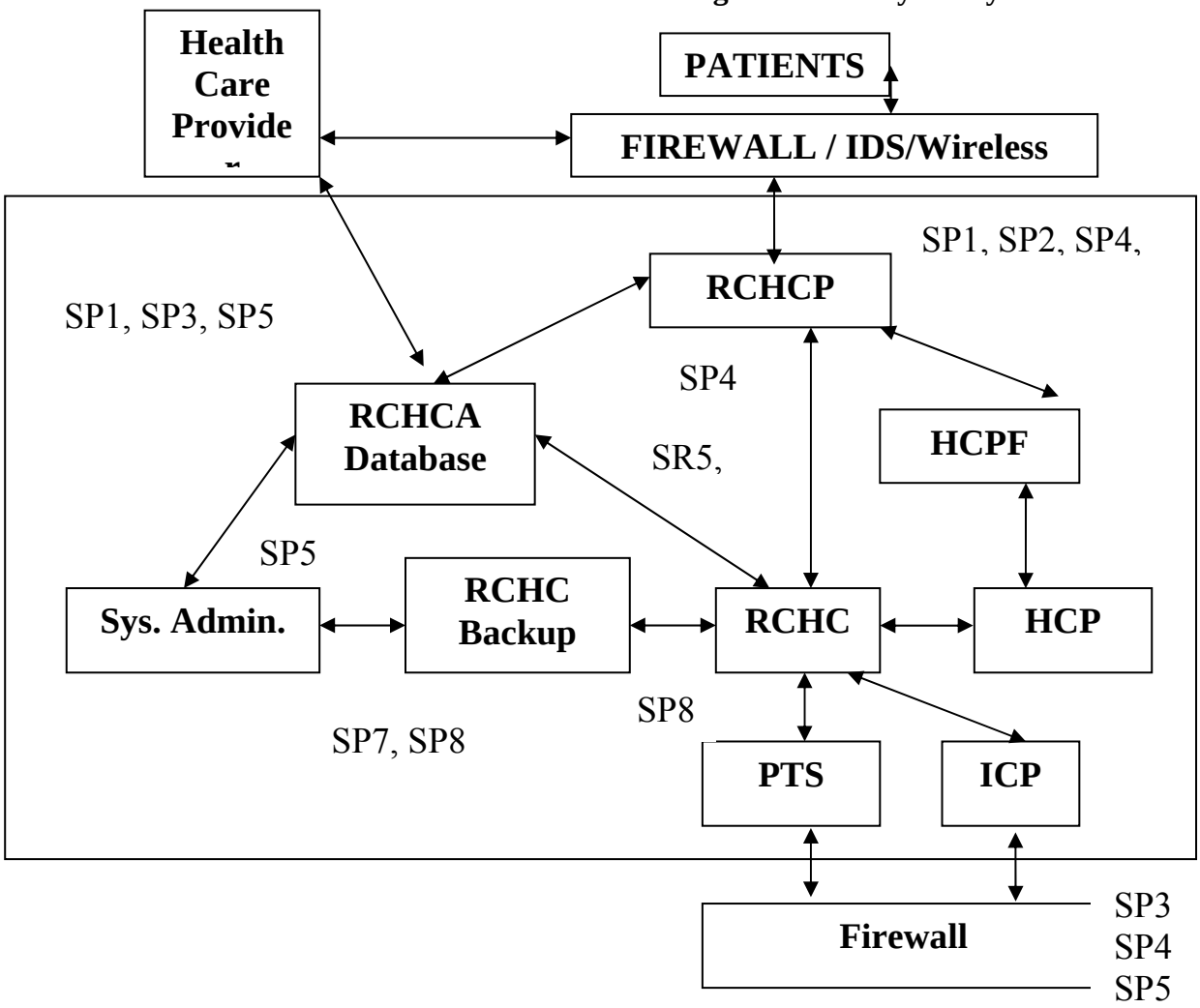
2. Mobile Health Functional Flow Diagram. The e-Learning default system implementation



Conclusions

After MCHC/RCHC Security analyses, the architecture for implementation was made and the e-Learning system is ready to be build in order to train mobile system managers.

MCHC ARCHITECTURE: E-Learning with Security Policy



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HARDWARE STATISTICAL TESTS FOR RANDOMNESS EVALUATION

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Abstract: *Of-line testing of a random number generator satisfies only its implementation requirements. In order to design a secure cryptographic system, permanent surveillance of its performance is mandatory. Since the random number generator is the most important block of any cryptographic system with respect to its security preservation, the attention should be focused on the perfect running of this small but essential block. Controlling the functionality of a random number generator can be done only with on-line testing. Herein we propose several statistical tests suitable for hardware implementation, to be added to the FIPS 140-2 test battery. .*

Keywords: *random, statistic test, test battery, FPGA.*

1. INTRODUCTION

A random number generator is the main quality indicator for a cryptographic system. Without an efficient random number generator this kind of systems are just weak targets on a field threatened by cryptographic attacks.

Though it is just a small component in the cryptographic system architecture, the random number generator has the most important goal with respect to the security efficiency of the system, namely the generation of the cryptographic keystream.

A large amount of literature was focused on the evaluation of random number generation. The most often criteria of investigation is based on statistical tests. However, it is very difficult to appreciate a random number generator as good or bad, without being more or less subjective. Regarding the statistics theory, it is known that, increasing the number of experiments one can approach the real scenario very much. Since a single statistical test is way too less for a good evaluation, usually several tests (generically called statistical tests battery) are used for a correct evaluation.

Another important aspect which should be taken into consideration in order to preserve the security of a cryptographic system is the nature of the statistical tests implementation. A large amount of statistical tests documented are software suitable designs. However, for a cryptographic system it is very important to have a permanent surveillance of its performance. This means that online testing, which supposes hardware statistical tests implementation, is mandatory.

The main purpose of this paper is to review statistical tests for randomness and choose the tests that can be added to the FIPS 140-2 battery, which we have already implemented in hardware. Thus the newly formed hardware statistical test battery can be used to test, evaluate or monitor the hardware random number generators implemented in FPGAs.

For the various statistical tests evaluation we have taken into consideration the most common statistical batteries described in literature:

- MILS;
- CRYPT-X;
- SE9001;
- AIS31;
- AIS20;

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- ENT;
- NIST;
- NESSIE;
- KNUTH;
- DIEHARD;
- TestU01.

2. ON THE FLY TESTING

On-the-fly testing of a hardware random number generator is a subject debated in some recent papers [4], [7], [8], which tends to become an indispensable completion for the traditional software testing methods in any cryptographic system design.

Usually a random number generator is tested in its implementation stage using a software statistical test battery as NIST, DIEHARD etc. For that, a huge random bit stream is harvested from the random number generator and then stored into a memory in order to be submitted to the software testing procedure. Each software test needs samples of bits of specific length, so the stored stream of random data is divided in several sub-streams having the needed length. Comparing the result of the sub-streams testing with a confidence interval one can evaluate the random number generator as efficient or inefficient. In order to perform a good evaluation, in [3] for example, is suggested that 1000 sub-streams should be used. It is also specified that for some tests, such as Linear Complexity test, the length of a sub-stream should be of at least 1Mb. Testing 1000 sub-streams of 1Mb length each is a time consuming task first of all, but also it imposes a high computation power.

However, the main drawback of software testing is the impossibility of having a permanent monitoring facility which is, as mentioned in the introductory section, mandatory for a high level secure cryptographic system. Thus, the monitoring activity should be available also while the cryptographic system is running. It is obvious that this task can be performed only with a hardware embedded testing module.

The main challenge is to find the software statistical tests suitable for hardware implementation and to solve this porting problem at the price of reduced power consumption, small occupied area or other application specific requirements.

Although many criteria can be used in order to select the statistical tests to be implemented in hardware, all of them are bounded by the most important one, which is the possibility of hardware implementation.

In order to identify the tests suitable for hardware implementations four guideline criteria were chosen, as follows:

- the tests should be suitable for the purpose of the random number generators analysis (e.g. detect different kinds of non-randomness);
- the tests should be suitable for hardware implementation (e.g. require low resources);
- the tests should be able to run on-the-fly (on line);
- the tests should run on a set of 20000 bits;

In the existent literature on-line testing uses in almost all cases the well-known FIPS 140-1 or FIPS 140-2 test battery composed of four statistical tests: Monobit (Frequency) test, Poker test, Runs test, Longest Run test. Our goal is to document a large amount of literature aiming the existent references for software statistical tests, in order to find as many test as possible to enlarge the existent hardware tests batery.

3. HARDWARE STATISTICAL TESTS

Longest gap test

The version of this test described in [4] has the purpose to determine whether the length of the longest run of ones within the tested sequence is consistent with the length of the longest run of ones that would be expected in a random sequence.

With respect to this test, FIPS 140-2 standard proposes that any sequence with a longest run over 26 to be classified as non-random.

We can add two small modifications to the conditions described in [4] and [10] in order to create a new version of Longest Run test. Firstly, we can count the longest run of zeroes

within a sequence and, secondly, we can use a more restrictive limit (smaller than 26).

The hardware implementation is mainly based on a simple counter used to count the longest run from the sample sequence. Since there is no acceptance interval to limit the results, any length can be used for the tested sequence.

Gaps test

Another test described in FIPS 140-2 which can be implemented for gaps scenario is Runs test.

The focus of this test is the total number of runs in the sequence, where a run is an uninterrupted sequence of identical bits. A run of length *k* consists of exactly *k* identical bits and is bounded before and after with a bit of the opposite value. The purpose of the runs test is to determine whether the number of runs of ones and zeros of various lengths is as expected for a random sequence [4].

In the existent literature it is only specified the checking of the runs of ones. However, this does not guarantee that the tested sequence does not have runs of zeros unexpected for a random sequence. Thus, in order to validate a sequence as random, a similar evaluation should be done for the successive sequences of zeros within the sequence.

Dibit test

Starting from Monobit test described in FIPS 140-2 an extension can be made to Dibit test (tests the frequency of non-overlapping two-tuples). The main difference is that, in this case, the number of appearance for four non-overlapping patterns (two-tuples) has to be counted (00, 01, 10, 11).

It is obvious that we also have to determine the appropriate acceptance intervals for this test. The statistic for this test can be computed starting from the one given for the Poker test [1], for the particular case m=2 (m being the number of bits within a pattern) .Using a significance level $\alpha = 0.0001$ for the superior limit of the interval and $\alpha = 0.9999$ for the inferior one in order to compute the chi-square values, we found the interval given in (1) for the Dibit test:

$$25000013 < n_{00}^2 + n_{01}^2 + n_{10}^2 + n_{11}^2 < 25052769 \quad (1)$$

Pentabit test

Another test that can be derived from the FIPS 140-2 Monobit test is Pentabit test (tests the frequency of non-overlapping five-tuples). Although we can go further with the number of bits within a pattern, it should be taken into consideration when extending to higher orders that the amount of resources is limited. For the Poker test (4-bit frequency test) we used 16 DSP48 (digital signal processing) blocks, so we assume that 32 DSP48's are enough for Pentabit frequency test implementation, this amount of resources being available on a Virtex5 FPGA. It can be noticed that increasing the order of the test we have to double the amount of resources needed for implementation, so for now we shall limit our extensions to Pentabit test.

The acceptance interval for this test should also be proper adjusted. Thus, using the same significance levels mentioned for the Dibit test, the interval given in (2) can be found for the Pentabit test:

$$501224 < n_{00000}^2 + \ldots + n_{11111}^2 < 508639 \quad (2)$$

Classical Poker test

This test considers n groups of k successive bits, each group being included in one category. For example, if we consider the case k=5, there will be five categories, as follows:

5 different = all different
4 different = one pair
3 different = 2 pairs, or 3 of a kind
2 different = full house, or 4 of a kind
1 different = 5 of a kind

In general, one has to count the number of k-tuples with r different values. Using the probability of observation r (p_r) [2] given in (3):

$$p_r = \frac{d(d-1)...(d-r-1)}{d^k} \left\{ {k \atop r} \right\} \quad (3)$$

one can calculate the statistic for the Poker test as fallows:

$$X_k = \sum_{r=1}^{k} \left[\frac{(O_r)^2}{N_O p_r} \right] - N_O \quad (4)$$

where $d = 2^k$, $\left\{ {k \atop r} \right\}$ are the Stirling numbers [2], N_O is the total number of observations, O_r is the number of observations in category *r*.

The hardware resources of a Virtex 5 FPGA allow the implementation of this test for $k \in \{4,5\}$. For the significance levels mentioned for the Dibit test, one can found the acceptance interval for *k*=4 scenario to be the one given in (5) and the one for *k*=5 as given in (6).

$$733827052707840 < 114660 \cdot O_1^2 + 1092 \cdot O_2^2 + 91 \cdot O_3^2 + 42 \cdot O_4^2 < 746215352064000 \quad (5)$$

$$19796628512283033600 < 18879000 \cdot O_1^2 + 40600 \cdot O_2^2 + 812 \cdot O_3^2 + 70 \cdot O_4^2 + 25 \cdot O_5^2 < 20261525272186060800 \quad (6)$$

Since the limits in (5) and (6) can be represented with maximum 64 bits, two DSP48 blocks are enough for the comparators implementation.

The difference between the Classical Poker test presented herein and the one described in FIPS 140-2 is that the latter generates 16 distinct categories with all 4 bits combinations, while the former only considers 4 or 5 categories depending on the value of *k*. Given this assumption, it is obvious that the test characteristics used will also be different.

Hamming weight test

For this test, the sequence is divided in 4000 blocks of 5 bits, and then the Hamming weight of each block is computed. The Hamming weight is the number of ones contained in the 5 bit block. The probability of each Hamming weight is calculated using the formula shown below:

$$p_h = C_5^h \cdot p^5 \quad (7)$$

where *h* is the Hamming weight and *p* is the probability of a bit being a one (*p*=0.5).

Using the probability given in (7), the statistic of this test can be computed using equation (8):

$$X_5 = \sum_{r=0}^{5} \left[\frac{(O_r)^2}{N_O p_r} \right] - N_O \quad (8)$$

Again, using the significance levels used for the rest of the tests, the acceptance interval given in (9) can be obtained:

$$5120036352 < 10 \cdot O_0^2 + 2 \cdot O_1^2 + O_2^2 + O_3^2 + 2 \cdot O_4^2 + 10 \cdot O_5^2 < 150096256 \quad (9)$$

Serial correlation test

As mentioned in [4] the focus of this test is the frequency of all possible overlapping *m*-bit patterns across the entire tested sequence. The purpose of this test is to determine whether the number of occurrences of the 2^m *m*-bit overlapping patterns is approximately the same as would be expected for a random sequence. Random sequences have uniformity; that is, every *m*-bit pattern has the same chance of appearing as every other *m*-bit pattern.

For the case of *m*=2 as we intend to use, there will be 4 2-bit overlapping templates, namely 00, 01, 10, 11, as can be seen in fig. 1.

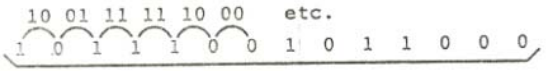

Fig. 1 Serial overlapping patterns generation

The statistic used for this test follows a chi-square distribution given in (10)

$$X = \frac{1}{10000}[(n_{01} - n_{00})^2 + (n_{11} - n_{10})^2] \quad (10)$$

Computing the chi-square values for 3 freedom degrees and the significance levels $\alpha = 0.0001$ and $\alpha = 0.9999$ the acceptance interval given in (11) was determined.

$$52 < (n_{01} - n_{00})^2 + (n_{11} - n_{10})^2 < 211075 \quad (11)$$

Binary matrix rank test

The focus of this test is the rank of disjoint sub-matrices of the entire sequence. The purpose of this test is to check for linear

dependence among fixed length substrings of the original sequence [4]. This test appears with different parameters (32*x*32, 31*x*31, 16*x*16, 6*x*8 etc.) in several software statistical test batteries such as DIEHARD, NIST, NESSIE etc.

This test supposes several steps. Firstly, the tested sequence is sequentially divided into $M \cdot Q$-bit disjoint blocks, which will be collected into M by Q matrices. Basically, each row of the matrix is filled with successive Q-bit blocks of the original sequence. Then, for each matrix generated, the binary rank is computed. Finally, based on the rank values, a chi-squared value is computed with the expression given in (12):

$$X = \sum_{i=0}^{n} \frac{(O_i - E_i)^2}{E_i} \qquad (12)$$

where n is the number of ranks categories, O_i is the number of observed matrices with a given rank, and E_i is the number of expected matrices with the same rank.

As specified in [4], the minimum number of bits to be tested must be at least $38 \cdot M \cdot Q$ (i.e., at least 38 matrices are created). Thus, in order to use all 20000 bits of the tested sequence we have chosen for the hardware implementation $20x20$ matrices (50 matrices are created). For this scenario, equation (12) can be written as follows:

$$X = \frac{(F_{20} - 0.2888N)^2}{0.2888N} + \frac{(F_{19} - 0.5776N)^2}{0.5776N} + \frac{(F_{18} - 0.1336N)^2}{0.1336N} \qquad (13)$$

where F_i, $i \in \{18,19,20\}$ is the number of matrices with rank i and N is the total number of matrices (N=50).

Using the same significance levels as those mentioned for the Dibit test and replacing the value of N in (13), one can obtain the acceptance interval given in (14):

$$964594 < F_{20}+F_{19}+F_{18} < 1319960 \qquad (14)$$

Binary derivative test

The purpose of this test is to check that the binary source is 1-bit memoryless, such that 50% of the bits differ from the previous bit value. It supposes several steps easy to implement in a hardware description language as VHDL or Verilog. It gives the possibility of choosing the length of the sub-stream to be tested, so we can stick to the 20000 bits length as we desired. This test is actually based on performing the frequency test on two bit streams generated from the initial stream, called first binary derivative and second binary derivative. Since the frequency test checks if that there is an equal proportion of ones and zeros in the bit stream, applying this test to the first derivative consists in checking the proportion of the overlapping two-tuples 00, 01, 10, 11, while in the case of the second derivative it consists in checking the proportion of the overlapping three-tuples 000, 001, 010, 011, 100, 101, 110 and 111.

As mentioned, the binary first and second derivatives are new streams, formed by the exclusive-or operation on successive bits in the original stream. The second derivative is obtained from the first derivative. The length of the new generated bit stream is 1 bit shorter than its predecessor, thus the length of the first derivative will be with 1 bit shorter than the original stream and so on.

Similar to the frequency test, counting the number of ones in the first and second derivative, it should fall into the acceptance interval given by:

$$9725 < n_1 < 10275 \qquad (15)$$

Since the length of the first and second order generated sequences differ with one and two bits respectively from the original one, the boundaries given in (15) are still a good approximation.

Disjointness test

This is another test that can be implemented in hardware at the price of reduced hardware resources utilization. It consists in comparing successive blocks of different length (8 bits, 32 bits etc.). The tested sequence passes the test if the subsequent members are pairwise different.

Since this test is based on comparing successive blocks of bits until a negative result is found, original sequences as long as desired can be used for testing.

Turning Point test

This test is based on counting the number of peaks and troughs in a sequence of specify length and verify if the obtained number is as would be expected for a random sequence.

For the hardware implementation of this test each set of 8 bits will be converted in its decimal correspondent. Since we use 20000 bits length sequences, 2500 decimal values (from 0 to 255) will be obtained. In order to find the total number of peaks and troughs we will run over the sequence of 2500 decimals from one end to another. If the next number is greater than the previous number a toggle register is set to one. The register remains at one if this trend continues. However, if the sequence decreases the toggle register switches to 0 and remains there as long as the sequence continues to decrease. Each time the toggle register changes a count is kept and after examining all 2500 values we have the total number of turning points. The total number of turning points is then compared to an acceptance interval, and if it falls anywhere in the interval then the sequence is considered random. For our scenario (20000 bits long sequences), using the theory proposed in [3] we found the acceptance interval given in bellow:

$$1624 < n_{TP} < 1707 \qquad (16)$$

The mechanism of detecting the peaks and troughs in a sequence of numbers is illustrated in figure 2:

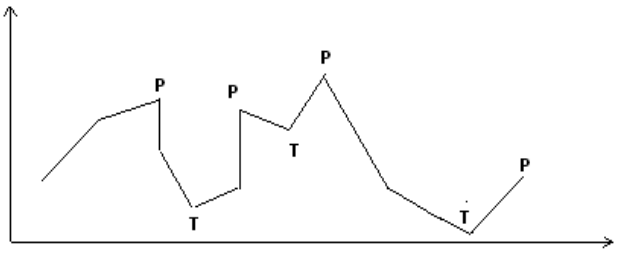

Fig. 2 Peaks & troughs detecting mechanism

Autocorrelation test

The purpose of this test is to check for correlations between the given sequence and (non-cyclic) shifted versions of it.

A simple method to perform the autocorrelation test for a 20000 bits long sequence is given in [11]. There is specified that only 5000 iterations are enough in order to obtain the autocorrelation result.

Let the tested sequence be $\{b_1, b_2, ..., b_{2000}\}$ and $d \in \{1,...,5000\}$. The sequence passes the autocorrelation test if $2326 < A(d) < 2674$, where

$$A(d) = \sum_{i=1}^{5000} b_i \oplus b_{i+d} \qquad (17)$$

In equation (17) $\oplus$ denotes the XOR operator. In order to perform the XOR operation between the given sequence and its shifted version in hardware, a linear feedback shift register having the length d can be used.

Runs up/down test

This test examines the length of monotone subsequences of the original sequence (i.e., segments that are increasing or decreasing). Therefore there are two tests configurations: “runs up” and “runs down”.

The tested sequence should have at least 4000 numbers [2]. In order to test our 20000 bits sequences, each nibble (4 bits) will be considered as a hexadecimal value, thus a 5000 hexadecimal values sequence will be obtained.

Since the original statistic proposed in [2] is very complicated for the hardware implementation, we have chosen the simplified version, as suggested in Exercise 14 of [2]. In this version one value between any two successive runs is skipped and therefore the increasing or decreasing subsequences are independent. In this case a chi-square test with five freedom degrees can be applied, with the probability $1/t! - 1/(t+1)!$ for a run of length t, $1 \le t \le 5$ and $1/t!$ for a run of length 6. The runs smaller than 6 have individual categories and all runs larger or equal to 6 are merged in a single category.

The statistic of this test can be computed using the following equation:

$$X_5 = \sum_{r=0}^{5}\left[\frac{(O_r - Np_r)^2}{Np_r}\right] \qquad (18)$$

where $N=O_0+ O_1+ O_2+ O_3+ O_4+ O_5$.

Again, using the probabilities mentioned above and the significance levels used for the rest of the tests, the acceptance interval given in (19) can be obtained:

$$10000\cdot N-24999590 < 2\cdot O_0^2+3\cdot O_1^2+8\cdot O_2^2+30\cdot O_3^2+144\cdot O_4^2+720\cdot O_5^2<10000\cdot N-24871276 \qquad (19)$$

Spectral test

The most difficult aspect regarding the hardware implementation of the Spectral test is the translation of the exponential function, existent in the Fourier transform, in a hardware description language.

However, since Xilinx ISE packet offers in its Digital Signal Processing toolbox the possibility of computing the Fast Fourier Transform, this test could be implemented in hardware.

4. CONCLUSIONS

Though random number generator online testing is essential for any cryptographic system, there are a small number of statistical tests implemented in hardware.

Most of the documented statistical tests can not be implemented in hardware due to exponential, logarithmic or other types of function that can not be translated in a hardware description language.

Sweeping the existent documentation which describes software suitable statistical tests, a number of tests to be adjusted for hardware implementation can be found. Based on the proposed searching criteria described in the second section, we found 14 tests suitable for hardware implementation.

5. FUTURE WORK

The tests described in this paper to be suitable for hardware implementation will be the items to be found in a new hardware statistical test battery.

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TEST STAND FOR ELECTRICAL MACHINES USED IN AUTOMOTIVES

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Abstract: *Testing electrical machines under laboratory conditions is compulsory to the purpose of simulating their behavior under different driving conditions. In the paper, there are analyzed the types of propulsion structures and the requirements imposed by the standard driving cycles, on whose basis the structure of the test stand is determined. The stand contains an electrical testing machine coupled to a reference machine simulating the operating conditions of the testing machine: in load, dynamic braking, regenerative braking. The test stand is provided with monitoring elements for comparision of the performance of electrical machines used in road transportation.*

Keywords: *electrical machines, test stand, automotives, road transport*

1. Introduction

The essential requirement of road transport within global society is sustainability. In this respect, current researches focus on the rise of the automotive performance, as key elements in promoting a durable and „green" transport. Regarding the use of electrical machines as source of primary or auxiliary propulsion, special requirements are imposed [1,2]:

- high efficiency of the electromechanical energy conversion;
- continuous regulation on wide scale of the speed and angular accelerations, respectively, of the mechanical torque at the shaft;
- starting, braking, acceleration conditions with transitory processes as brief as possible;
- safety in functioning.

In the classical automotive, the traditional electrical machines are the alternator and the starter.

Current technologies allowed obtaining alternator-starter integrated structures.

The block chart variants of the driving system encountered in the classical automotive are rendered in Fig 1, in which starter and alternator are the main elements.

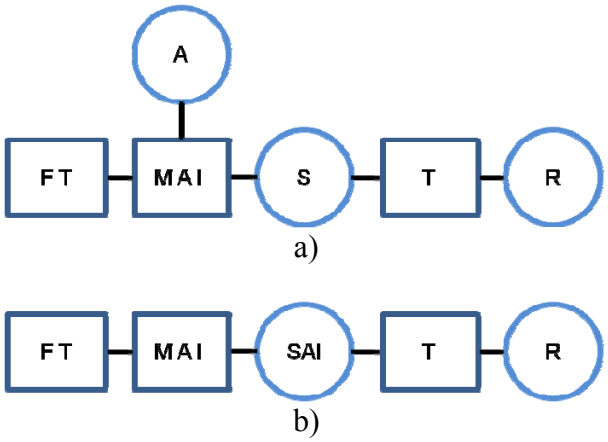

Fig. 1 classical automotive propulsion structures: a) conventional structure; b) integrated structure

The component elements are: FT - fuel tank, MAI - internal combustion engine, A - alternator, S - starter, SAI - integrated starter-alternator, T - drive line, R - wheel.

The starter is a continuous current machine with collector and with/without permanent magnets that provide the start of the internal combustion engine. The alternator is a synchronous generator with poles in claw, playing the part of ensuring the electrical energy, necessary in the automotive [3].

A solution for reducing the pollution is currently represented by the use of the hybrid

motor vehicle, propelled in urban traffic by an electrical motor, and on the express highways by the internal combustion engine. The block scheme variants of the hybrid drive system of parallel type and of series type [4], are illustrated in Fig. 2.

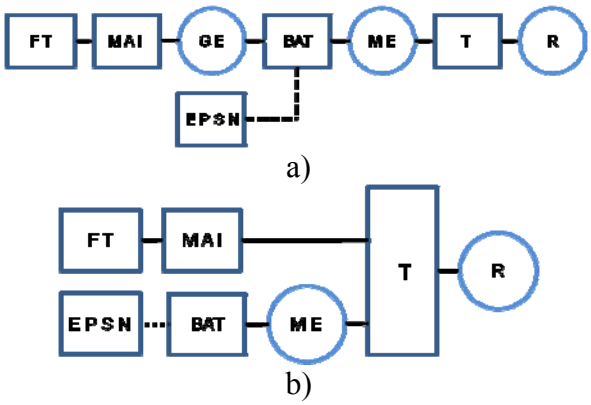

Fig. 2 Hybrid automotives propulsion structures: a) series structure; b) series-parallel structure

The component elements are: GE - electric generator, BAT - traction accumulator/battery, E P S N - electric-power-supply network, ME - electric motor.

The electrical machines used in propelling hybrid and electrical vehicles are the continuous current machines, the asynchronous machines and the synchronous machines. The continuous current machines have been long used in propelling automotives in the variants with series excitation and with separate excitation; however their main deficiency is the mechanical collector. The technological progress marked up in advanced magnetic materials – the use of soft magnetic materials with superior characteristics in building the magnetic circuits of electrical machines and the use of high performance permanent magnets – allowed creating efficient structures of electric drives. The researches upon electrical machines prove higher characteristics in the synchronous electrical machine with permanent magnets. The types of synchronous machines with permanent magnets particularly used for propelling the automotives are the synchronous motor with double excitation, respectively the synchronous motor with double feed and rotor disk-type [2,3].

The new variants of machines submitted to be used in transport undergo specific testing, according to the international standards [5].

The necessity of diminishing the costs, of reducing the delays in design and manufacturing, brought along the development of state-of-art testing methodologies associated with new solutions for the test stands [6,7]. These stands must provide the evaluation of the solutions and also optimizations as regards the energy management and the functioning in the automotive propulsion system.

Evaluating and comparing the performance of the electrical machines propelling the automotives is done through resorting to standard driving cycles, which simulate the automotive behavior under various road conditions. The purpose of the work is to analyze and design a test stand of electrical machines used in road transport, for monitoring the parameters and assessing the performance of the electrical machines propelling the vehicles.

2. Standard driving cycles and electrical machines characteristics

Standard driving cycles describe the evolution of the vehicle speed in time [5,8], having in view to render as faithfully as possible the automotive real behavior under different rolling conditions. Several types of regulated cycles exist in order to simulate an urban, extra-urban trajectory or combinations between them. In Fig. 3 and Fig. 4, the profiles of European driving cycles are shown.

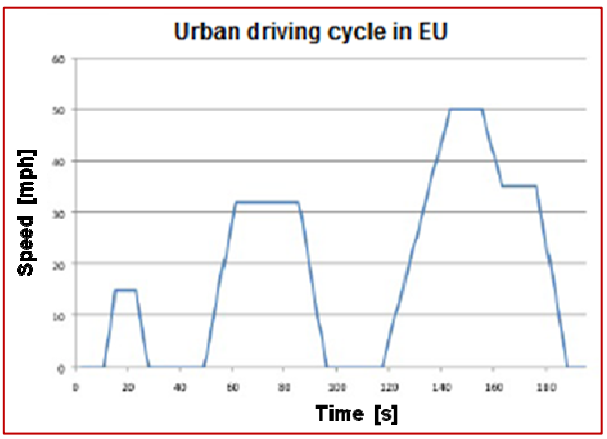

Fig. 3 European urban driving cycles

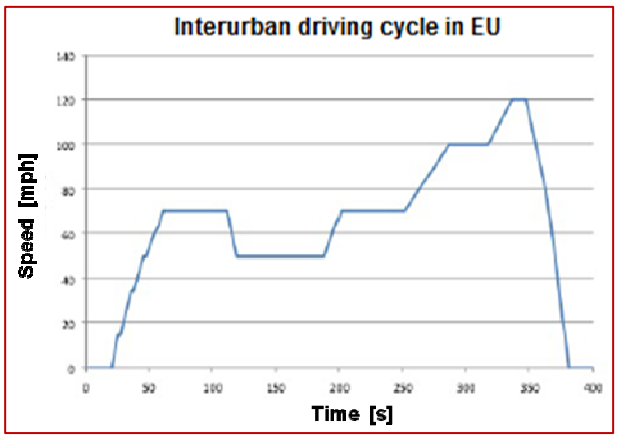

Fig. 4 European interurban driving cycles

The purpose of testing propulsion electrical machines under these rolling cycles is determining the necessary of current, respectively electrical power required by the machine for propelling the automotive under the specified speed conditions.

The necessary electrical power [9] is directly connected to the characteristic torque-speed (Fig. 5).

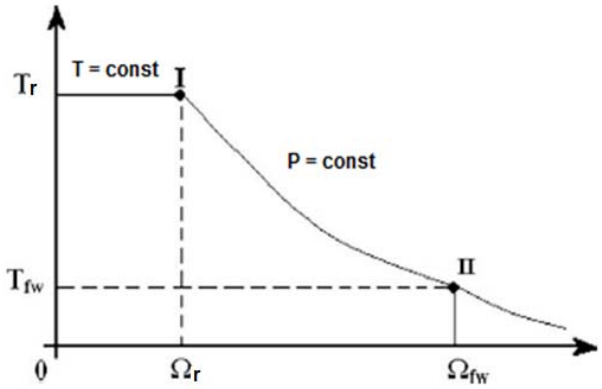

Fig. 5 Characteristic torque-speed in the electric propulsion systems

Three regions exist on the torque-speed characteristic in the case of the propulsion systems with electric motors:

- a region of constant torque, delimitated up to the motor rated speed Ω_r;
- a region of diminishing torque, in which the power remain constant, delimitated by the rated speed Ω_r and by the maximal speed of magnetic flux weakening Ω_{fw};
- a region in which the torque and the power concomitantly diminish, up to zero.

3. Test stand of electrical machines for transport

For monitoring and comparing the performance of electrical machines used in road traction, under laboratory conditions, the achievement of a stand whose general block scheme is rendered in Fig. 6 has been submitted.

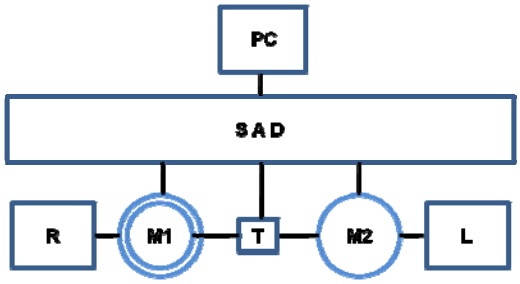

Fig. 6 General block scheme of the test stand

The component elements are: R – feed grid, M1 – tested electrical machine, M2 – driving electrical machine, T – transducers, SAD – data acquisition system, PC – computer.

The designed test stand is electric supplied from the grid of 400 V, 50Hz, and allows the testing of an electrical machine M1 under various operating conditions. To this purpose, on the same shaft with the electrical machine to study, the driving machine is hitched M2, as a means for simulating the electrical machine operating conditions: load, dynamic braking, and regenerative braking (Fig. 7).

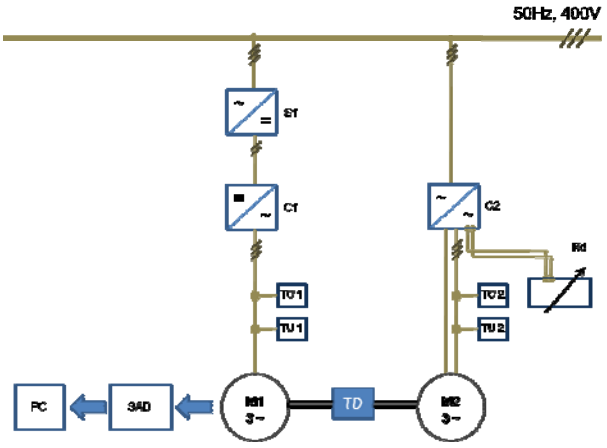

Fig. 7 - Block scheme of the electric machines test stand

The component elements are: M1 – tested electrical machine, M2 – driving electrical machine, S1 - source AC/DC, C1 – voltage inverter, C2 – motor speed control, TC1, TC2 – current transducers, TU1, TU2 – voltage transducer, TD – torque transducer, Rd – energy dissipative resistance SAD – data acquisition system, PC – computer.

The test stand is provided with elements for monitoring and controlling the parameters of the tested machines. The torque and the rotation speed in the machine shaft are directly measured resorting to a high performance torque/speed transducer, displaying the following advantages: solid build-up, increased sensitivity to the torque variations at high frequencies.

Static frequency converters, ensuring the feeding and the command of the electrical machines, have the adequate parameters: reduced size, increased efficiency in the applications of electrical traction, easy installation, safe operations and easy maintenance, wide range of served powers, wide range of functioning temperatures.

Current transducers, respectively voltage transducers, which are used for monitoring the wave forms of the currents for the three feeding phases of the electrical machine, of the current and of the voltage proceeding from the source of current AC/DC, of the voltages feeding the voltage machine, display superior characteristics: very good linearity and precision, wide range of frequencies, immunity to perturbations, reduced consumption for itself.

4. Conclusions

The rise in performance of electrical and hybrid automotives, as key elements in promoting a durable transport entails designing state-of-art and efficient test stands, to the purpose of evaluating the real behavior of the machine, respectively of the automotive, under different driving conditions.

In the paper, an analysis is made upon the propulsion system structure of the hybrid and electrical automotives.

There is emphasized that regulations upon the standard driving cycles sufficiently cover the spectrum of road problems encountered in electrical machines. The structure of a test stand for electrical machine used in automotive is proposed with specific elements of monitoring and control.

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MODELING AND SIMULATION OF A HIGH ELECTROMAGNETIC PULSE

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Abstract: *The paper presents a calculus and a simulation model to generate a high power electromagnetic pulse – one of the frequent causes of the electromagnetic interferences in case of electronic equipment; these phenomena being usually produced by natural phenomena, such as thundering, but also by the electromagnetic pulse weapon, in case of military conflicts. As a source of this type of pulse, it is used a flux compression generator (FCG), whose resistance and inductivity will vary linear parametrically, during the magnetic flux compression. This one being produced by an ultra-rapid short-circuits process of the FCG coil by means of one metal framework, using a controlled explosion.*

1. INTRODUCTION

One of the important problems of the Electromagnetic Compatibility (EMC) is focused on the behavior of the electronic circuits, devices, equipment and systems in case these are affected by the great power electromagnetic pulses, generated by natural phenomena (lightning) or of the pulse of electromagnetic weapons. In these cases it is necessary to know how such pulses are generated and their features.

In this context, our work presents a calculus and a simulation model of the great power electromagnetic pulse, generated by a device especially designed for this reason i.e. flux compression generator (FCG).

The used method consists of obtaining this pulse by the *compression,* respectively by the ultra-rapid amplification of the initial current, and of the associated magnetic flux, produced into a specially designed coil, which has at its end a electrical current loop, by discharging upon it of a super-capacitor (0,1 F). Inside the coil there is a metal cylinder of copper or iron, named *framework*. *The compression* of the magnetic flux is progressively developed by an ultra-rapid short-circuit process of the coil aided by the framework, using a controlled explosion. Finally, a very great power pulse of electrical current is obtained and, as a result, one can obtain a magnetic flux that can produce negative effects upon the nearby electronic equipments.

2. THE ESTABLISHMENT OF THE PARAMETRIC RELATIONS FOR THE RESISTANCE AND COIL OF THE GENERATOR

The initial electric current into the coil is obtained by the discharge of a super-capacitor of 0,1 Farad upon this, and the final current is obtained by an ultra-rapid short-circuit process of the coil aided by the framework, using a controlled explosion. The simulation of these currents was performed by a transitory regime analysis, using parametric components of the circuit, because while the process of short-circuit is developed, the values of the resistance and coil are modifying themselves (are decreasing to zero).

In the following it is considered the case where the resistance and the coil have a linear parametric evolution during the flux compression process:

$$R(t)=R_0(1- kt) \quad (2.1)$$

$$L(t)=L_0(1- kt) \quad (2.2)$$

where it is noted below:

$R_0=R$; $L_0=L$;

$$k = \frac{1}{t_i} = \frac{1}{52,14 \cdot 10^{-6}} = 1,9178 \cdot 10^4 \, (s^{-1});$$

$$t_i = \frac{1}{v_C} = \frac{0,365}{7000} = 52,14 \cdot 10^{-6} \, (s) = 52,14 \, (\mu s)$$

represents the duration of explosion propagation.

The real electrical parameters (the measured parameters) of the coil with internal copper cylinder (the framework) and the final electrical current loop are the following:

- the coil inductivity: L_0=42 (μH); the coil resistance: R_0=0,097 (Ω);
- the inductivity of the current loop (the charge): L_b=0,1498 (μH);
- the resistance of the current loop: R_b=0,006466 (Ω);
- the loss and residual inductivity of real circuit: L_p=2 (nH).

They note below:

$$R_c = R + R_b; \qquad L_c = L + L_b + L_p \quad (2.3)$$

because these parameters are constant.

With these notations one can write:

$$R_T(t) = R(t) + R_b = R_c - kR_0 t;$$
$$L_T(t) = L(t) + L_b + L_p = L_c - kL_0 t \quad (2.4)$$

3. THE STUDY OF THE TRANSITORY REGIME DURING THE COIL SHORT-CIRCUIT

In this chapter, the transitory regime of the short-circuit coil, starting from an initial known current I_0 is analyzed. The homogeneous differential equation of the parametric series circuit R, L is the following:

$$\frac{d}{dt} L_T(t)\, i(t) + R_T(t)\, i(t) = 0 \quad (3.1)$$

Taking into an account the above relations, one can write:

$$\frac{d}{dt}\left\{\left[L(t) + L_b + L_p\right] \cdot i\right\} = \left[L(t) + L_b + L_p\right] \cdot \frac{di}{dt} + i \frac{d}{dt}\left[L(t) + L_b + L_p\right] \quad (3.2)$$

$$\frac{d}{dt}\left[L(t) + L_b + L_p\right] = -kL_0 \quad (3.3)$$

The (3.1) formula becomes:

$$\left(L_c - kL_0 t\right)\frac{di}{dt} - kL_0 i + \left(R_c - kRt\right) \cdot i = 0 \quad (3.4)$$

or:

$$\left(L_c - kL_0 t\right)\frac{di}{dt} + \left[\left(R_c - kL_0\right) - kRt\right] i = 0 \quad (3.5)$$

The (3.5) equation can also be written:

$$\frac{di}{dt} + \frac{(R_c - kL_0) - kRt}{L_c - kL_0 t} i = 0 \quad (3.6)$$

or:

$$\frac{di}{dt} + \left[\frac{R_c - kL_0}{L_c - kL_0 t} - \frac{kRt}{L_c - kL_0 t}\right] \cdot i = 0 \quad (3.7)$$

It is noted below the square parenthesis with P(t):

$$P(t) = \frac{R_c - kL_0}{L_c - kL_0 t} - \frac{kRt}{L_c - kL_0 t} \quad (3.8)$$

As a result the (3.7) equation, one can write the following:

$$\frac{di}{dt} + P(t) \cdot i = 0 \quad (3.9)$$

The solution of the (3.9) homogeneous equation, in other terms – the free response to a null excitation, corresponding to an initial state of the transitory regime has the form [1]:

$$i_l(t) = I_0 \cdot e^{-\int_0^t P(t')dt'} \quad (3.10)$$

The current I_0 is obtained from the initial condition $i(0)=I_0$ and represents the starting current.

Further on, they compute the integral from the (3.10) formula:

$$\int_0^t P(t')dt' = \int_0^t \left[\frac{R_c - kL_0}{-kL_0 t' + L_c} - \frac{kRt'}{-kL_0 t' + L_c}\right] dt' =$$

$$\left(R_c - kL_0\right)\int_0^t \frac{1}{-kL_0 t' + L_c} dt' - kR \int_0^t \frac{t'dt'}{-kL_0 t' + L_c} \quad (3.11)$$

The (3.11) relation can be written as in the following:

$$\int_0^t P(t')\,dt' = (R_c - kL_0) \cdot I_1 - kR \cdot I_2 \quad (3.12)$$

where:

$$I_1 = \int_0^t \frac{1}{-kL_0 t' + L_c} dt' \quad (3.13)$$

and:

$$I_2 = \int_0^t \frac{t'dt'}{-kL_0 t' + L_c} \qquad (3.14)$$

Taking into an account that:

$$\int_0^t \frac{dx}{ax+b} = \frac{1}{a}\cdot \ln(ax+b)\Big|_0^t = \frac{1}{a}\cdot \ln\left(\frac{a}{b}\cdot t + 1\right) \qquad (3.15)$$

and:

$$\int_0^t \frac{x\cdot dx}{ax+b} = \left[\frac{x}{a} - \frac{b}{a^2}\cdot \ln(ax+b)\right]\Big|_0^t = \frac{t}{a} - \frac{b}{a^2}\cdot \ln\left(\frac{at+b}{b}\right) = \frac{t}{a} - \frac{b}{a^2}\ln\left(\frac{a}{b}t+1\right) \qquad (3.16)$$

as well as the fact that in the analyzed case: $a = -kL_0$ and $b = L_c$, they result for I_1 and I_2 the following expressions:

$$I_1 = \frac{1}{-kL_0}\cdot \ln\left(\frac{-kL_0\, t}{L_c} + 1\right) \qquad (3.17)$$

$$I_2 = -\frac{t}{kL_0} - \frac{L_c}{(-kL_0)^2}\cdot \ln\left(\frac{-kL_0}{L_c}t + 1\right) \qquad (3.18)$$

Further on, one can write:

$$el(t) = -\int_0^t P(t')\,dt' = -(R_c - kL_0)\cdot I_1 + kR\cdot I_2 \qquad (3.19)$$

Taking into an account the (3.17) and (3.18) formula, (3.19) relation becomes:

$$el(t) = \frac{R_c - kL_0}{kL_0}\cdot \ln\left(\frac{-kL_0\, t}{L_c}+1\right) + kR\left[-\frac{t}{kL_0} - \frac{L_c}{(-kL_0)^2}\cdot \ln\left(\frac{-kL_0}{L_c}t+1\right)\right] = \left(\frac{R_c - kL_0}{kL_0} - \frac{kRL_c}{(-kL_0)^2}\right)\cdot \ln\left(-\frac{kL_0}{L_c}t+1\right) - \frac{R}{L_0}t \qquad (3.20)$$

As a result, the formula of the transitory regime current into the coil will be:

$$i_l(t) = I_0\cdot e^{-\int_0^t P(t')dt'} = I_0\cdot e^{el(t)} \qquad (3.21)$$

4. CALCULUS OF THE INITIAL ELECTRICAL CURRENT IMPOSING VARIOUS FINAL CURRENTS INTO THE COIL

The next procedure will be followed when one wants to calculate the initial current imposing different final currents into the coil:

- it is calculated the value of (2.4) formula, imposing the final values $i(t_i)$=130kA; 75kA; 30kA, 15kA and $t=t_i$, (after the time interval t_1, corresponding to the explosion propagation):

$$el(t)\big|_{t=t_i} = el(t_i) = \left(\frac{R_c - kL_0}{kL_0} - \frac{RL_c}{kL_0^2}\right)\cdot \ln\left(-\frac{L_0}{L_c}+1\right) - \frac{R}{L_0}\cdot t_i \qquad (4.1)$$

- using the coil parameters, it is obtained: $el(t_i)$=5,4486;
- then, using the (3.13) formula it is obtained the expression of the initial current:

$$I_0 = \frac{i(t_i)}{\exp[el(t_i)]} \qquad (4.2)$$

where the final current is: $i(t_i)$=130kA; 75kA; 30kA; 15kA.

- finally, the following values of the initial currents are obtained:

$$I_{01} = \frac{130000}{\exp[el(t_i)]} = 559{,}2480(A)$$

$$I_{02} = \frac{75000}{\exp[el(t_i)]} = 322{,}6430(A)$$

$$I_{03} = \frac{30000}{\exp[el(t_i)]} = 129{,}0572(A)$$

$$I_{04} = \frac{15000}{\exp[el(t_i)]} = 64{,}5286(A)$$

5. THE GRAPHIC REPRESENTATION OF THE FINAL CURRENT INTO THE FCG COIL

For the graphic representation of the final current into the loop of the coil, an initial current into the coil of value I_0=551(A) is considered. The graphic i(t) for the time interval $t \in [0.00, 52.14\cdot 10^{-6}]$ seconds is presented in fig.1 and for the time interval $t \in [0.00, 52.14\cdot 10^{-6}]$ seconds - in fig.2.

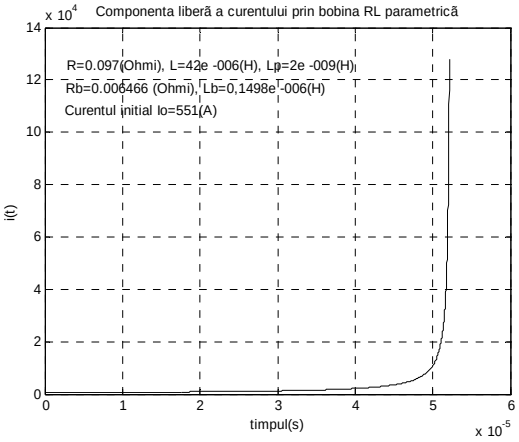

Fig.1 Evolution of the final current for the time interval

$t \in [0.00, 52.14 \cdot 10^{-6}]$

It results from these graphs that the final value of the current that *was accumulated* into a loop of the coil is: I_{fin}=128.158,84 A. The intensity of the adequate magnetic field into the center of the loop will be H_{fin} = 4,22x10^5 Asp/m. The loop will be finally destroyed by explosion and will produce an instantaneous interruption of this flux, having a negative effect upon the functionality or physical integrity of nearby electronic equipment.

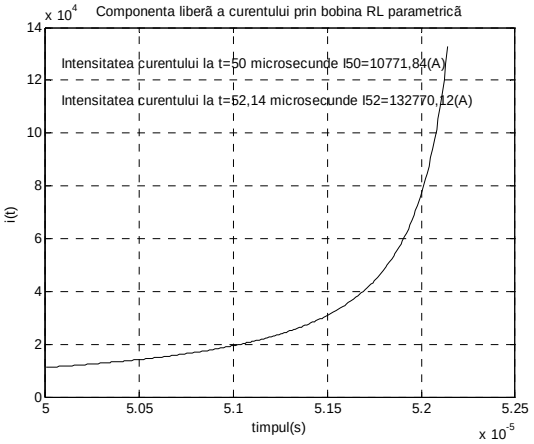

Fig.2. Evolution of the final current for the time interval

$t \in [50 \cdot 10^{-6}, 52.14 \cdot 10^{-6}]$

6. Conclusions

In this work it is demonstrated the fact that it can be obtained, using a Flux Compression Generator and an adequate calculus and simulating model, a great power electromagnetic pulse, which can, in its turn, to functionally disturb, or even destroy the nearby electronic equipment.

The experimental tests carried out in a military location emphasize the fact that the model is valuable and, as a result, it can be used to develop similar tests on a large range of military or civilian electronic equipment, which must conform to the EMC directives.

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LIGHT AIRCRAFT WEIGHT REDUCTION USING NOVEL AVIONICS TECHNOLOGIES

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Abstract: *Article deals with some applications used in light aircraft design and production, such as integrated EFIS-EMS, NAV-COM and automatized on-board flight control systems are to be presented. These are standard solutions used in production of serial aircraft of classes of UL (ultra light aircraft), LSA (light sport aircraft), VLA (very light aircraft – Fig. 1) produced by Corvus Aircraft Ltd., Ballószög, Hungary.*

Keywords: *modern aircraft design philosophy, on-board systems, weight reduction, integrated aircraft avionics systems.*

1. INTRODUCTION

The article is focusing on up-to date on-board aircraft systems, on their use to increase flight safety in relation GAT (General Air Traffic), which is popular and advanced in XXIst century. Today one can observe the growing tendency of use of small and light aircraft, furthermore analyzing some prognosis, the numbers of GAT aircrafts will probably be doubled in the future compared the number we have now all over the world. Small aircrafts used daily will be as normal for next generation like cars are applied in our life today.

As follows, a new, modern philosophy must be introduced in the aircraft design and manufacturing procedures according by applied and operative regulations. On the one hand, really important consideration is the arrangement of cockpit, which must be simple.

On the other hand up-to date digital instrument integration is basic requirement. The design of the cockpit should consider all aspect of ergonomy; human friendly flight environment creation is one of the main goals. Substantial point is that the civil and military flights can be coordinated flexible in same time; the quick identification and the accuracy of separation are significant questions.

Fig. 1 Corvus CA-21 Phantom Aircraft.

II. SOME PROBLEMS OF GAT FLIGHTS

In non-controlled airspaces, where the GAT and non-commercial flights are completed in conditions VFR[1], in VMC[2] transponders are very often inactivated. According to ICAO[3] rules as G-class free airspace is provided for that kind of flight and this airspace can be used by any planes.

The G-class airspace is limited by borders in horizontal, upper and lower limits in vertical, no traffic coordination is available, only flight information service is activated, it

[1] VFR: visual flight rules
[2] VMC: visual meteorology conditions
[3] ICAO: International Civil Aviation Organization

is one of reason why called non-controlled airspace. The G-class airspace is defined in Hungary from ground level to AMSL[4] 9500 feet. All area of the country is masked but some part is subtracted, these are functional as a controlled airspace, i.e. TMA[5], MTMA[6], TRA[7].

One common daily problem is appears when light aircrafts having no flight plane accidentally crosses controlled airspaces and the coordinator information service does not have correct information about flight path. In that case, unidentified airplane, (albeit no ill-intentioned goal) follows this procedure very close to airport, the control service must reorganize and modify the departure and approach time of other aircrafts. This activation can generate higher risk for flight safety.

For instance, in Hungary in last few years it happened many times that glide-sale parachutes crossed the Budapest TMA, where it is prohibited. Furthermore, standard problem, when ultra light aircrafts flies, and they proceed direct into military TRA sectors.

Due to fast development of digital electronics small aircrafts could be equipped integrated on-board flight and navigation modules, which systems particularly facilitate the flight safety for example sending an alert message to the pilots in case they crosses prohibited, dangerous or military area.

Advantage of the use of integrated EFIS-EMS and NAV-COM systems is that they support both night and instrument flight activities.

III. PAST, PRESENT AND FUTURE IN GAT ON-BOARD SYSTEMS TENDENCIES OF DEVELOPMENT

3.1. On-board flight systems in 1970 and 1980.

Typical examples of the second generation on-board systems are CESSNA 150, 152, 172, 182 aircraft series. Such general on-board system environment is shown on Fig. 2, where cockpit instruments of a CESSNA 172 N model are presented. The flight, navigation and engine condition monitoring instruments are separated and we cannot define integrated on-board systems and instruments.

The flight and engine condition monitoring instruments are controlled by mechanical analogue method, the NAV and COM systems powered electrically. The navigation instruments cannot create inertial contact by the external GPS[8] equipment.

Fig. 2 Conventional cockpit of CESSNA 172 N / 1976.

In Table 1 functionality of the on-board flight instruments and systems has been summarized. We can ascertain also on Fig. 2 that all instruments are separated and no integrated hardware application is available in the cockpit.

Due to the highly developed informatics and computer applications, the fifth generation on-board system integration is used and GAT pilots can fly in digital environment.

Main advantage of the integrated systems is that they can operate many conventional functions of sensing and displaying parameters via digital databus. Fig. 3 shows cabin elements of CORVUS CA-21 Phantom aircraft in glass-cockpit arrangement.

[4] AMSL: altitude mean sea level
[5] TMA: Terminal Control Area
[6] MTMA: Military Terminal Control Area
[7] TRA: Terminal Restricted Area

[8] GPS: global positioning system

Table 1 Individual instruments (summary)

Instrument	System	Functionality
airspeed indicator ASI	pitot-static	flight condition check
altimeterALT	static	flight condition check
variometer VARIO	static	flight condition check
attitude director	vacuum	flight condition check
turn coordinator	gyroscope	flight condition check
slip indicator	centripetal force	flight condition check
on-board compass	vacuum	navigation check
magnetic compass	magnetic property	navigation check
NAV system (VOR[9], ADF[10], ILS[11])	electric	navigation check
COMM system (radio, transponder)	electric	navigation check
engine state conditions (CHT[12], EGT[13], oil pressure, oil temperature, fuel quantity, tach)	electric	engine state conditions

The main instrument is the DYNON FlightDEK-D180 integrated EFIS-EMS on-board module, (6). The main purpose of this instrument is to display engine parameters simultaneously [1].

The integrated NAV-COM system (19) is able to collaborate with external GPS (11 on the fig. 3), and available function is that the GPS and NAV data can be transferred directly into the DYNON central panel. Of course, in can not be avoided that general mechanical analogue instruments in the cockpit (No. 8 on Fig 3). However, these functions are only back-up ones.

In that case, any problems appearing in electrical network pilot must use four most important instruments as horizontal airspeed indicator, variometer, altimeter, and magnetic compass.

[9] VOR: VHF omni directional range
[10] ADF: automatic radio direction finder
[11] ILS: instrumnet landing system
[12] CHT: cylinder head temperature
[13] EGT: exhaust gas temperature

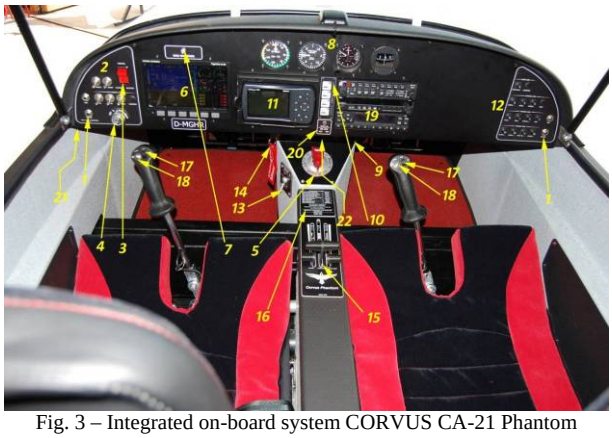

Fig. 3 – Integrated on-board system CORVUS CA-21 Phantom aircraft cockpit

3.2 On-board EFIS and EMS systems DYNON FlightDEK-D180 flight computer on CORVUS models

The DYNON FlightDEK-D180 Electronic Flight Information System is a modular appliance, displaying all flight condition information (see details on Fig. 4.) on the central monitor panel. On the background, the actual flight position of the airplane is indicated as attitude director, turn coordinator, slip indicator [1,2,3,4].

Besides this, any other significant flight parameters such as altitude, airspeed, vertical speed indicator climb or descent ratio, heading bag, wind direction and speed, outside temperature, angle of attack and autopilot condition also can be displayed.

The EFIS block is linked with many sub-systems and with central computer gathering data and computing reference values. The heart of EFIS is the ADAHRS (Air Data Attitude and Heading Reference System) internal module, supported by external reference sensors.

On Fig. 5 shown the ADAHRS and aircraft reference systems and the Table 2 contains the integrated modular pattern elements. (The numbers in Table 2 are in coherence with another numbers, assigned on Fig. 5.)

The DYNON system is supplied by main electrical system of the aircraft, for external power 10-30V DC is necessary. In case, when there is no available external power, the DYNON switches to internal back-up battery, providing 13-17V DC and maintains this state for minimum 1.5 hours (1,2,3,4].

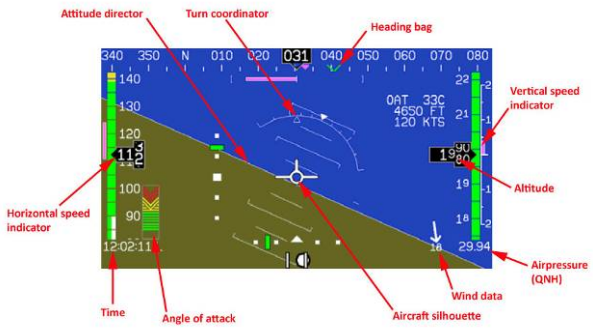

Fig. 4 – DYNON FlightDEK-D180 EFIS displayed information

Table 2 – The ADAHRS reference systems (ref numbers on Fig 5)

Instrument system	GPS	Pitot	Static	AOA[14]	Magneto-meter	Sensor	Accele-rometer
vertical speed indicator			X-1				
horizontal speed indicator		X-1	X-1				
altitude			X-1				
angle of attack		X-1	X-1	X-2			
turn coordinator	X-7					X-3	X-3
heading	X-7				X-5	X-3	X-3
slip indicator							X-4
attitude indicator	X-7		X-1		X-5-6	X-3	X-3
air pressure QNH			X-1				
wind data						X-3	X-3
autopilot system	X-7	X-1	X-1	X-2	X-5-6	X-3	X-3

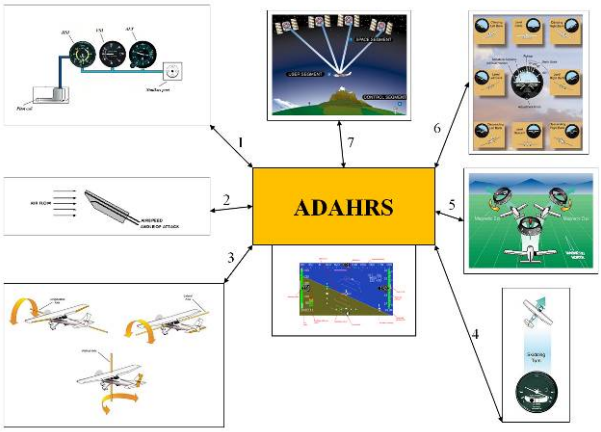

Fig. 5 – The ADAHRS hardware's reference.

The DYNON FlightDEK-D180 is an integrated on-board computer and able to function as Engine Monitoring System (Fig. 6). The principle of work method of the EMS is similar to EFIS. The central panel displays parameters of the engine as RPM[15], manifold pressure, oil temperature, oil pressure, and cylinder head temperature; exhaust gas temperature, fuel pressure, fuel quantity, electrical current. The advantage of EMS arrangement is that all data are shown on one display. During flight the EFIS and the EMS information can be displayed simultaneously on the same display [1,2,3,4].

It is really important fact that all EFIS and EMS info is integrated into one module and subsequently it is not necessary to built up self-contained instruments, and as a result - the weight of instrument panel decreases. Probably, it is the most significant consideration of design light aircrafts.

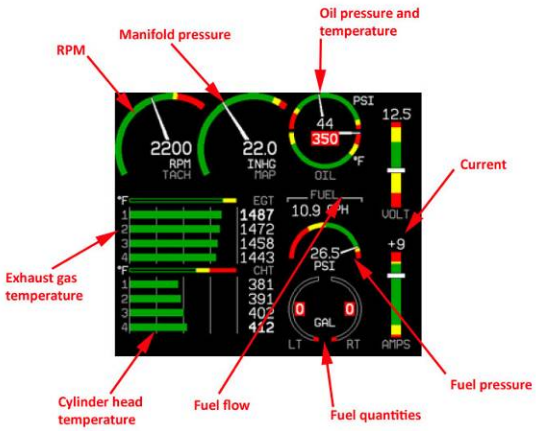

Fig. 6 – DYNON FlightDEK-D180 EMS displayed information

3.3. Applied NAV/COM/GPS system integration with the DYNON FlightDEK-D180 EFIS-EMS on-board computer on the CORVUS planes

The DYNON FlightDEK-D180 equipment is able to communicate with some NAV-COM on-board systems. Thus, this application supports the instrument navigation possibilities.

Obviously, it is an important point of view, that many GAT light categories aircraft are unable to fly in IMC[16], i.e. they are not equipped with anti-ice systems, double pitot-static systems. Without these elements the flight in IMC is not allowed.

The idea of integrated EFIS-NAV-COM applicants is to endorse activities of the pilot. Dynon's EFIS-based instruments include an

[14] AOA: angle of attack
[15] RPM: revolution per minute
[16] IMC: instrument meteorology condition

HSI[17] page whenever connected to a supported external navigation source [1,2,3,4].

The horizontal situation indicator commonly called the HSI is an aircraft instrument normally mounted below the artificial horizon in place of a conventional directional gyro (DG). It provides an easily understood pictorial display and is one of the most popular navigation instruments ever devised.

The HSI page offers a precise navigation tool to guide pilots throughout the enroute, terminal and approach phases of flight. It also reduces pilot workload and offers a cost-effective and space-saving alternative to traditional mechanical HSI or CDI instruments.

In case, when the DYNON FlightDEK is integrated with external NAV or GPS, the HSI can be displayed on the on-board monitor, which is really effective indicator during navigation procedures.

Primarily, the DYNON FlightDEK can be combined directly with GARMIN SL-30 NAV-COM and GARMIN GNS-430/530 GPS-NAV-COM systems, but of course many other similar standardized equipment also available to work together with the DYNON network [4].

The HSI is able to operate in two modes; first combination is the HSI-NAV and the second is the HSI-GPS functions. If data transport happens in HSI mode between DYNON and on-board NAV applications, it is able to indicate course direction, VOR info as OBS[18], NAV, DME[19], TO-FROM INDICATION, in addition if the navigation module is integrated with LOC[20] mode ILS[21] and GLIDESLOPE approach information also can be indicated on the screen.

The HSI operates together with on-board GPS; in this case the course, vertical guidance, aberration, heading, ground speed; ground level and distance from waypoint are indicated. The Fig. 7 is presenting HSI screen in NAV mode and Fig. 8 the HSI-GPS can be seen.

Fig. 7 – HSI in NAV mode

Fig.8 – HSI in GPS mode

[17] HSI: horizontal situation indicator
[18] OBS: omni bearing selector
[19] DME: distance measuring equipment
[20] LOC: localizer
[21] ILS: instrument landing system

The DYNON and NAV-COM-GPS systems communicate via an internal network, which is the DSAB[22]. The preliminary function is the data transport of the DSAB, howbeit really significant, the DSAB can be used in duplicated mode called duplex state. In duplex mode two DYNON FlightDEK computers are on the board, one of them works in EFIS, another one in EMS mode.

The biggest advantage of duplicated operations is that EFIS and EMS functions are separated ones, i.e. the display resolution can be better, and information becomes much more readable.

A duplicated system integration block diagram is shown on Fig. 9, where the main on-board FlightDEK computer is the DSAB Master EFIS, another FlightDEK operates in EMS mode and secondary function of this module is the back-up EFIS.

The DSAB Master is electrified by primary EDC all other equipments are supplied with electric energy via the DSAB network. Two OAT sensors are integrated into one network. EFIS and EMS also have independent external sensors to increase flight safety.

The second FlightDEK is able to work as a back-up EFIS. As the consequence, this on-board applicant has an external electric supply network with an OAT[23] sensor. The HSI channel is wired directly onto the DSAB network and GPS, NAV, COM, DME, MARKERS are integrated with the HS34 HSI module.

The HSI data comes from external panel mounted on portable navigation devices. These devices can either be interfaced to Dynon's EFIS or EMS systems via their single wire serial connection or through Dynon's optional HS34 HSI Expansion Module.

The HS34 module expands the interface to include multiple connections to analogue, and serial signals to facilitate a larger variety of NAV radios and devices. On Fig. 10 the outer connection plugs of DYNON FlightDEK are presented [1,2,3,4].

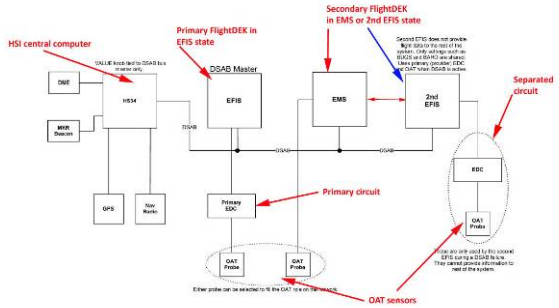

Fig. 9 – Duplicated EFIS – EMS on-board system

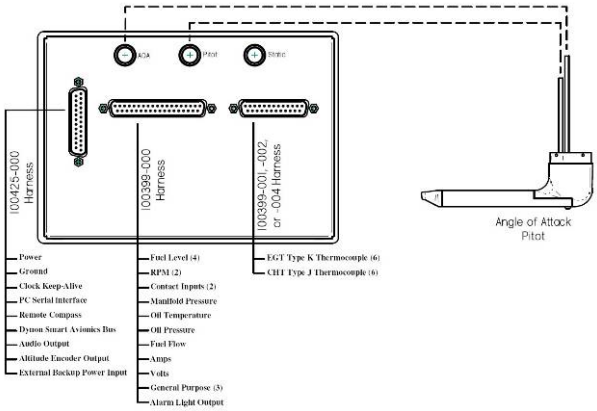

Fig. 10 – DYNON FlightDEK D-180 connector plugs

3.4. Automated flight control – autopilot – systems on CORVUS models

There is a basic procedure in the commercial flight sector to combine the on-board systems with automated flight control (called autopilot) equipments.

The DYNON FlightDEK-D180 computer in HSI mode provides collaboration possibilities with autopilot systems. The integrated EFIS and NAV-COM-GPS navigation module can be combined the DYNON AP (AP is autopilot) assemblies.

The operational base of the DYNON AP is a reference system, which are the HS34 HSI computer and the DSAB network. The DYNON AP is able to control the aircraft automatically around two - the roll and the pitch - axis. The DYNON AP can work in four main modes and fourteen sub-modes.

The four main modes are following ones:

1. AP status HDG[24] OFF / ALT OFF, - the pitch and roll control are switched off;

[22] DSAB: Dynon smart avionics bus
[23] OAT: outside temperature
[24] HDG: heading

2. AP status HDG ON / ALT OFF, - the roll is activated and pitch is in off;
3. AP status HDG OFF / ALT ON, - the roll is inactive and pitch is activated;
4. AP status HDG ON / ALT ON, - both functions are activated.

The output components of the DYNON AP are servos, wires and stop block elements, which must be built up into the aileron and elevator control mechanisms.

The installation method and the location of parts depend on the control surface deflections, gear and transfer ratios and the control system pilot force. The most important aspect is the arising pilot force in the aileron and elevator system.

Redundant servos models are available to suit different aircraft control force requirements, for instance from at 4 Nm to that of 10 Nm of torque. The weights of servos are optimized, especially to light aircrafts requirements. A lightweight aluminium case houses a stainless steel gear train to decrease weight while not sacrificing strength.

The servo control arm is captured by a castellated nut and secured by a cotter pin, just like other critical interfaces in the aircraft. Each servo is managed by its own microprocessor, making the servo an active, smart extension of the autopilot [1].

This simplifies the control-surface-to-servo calibration, and prevents the servo from driving itself endlessly like other servos can.

As an ultimate mechanical failsafe, a simple and effective shear pin is employed to let you break the servo free of the aircraft control surface in an emergency. In next, to concentrate how the roll and pitch modes can work, firstly about activated roll reference cases [1,2,3].

Roll modes:

1. HDG status, this is the HEADING activation, when the magnetic direction of the aircraft is in reference. The AP communicates with the DYNON EFIS heading bag;
2. TRK[25] status, this is the TRACK activation, when the GPS ground track is in reference. The AP communicates with the integrated GPS system;
3. 180° status, this is a special mode, when the aircraft makes a 180° turn back, oppositely the defined flight direction;
4. NAV GPS status, when the reference data coming from the GPS. The AP is able to maintain the flight path to the predefined GPS coordinates, in addition considering wind traverse deviatory effects;
5. NAV VOR status, when the reference point is a VOR station's radial;
6. NAV LOC status, when the reference point is a LOC station and ILS approach can be made with this method.

Pitch modes:

1. ALT MAX AIRSPEED status, when the AOA of plane is controlled as the predefined airspeed can be reached but never had been in overstepped. As follows the pitch, elevator deflection is governed;
2. ALT MIN AIRSPEED status, when everything happens out of accordance beforehand analyzed procedure.

Of course, all presented modes will be combined and pitch and roll modes can be active in same time. On Fig. 11 an installed model is presented, the servo is fixed to the wing rib; the control arm joins to aileron hinge and mechanical input arm of digital transmission of servo.

[25] TRK: track

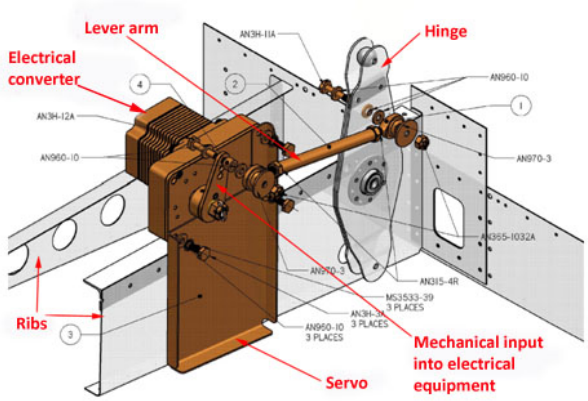

Fig. 11 – Example to installed servo in aileron control system

4. CONCLUSIONS

We have experienced that today in aviation industry sector the development and research activities concentrate on digital electronic, intelligent automatized sub-systems and weight reduction solutions.

Today, question under discussions how to manufacture the light weight constructions with high strength materials, Subsequently once you save weight the fuel consumption can be less, alternative power-driven systems, environment-friend base materials and full-automated on-board systems can be applied.

All aircraft manufacturers must modify the design and production philosophy and apply new on-board integrated automatic systems without traditional cockpit instruments. There is a single possibility to consolidate raison d'être on the market because the number of aircraft in the airspace will be double or even more increased in the future than we can see now.

The safe navigation and the exact quick identification are impossible without modern electronic systems. This trend is actual requirement both in civil and military sectors.

Our viewpoint is we do not have to wait long time that the on-board system's configuration of light and small aircraft will be absolutely same as civil heavy passenger and military cargo aircraft.

Thus, flight-by-light planes will have automatic procedures, which do not depend on the meteorological conditions and other more factors, which are embarrassing effects nowadays.

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AIRBORNE SYSTEMS ON HELICOPTER USED TO VERIFY GUN SHUTING PRECISION FOR AMMUNITIONS

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This paper presents a complex, onboard and ground, data acquisition system used to verify the shooting precision of the ammunitions gun from helicopter.

1. INTRODUCTION

For the instrumentation system it was selected a solution which was focused to provide all the information of interest from different, time synchronized, sources:

A. Data from the 1553 mux-bus of helicopter (onboard),
B. Video signal from video recorder of helicopter (onboard),
C. Video signal from high speed camera system (on ground).

2. ONBOARD DATA FROM MUX-BUS 1553

In order to obtain data of interest from the 1553 mux-bus of helicopter it was utilized an onboard data acquisition system presented in figure 1, with the following

- BU- 65553 PCMCIA card;
- Laptop with DataMARS 3.1.2. software.

The BU- 65553 PCMCIA card together with DataMARS 3.1.2. software permit to acquire a different kind of parameters from one dual-redundant MIL-STD-1553 mux-bus of helicopter. DataMARS software provides a large variety of displays in which on visualize engineering-units and raw monitored data. These include time plots, bars, gauges, sequential displays, raw message displays, quick views and many others. Monitored data is displayed and presented on-line, at high speed. The software controls recording data manually or automatically, using triggers and many other criteria.

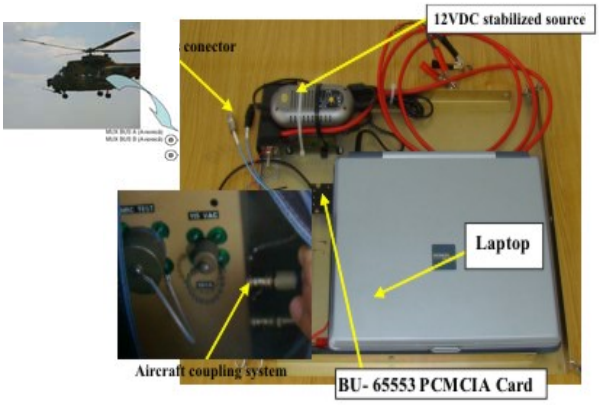

Fig1Onboard data acquisition system of helicopter

During the Monitoring mode or Replay mode the DataMARS software can monitor live communications data or it can replay recorded communications data (from a previously made recording) back to the screen and, in the same time, it can generate reports of recorded data of interest. It can decode the replayed data into engineering-units and it can display these data or it can replay data at various rates, or single-step and back-step through recorded data. It can also skip directly to a time position in the recording, or search for complex engineering-units events in the data. Figure 2 illustrates the data flow in dataMARS during the Monitoring or Replay mode. DataMARS generates reports

of recorded data for distribution and presentation of various events in the recorded data. Reports may also be imported into third-party tools (e.g., Excel® and MatLab®) for further analysis. Figure 3 illustrates a generated reports for some of parameters of interest which flow on the 1553 Avionics mux-bus of helicopter and figure 4 shows some flight parameters obtained from data report recorded in shooting test.

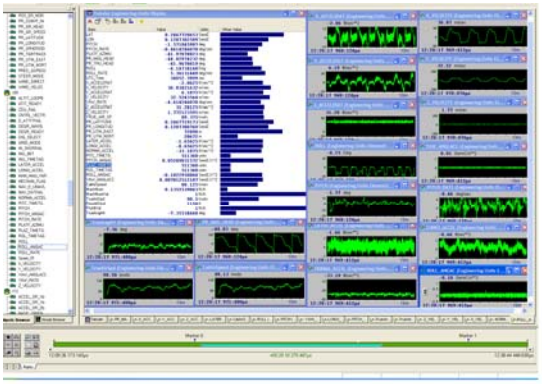

Fig. 2 Variety of displays used in monitoring and replay mode.

Time	LON	LAT	ROLL_ RATE	ROLL	PITCH_RAT E	PITC H	NORMA_ ACCEL	LONGI_ ACCEL
H M S MS	grd	grd	grade/se c	grade	grade/sec	grade	m/s**2	m/s**2
11:05:59 500	23.14967594	44.42781785	1.21	-23.25	3.12	-1.63	-11.14	0.38
11:05:59 550	23.14968543	44.42779539	1.05	-23.18	3.16	-1.66	-11.36	0.37
11:05:59 600	23.14968543	44.42779539	1.03	-23.11	3.12	-1.69	-10.77	0.40
11:05:59 650	23.14969531	44.42777293	1.23	-23.03	3.10	-1.72	-10.89	0.47
11:05:59 700	23.14970377	44.42775071	1.30	-22.95	3.47	-1.73	-10.88	0.25
11:05:59 750	23.14970377	44.42775071	1.41	-22.86	3.43	-1.75	-11.10	0.25
11:05:59 800	23.14971434	44.42772841	1.32	-22.77	3.60	-1.77	-11.38	0.21
11:05:59 850	23.14972516	44.42770629	1.34	-22.69	3.34	-1.79	-11.13	0.35
11:05:59 900	23.14972516	44.42770629	1.76	-22.60	3.41	-1.80	-11.86	0.40
11:05:59 950	23.14973639	44.42768415	2.00	-22.49	3.38	-1.81	-11.53	0.34
11:06:00 000	**23.149736**	**44.4276842**	**2.29**	**-22.36**	**3.30**	**-1.83**	**-12.09**	**0.35**
11:06:00 050	23.14974787	44.42766219	2.44	-22.21	3.52	-1.83	-11.55	0.49
11:06:00 100	23.14975977	44.42764032	2.59	-22.07	3.43	-1.84	-11.49	0.48

Fig.3 Data reports from helicopter

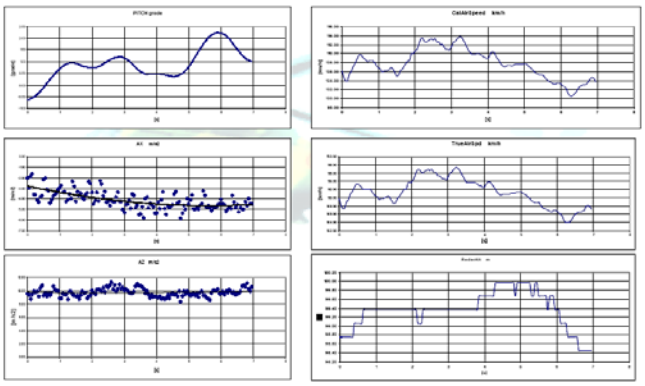

Fig.4 Flight parameters obtained from data report recorded in shooting test

3. VIDEO SIGNAL FROM ONBOARD SOURCE

Video signal from the video-recorder of helicopter are analyzed with TEMA Motion software, which is the world leading system for camera control and advanced motion analysis on military test ranges. Starting with digital image sequences it uses TEMA to track objects in images, make analysis of the movement and present result in tables and graphs. TEMA Motion covers the entire process from digitizing images (film or video) through automatic tracking and advanced motion analysis to a complete predefined report. The implemented functionality handles tracking in several levels, from 2D, 3D and 6D to the most sophisticated range motion analysis tracking requirements. The operator can choose between a large numbers of tracking algorithms and track an unlimited number of points through the image sequence. The result can be presented in any of a large number of predefined graphs and tables. Free scaling for print outs makes it very easy to design reports or images. Bellow in figure 5 are presented some images which were preserved from helicopter HUD during shooting tests. Points #1 and #2 are used for distances calibration (here target has 8 meters). Shooting point was marked as Point #3 and targeted point was marked as Point #4. By angular transformations on distances between these points on calculates shooting precision. After tracking and analysis TEMA can export the result to several different formats like: Excel, CASDAS, DIADEM, ISO, Matlab or

ASCII files. In figure 6 are presented the results of the evaluation of shooting precision of the ammunitions gun from helicopter.

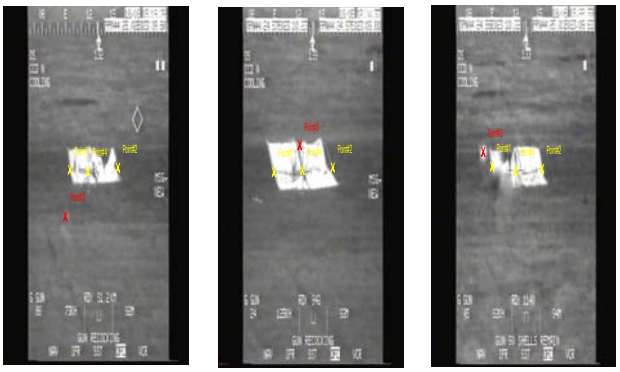

Fig.5 Images from the helicopter HUD in shooting tests.

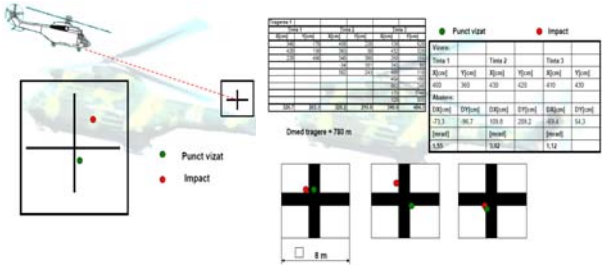

Fig.6 Evaluation of shooting precision of the ammunitions gun from helicopter.

4. VIDEO SIGNAL FROM GROUND SOURCE

On the ground it was utilized a X-Motion high speed camera (fig.7) connected to a laptop to capture video images from shooting tests (fig.8).

X-Motion high speed camera can record images into his own memory. After finish recording, these images are transferred on a flash memory or on a laptop HDD via network connection. Camera are controlled by a dedicated software, AOS Imaging Studio V2, running on laptop. Images acquired from X-Motion high speed camera in the shooting time are analyzed with TEMA Motion software.

Fig.7 X-Motion high speed camera with its accessories

Fig.8 Ground high speed video capture of the shooting process

In conclusion all the information obtained during tests: flight data, provided by mux-bus 1553 recordings, onboard video data analyzed from HUD images, and ground video data, analyzed from X-Motion high speed camera images, must be properly correlated to obtain a correct final results in the evaluation of shooting precision of the ammunitions gun which is mounted on the helicopter.

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UNBALANCE IN ELECTRICAL NETWORKS AS INDICATOR OF POWER QUALITY

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Abstract: *In the paper a model of the unbalanced regimes analysis produced by the low voltage nonlinear consumers is presented. With the method of symmetrical components, in the hypotheses of symmetrical voltage system, the mathematical model for the three phase network with null conductor is described and the relationships between the complex quantities components of positive, negative and zero sequences of currents are established. To verify the method, a stand was designed and realized and the experiments for balanced / non-balanced regimes with linear/nonlinear consumers have been proposed. In the hypotheses of the three phase network of balanced voltages, different cases have been analyzed, measuring the values and waveforms of intensity of the electrical currents on every phase and null, as well as the phase change corresponding to every case. The procedure for monitoring the voltage and current unbalance was verified and unbalance factors are established.*

Key words: *unbalance, electrical network, quality indicator, monitoring method.*

1. INTRODUCTION

The unbalance of the three voltage system in electrical networks is defined by the inequality of the effective values on the three phases, by the existence of a phase change different from 120^{o} or by the existence of different harmonic levels on the three phases of the network.

The causes of the voltage system unbalance in electrical networks may be:

- Structural, determined by the different value of the impedances on the three phases (lines, cables, transformers etc.);
- Functional, determined by the unequal distribution of the single phase consumers on the three phases (street lighting, household consumers etc.), by two phase consumers (devices for electric welding, electric induction furnaces at industrial frequency, electric traction etc.), by three phase receivers with variable electrical load (arc furnaces), non-linear receivers.

The unbalance effects are multiple. Disturbances occur, because of the unbalanced system, both in electrical equipment (rotary electrical machines, transformers, condenser batteries, static power converters), and in electrical networks.

The unbalance effects upon electrical receivers are multiple: heating, insulation deteriorations, abnormal functioning, protection faults etc. The effects are different in the case of the balanced or unbalanced three phase consumers, depending on the type of connections (wye with working null, wye without working null, delta etc.).

In rotary electrical machines, the unbalance of the feeding voltages causes supplementary heating, pulsating torques of high frequency, vibrations, which leads to the diminution of the active torque, of the speed and finally, of the lifetime.

Voltage unbalance causes the reduction in the reactive power supplied by the capacitor battery [1].

The current unbalance mainly effects in the production of supplementary losses within transport and distribution electrical network, as well as in industrial networks, with negative consequences upon the energy transfer efficiency.

The researches carried out so far [2,3,4,5] refer to the unbalance influence upon the functioning characteristics of the equipment fed with unbalanced voltages, as well as to the influence upon the technical and economic parameters of the transport and distribution networks, and also upon the generators within the system.

The measures taken for reducing the unbalanced regime [1] depend on the unbalance character:

- temporary asymmetries, if the disturbance is determined by faults or by short term operating conditions (asymmetrical circuits, phase interruption, faults in the consumers);
- permanent asymmetries, if the network presents different circuit parameters on the three phases under normal operating condition.

These measures apply according to the characteristic indicators of the unbalance regimes.

2. INDICATORS OF ELECTRIC UNBALANCE

Two definitions on wide scale exist for the voltage unbalance, given by IEC (International Electrotechnical Commission) and NEMA (National Electrical Manufacturers Association) [2].

According to IEC 61000-4-30 [3], the definition of the factor of unbalance voltage K_{2U} represents the ratio between the negative and positive sequence of voltage.

$$K_{2U}[\%] = \frac{U_2}{U_1} \cdot 100 \qquad (1)$$

where: U_2 – negative sequence voltage; U_1 – positive sequence voltage.

The factor of voltage unbalance may also be determined, knowing the line voltages U_{ab}, U_{bc}, U_{ca}, with the relation:

$$K_{U2}[\%] = \sqrt{\frac{1-\sqrt{3-6\cdot\beta}}{1+\sqrt{3-6\cdot\beta}}} \qquad (2)$$

where:

$$\beta = \frac{U_{ab}^4 + U_{bc}^4 + U_{ca}^4}{\left(U_{ab}^2 + U_{bc}^2 + U_{ca}^2\right)^2} \qquad (3)$$

Another relation for the factor of unbalance voltage is submitted by NEMA and by IEEE 1159-95:

$$K_{2U}[\%] = \left|\frac{U_{med} - U_{\max}}{U_{med}}\right| \cdot 100 \qquad (4)$$

where: U_{med} is the average of the line voltages and $U_{\max}$ is the line voltage of the highest value.

The factor of zero unbalance voltage is the ratio between the zero sequence voltage and the positive sequence voltage.

$$K_{0U}[\%] = \frac{U_0}{U_1} \cdot 100 \qquad (5)$$

The quality of the absorbed current may be characterized through the following indicators [4]:

- Factor of negative unbalance, defined by the relation:

$$K_{2I}[\%] = \frac{\underline{I}_2}{\underline{I}_1} \cdot 100 \qquad (6)$$

- Factor zero unbalance, defined by the relation:

$$K_{0I}[\%] = \frac{\underline{I}_0}{\underline{I}_1} \cdot 100 \qquad (7)$$

The factor of current unbalance K_{2I} may be also expressed with a relation of the type (2), if we know the line currents I_{ab}, I_{bc}, I_{ca}.

Determining the components of zero, positive and negative sequence for the intensity of the phase currents is done with the relations [4]:

$$\left(I_0\right)^2 = \left(I_R^2 + I_S^2 + I_T^2 + 2I_R I_S \cos\varphi_{RS} + 2I_S I_T \cos\varphi_{ST} + 2I_T I_R \cos\varphi_{TR}\right)/9$$
$$\left(I_1\right)^2 = \left[I_R^2 + I_S^2 + I_T^2 + 2I_R I_S \cos\left(\varphi_{RS} - \frac{2\pi}{3}\right) + 2I_S I_T \left(\cos\varphi_{ST} - \frac{2\pi}{3}\right) + 2I_T I_R \left(\cos\varphi_{TR} - \frac{2\pi}{3}\right)\right]/9 \quad (8)$$
$$\left(I_2\right)^2 = \left[I_R^2 + I_S^2 + I_T^2 + 2I_R I_S \cos\left(\varphi_{RS} + \frac{2\pi}{3}\right) + 2I_S I_T \left(\cos\varphi_{ST} + \frac{2\pi}{3}\right) + 2I_T I_R \left(\cos\varphi_{TR} + \frac{2\pi}{3}\right)\right]/9$$

According to IEC 61000-4-30, the following levels of compatibility are adopted for the case of low voltage network (LT), for levels of medium voltage (MT), and high voltage (HT):

- for LT, $K_{2U} \leq 2$ %
- for MT, $K_{2U} \leq 2$ %
- for HT, $K_{2U} \leq 1$ %.

Within the standards adopted in different countries, such as Great Britain, the values above are: for LT $K_{2U} \leq 2\%$, for MT $K_{2U} \leq 2\%$ and for HT $K_{2U} \leq 2\%$ [5].

In this paper, three cases are studied wherein the feeding voltages on consumers as well as the voltage (current) phase change modify, because of the receiver non-linear character.

3. STAND FOR UNBALANCE MODELING AND SIMULATION

For modeling and simulating the unbalance regime for feeding the consumers in low voltage networks, a stand was designed and achieved, with the following characteristics:

- feeding voltage $U = 230$ V,
- frequency $f = 50$ Hz,
- maximal apparent power $S = 500$ VA.

The stand allows carrying through experimental studies and measuring, upon:

- Characterizing the unbalance through measurements and calculating the zero and negative unbalance factors;
- Analyzing the asymmetric regime caused by non-linear consumers;
- Studying the connection between the zero sequence components and the current on the null conductor;
- Checking the calculation method of the symmetrical components of zero, positive and negative succession, for the system of three phase feeding voltages.

The electrical scheme of the stand is shown in Fig. 1.

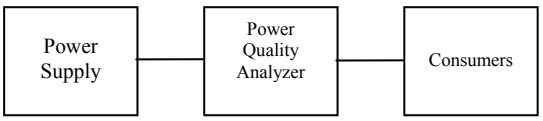

Fig. 1 Scheme of the stand for electrical unbalance modeling and simulation

The stand contains:

- Feeding source, ensuring the protection against short-circuit and overload,
- Analyzer, for the electrical energy quality monitoring,
- Single phase consumers, linear and non-linear.

4. EXPERIMENTAL DETERMINATIONS

In the hypotheses of the three phase network of balanced voltages, the analyzed cases are:

A. Case of connection of several linear single phase consumers, of similar power on the phase, shown in Fig. 2;
B. Case of connection of linear single phase consumers (of similar power on the phase) and non-linear (on all phases, of the same level of harmonic pollution), represented in Fig. 3 ;
C. Case of connection of linear single phase consumers (of similar power on the phase) and non-linear (on R phase), shown Fig. 4.

The results of measuring the intensity of the electrical currents on every phase and null, as well as the phase change corresponding to every case (A, B, C) are rendered in Table 1.

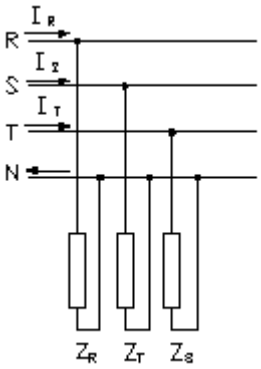

Fig. 2. Balanced three phase load, consisting in three single phase linear loads

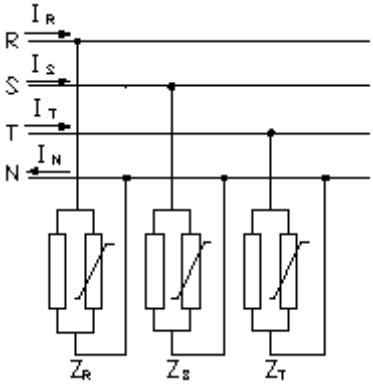

Fig. 3. Balanced three phase load consisting in single phase (linear and non-linear) loads

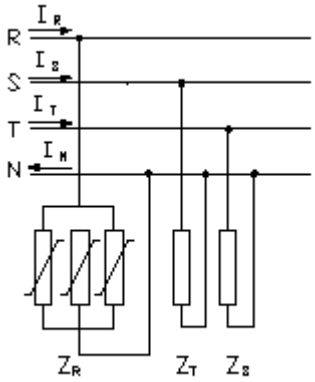

Fig. 4. Balanced three phase load consisting in three single phase (non-linear on *R* phase and linear on S phases) loads

In Table 1 the measurement values of the intensity and phase of the electrical currents of the balanced resistive three phase consumer (wye connection with neuter conductor) I_R, I_S, I_T - the phase currents on consumers and I_N – the current on the consumer's null are presented.

Table 1. Currents measurements for A, B, C cases

I_R [A]	I_S [A]	I_T [A]	I_N [A]	φ_R	φ_S	φ_T
1.74	1.74	1.73	0.045	0.3	-121.6	118.6
1.75	1.79	1.81	0.15	1.8	-121.9	116.8
2.58	2.19	2.17	0.64	0.4	-118.6	114.4

In Table 1, the influence of the non-linear consumers (the 3 data range - case C) on the electrical energy quality may be noted, through the uneven values of the electrical current intensity between the phases and through the apparition on the null of a current of significant value.

The results of the calculation for the symmetrical components, resorting to the relations (8) for every case in part, are rendered in Table 2.

Table 2. Current symmetrical components

Analyzed cases	I_0 [A]	I_1 [A]	I_2 [A]
A	0.015	1.74	0.021
B	0.05	1.78	0.049
C	0.213	1.85	0.071

The values of the unbalance current factor K_{2I} calculated with the relations (6), (2) and (4) are submitted in Table 3.

Table 3. Unbalance current factor

Analyzed cases	K_{2I} (6)	K_{2I} (2)	K_{2I} (4)
A	1.2	0.38	0.19
B	2.7	1.97	1.49
C	3.9	11.96	11.53

In the case A, the admitted maximal value will not be reached, whatever the calculation formula might be.

In the case B, according to IEC 61000-4-30 [6], through the use of the calculation formula, (6) and (2), with the components of negative and positive sequence, the negative unbalance factor is null. The zero unbalance factor is null in the cases A and B, and in the case C, the maximal values are exceeded. By using the calculation relation (4) with line voltages according to IEEE 1159-1995 [7] the maximal admitted values are not exceeded for the negative unbalance factor in the cases A and

B; however in the case C, the maximal admitted values are exceeded.

The measurement results for the phase voltages and neutral, as well the phase change, corresponding to every case in part, is rendered in Table 4.

Table 4. Voltage measurements for A, B, C cases

U_{RN} [V]	U_{SN} [V]	U_{TN} [V]	U_{N0} [V]	φ_R	φ_S	φ_T
232.5	233.6	234.7	0	0	-119.8	119.1
233.3	233	233.5	0	0	-119.8	119.4
232.6	235	232.4	0	0	-119.6	119.6

The results of calculation for the symmetrical components as well as for the unbalance factors corresponding to every case in part are rendered in Tables 5 and 6.

Table 5. Voltage symmetrical components

Analyzed cases	U_0 [V]	U_1 [V]	U_2 [V]
A	1.091	233.6	1.852
B	1.045	233.3	0.931
C	0.949	233.3	1.505

Table 6. Unbalance voltage factor

Analyzed cases	K_{2U}		
	(1)	(2)	(3)
A	0.54	0.47	0.79
B	0.12	0.1	0.39
C	0.71	0.71	0.64

In the case of three phase electrical network of low voltage which feed a balanced three phase receiver with wye connection with neutral conductor, the voltage on the null conductor is zero; consequently the null displacement does not occur.

In the case of the voltages, the maximal admitted values of the unbalance voltage factor are not exceeded. The Romanian standard PE 143/2001 [8], aligned to the international standards, settles the necessity for the statistical analysis upon voltage unbalance and fitting within the limit of 2 % of the total unbalance factor along 95% of the observation period (generally, a week).

The waveform of the currents and of the phase voltages corresponding to the case B are shown in Fig. 5 and Fig. 6.

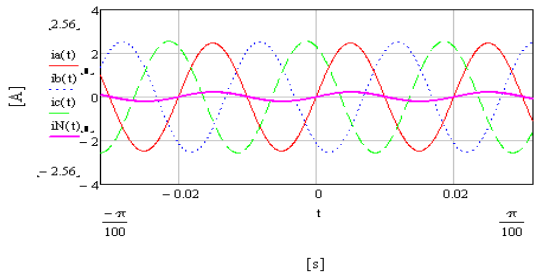

Fig. 5 Waveform of the phase and null currents in the case B

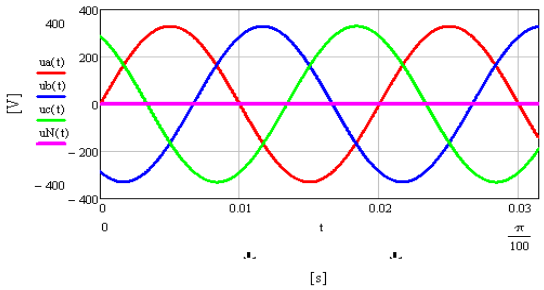

Fig. 6 Waveform of the phase voltages in the case B

The waveform of the currents and of the phase voltages corresponding to the case C are submitted in Fig. 7 and Fig. 8.

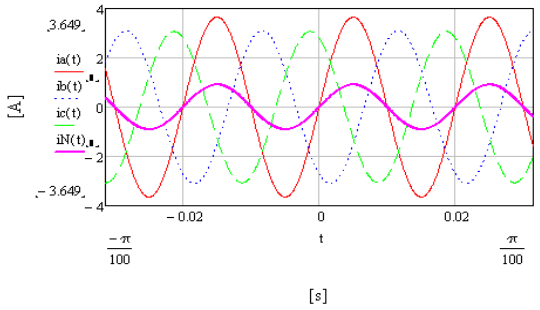

Fig. 7 Waveform of the phase and null currents in the case C

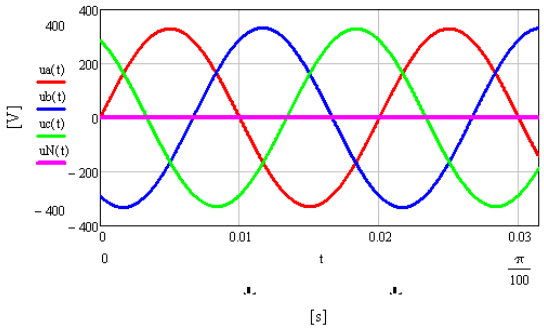

Fig. 8 Waveform of the phase voltages in the case C

From Fig. 5-8, the following observations may be made:
- The consumers' non-linear character does not influence to a great extent the unbalance voltage factors on the consumers;
- The consumers' non-linear character modifies the waveform of the phase currents;
- A current appears on the null, having an equal value to three times the zero unbalance factor of current.

5. CONCLUSIONS

The unbalance regime may be determined by:
- uneven distribution on the three phases of the single phase receivers,
- existence of unbalanced two phase and three phase receivers,
- different levels of pollution with harmonics on the phases.

The variations of the phase change angles of the three phase voltage system result in great variations of the voltage unbalance factor values. For instance, a modification of 2^0 may lead to unbalances of 2 %.

Due to the rise of the number of single phase loads with non-linear character and to the development of power electronics, which bring along unbalance, the periodical monitoring and analysis (monthly, yearly) are compulsory upon the operating condition in the consumers, aiming at:
- determining the distortion level of the voltage and current waves and, respectively the unbalance level for voltage and current;
- determining the previously specified indicators, corresponding to the operating condition;
- determining the measures which is incumbent on the supplier and respectively on the consumer for eliminating or diminishing the effects unbalances.

The experimental determinations carried through with the proposed stand allow verifying the procedures for monitoring the voltage and current unbalance.

The calculation of the voltage negative unbalance factor with the relations proposed by the standards IEC 6100-4-30 and IEE 1159/95 leads to obtaining different values, with differences from 0.19 % to 0.48 %.

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WIRELESS PULSE OXIMETRY

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Abstract: *The implemented solution is part of the BIOMED-TEL project and this system combines two methods that represent the basis pulse-oximetry: spectrophotometry with role in measuring the concentration of hemoglobin (the light absorption is a function that depends on the level of blood oxygenation) and optical pletismography with role in measuring the pulsatile changes in the level of arterial blood (changes that are due to the variations in the level of arterial blood in tissues and dependent on the systolic-diastolic cardiac regime). This way the pulse-oximetry is defined as being o method noninvasive of monitoring the saturation with oxygen of the hemoglobin (blood component that has the role of transporting oxygen through tissues). The product is remarcable trough it's small dimmensions, mobility offered to the patient and low power consumption that makes possible the long on-time of the device.*

Key words: *pulse-oximetry, wireless, sensor, battery powered*

1. INTRODUCTION

The optical proprieties of the tissues are used in biomedical applications for diagnosing, treatment and surgery. Certain processes can take place as many times as the tissue is irradiated with light, these processes being able to include reactions: photo-thermic, photo-chemical, fluorescence, reflection and optical transmittance. These processes are not dependent on energy, for example the incidental power is equal to the sum of reflectance, absorption and transmittance.

For the pulse-oximetry application, the interesting term is the one of the time dependent absorption, by blood, due to the pulse, this way generates a lack of transmittance.

The oxygen saturation from blood, SO_2, is defined by the concentration of oxygenated hemoglobin (HbO_2) related to the sum of oxygenated and unoxygenated hemoglobin (HB):

$$SO_2 = \frac{C_{HbO2}}{C_{HbO2} + C_{Hb}}$$

The result given by a pulse-oximeter is an estimation of the concentration of functional arterial oxygen and should be interpreted as "the concentration of arterial oxygen measured by pulse-oxymetry" or S_pO_2. In total there are three terms that denote the saturation of functional oxygen from blood:

- SO_2: the saturation of oxygen from blood
- S_aO_2: the saturation of oxygen from the arterial blood
- S_pO_2: the saturation of oxygen from the arterial blood measured by the pulse-oximeter.

Figure 1 presents the optical measure of the cardiac rhythm that is also called photopletismogram, where photo denotes (shows) the fact that an optical method is used, and pletismogram refers to the fact that the variations are caused by changes in volume (here of blood vessels) due to blood pressure.

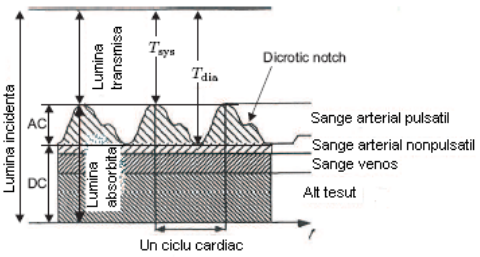

Fig. 1 Changes in the areterial volume caused by the arterial pulse

The blood as well as the skin, bones and tissue concur to the absorption. Only the arterial blood has an AC component because of the pulse. On the graphic, diastole state (the minimum) and systolic state (the maximum) can be observed together with the dicrotic notch (small plateau at the middle of the descent). The signal presented is inversed in comparison with the signal from the photo-detector, inversion made to determine a rise of the signal of the increasing pressure in blood (which is more intuitive for medical use).

2. PULSE-OXIMETER SpO_2

The bio-physical signal is captured at the level of a segment of the body (the forefinger or the earlobe) through the use of the pair LED-photodiode (optical principle). Two LEDs with two different wave lengths 660 nm (red) and 940 nm (infrared) are used due to the light absorption's different coefficients of the component elements of the hemoglobin: oxyhemoglobin (HbO_2) and the reduced hemoglobin (Hb). The LEDs work alternatively, the duration of the light pulse/ LED is of 50 μs, and the work frequency is of 1kHz (much bigger than the cardiac frequency). The resulted signal, synchronous systolic-diastolic cardiac cycle is processed through levels of conversion, amplification, gear and filtration, like this resulting the signal needed for the subsequent processes.

The signal sizing and the optimization are made through direct comparative tests, with commercial or hospital pulse-oxymetrical systems made available by the team of doctors involved in the project.

2.1 Red/Infrared Sensor

The central element of the pulse-oxymetrical system is the acquisition sensor. This is provided with two leds, a red one and an infra-red one and a photo-detector diode, Fig.2**.**

The sensor must be of high quality, and for this purpose a well compatible with a series of commercial pulse-oximeter was acquisitioned. It was done this way because we wish for the acquisition of a precision and quality of the bio-physical signal as high as possible.

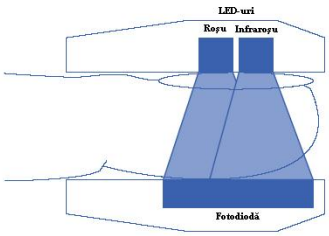

Fig. 2. Sensor with LEDs and photodiode

Its purpose is to emit two different wave lengths through the tissue. The red led emits 660 nm and the infra-red one emits 940 nm. Depending on the level of blood oxygen a certain part of the light beam will be absorbed by the tissue, the rest being detected by a photo-diode.

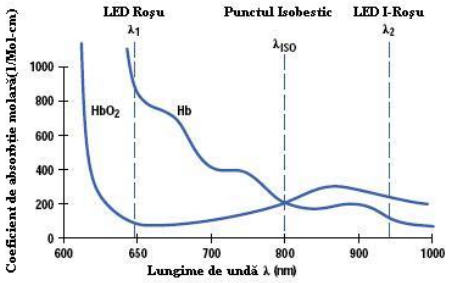

Fig. 3. Light absorbtion at different wave lenghts

The acquisition sensor of the signal, SF-1011N, Fig.3, is produced by Nuova GmbH from Germany. It is a reusable sensor, compatible with a series of pulse-oximeters produced by Nellcor: NPB40, NPB75, N-100 etc.

2.2 Method

To capture the useful/practical signal a non-invasive method is used because of the use as an acquisition sensor of the signal of the well provided with two LEDs and a photo-detecting diode, elements that don't produce a violation of the integrity of the human body nor contraindications or adverse effects subsequent to their use.

The method is based on the *Beer-Lambert principle*, Fig. 5, according to which the signal detected by the photo-detector (transmitted light) is the difference between the emitted signal (incidental light) and the tissue

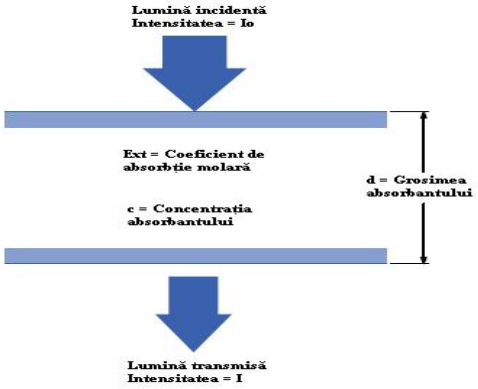

Fig. 5. The light absorbtion in tissue

absorber. The absorber holds a series of tissue intrinsic factors: the coefficient of the molar absorption, the concentration of the tissue, the thickness of the tissue.

In the project it was used a sensor (SF-1011N) that has the following characteristics:

Measurement techniques	Dual wave length
Cable length	1,0 m
Connector	Sub-D9 header
Measurement range	0-100% SpO2
Pulse range	20-250 bpm
Precision	80%-100% ± 2 digits, 70%-79% ± 3 digits, 0%-69% NA
Operating temperature	5-40 ^{0}C
Application	Adult, > 40kg,forefinger

3. PULSE OXIMETER HARDWARE

The current to voltage amplifiers have a double role: to *convert* the current detected by the photo diode in voltage and to *amplify* the detected signal. The signal detection will be made with the photo diode reverse polarised, in photoviltaic mode (Fig. 6).

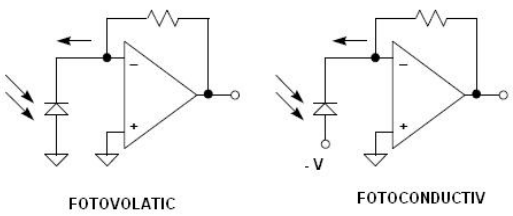

Fig.6. Operating modes of the photodiode

This setting in comparison to the photo-conductive mode presents the advantage of linearity, Jonson noise elimination and signal precise measurement at the expense of the acquisition speed.

The detected signal is of the order of tens of 10^{-9} ampers.

The operational amplifier in this level is AD8618. Compared with the operational amplifiers with bipolar transistors on input, this operational amplifier with CMOS has a few advantages: very high entry impedance, very low/small values of the voltages and offset currents, a very good value of the rejection report of the common mode and also very good slew rate and gain-bandwidth product.

The detected signal will so be amplified and displayed at the exit AD8618. Due to the use of the diode as well as of the amplifier in reverse configurations, the signal phase will not be modified. The estimated current consumption is of 1.7mA.

3.1. Analogue signal filters

To configure the filters some information offered to the collaborator doctors' team of this project referring to the values of cardiac pulse must be taken into account:

- Adult, healthy person: 60-100 beats per minute (BPM)
- Athlete, standing: under 60 BPM
- Athlete, in case of physical effort: 150-200 BPM
- Adult, during sleep: 40 BPM
- New-born and children: average 110 BPM

Considering all these information we have configured the central frequencies of the filters as follows: low pass filter 0.1 Hz and band pass filter 1.2 Hz (72 BPM).

3.2. Low Pass Filter

The low pass filter presents importance in the *separation of the direct component* of the signal (DC) from the rest of the detected signal. The continuing value will be processed the microcontroller and will be used to calibrate the value of the current through leds depending on the patient's tissue characteristics.

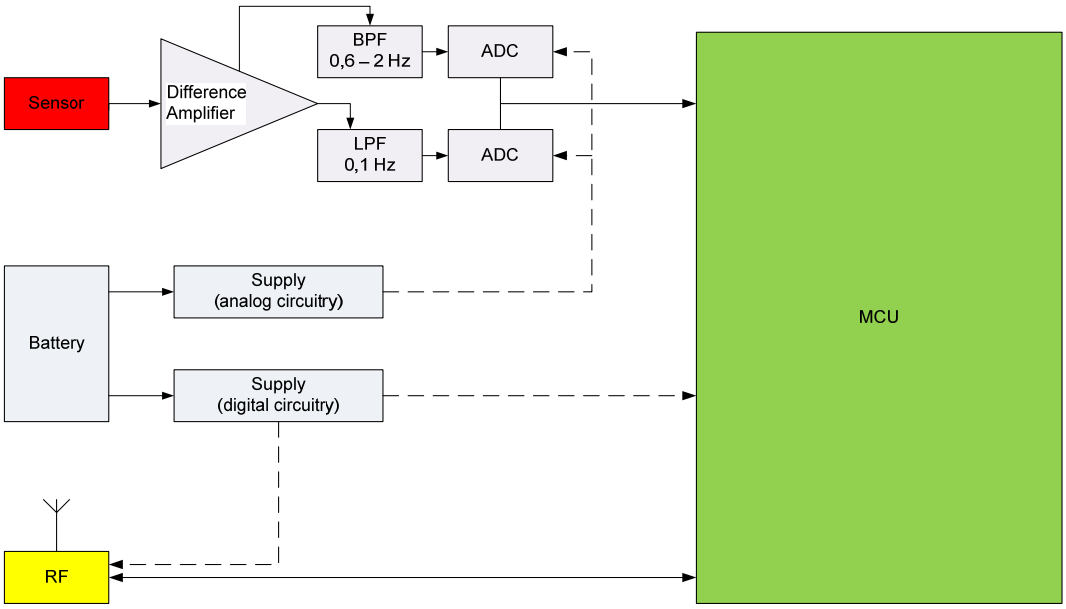

Fig.7. Block diagram of the wireless pulse-oximeter

A second order filter, Sallen-Key, with a falling slope of 40 dB/decade will be used. The Sallen-Key topology allows a better independence of the filters performance compared to the amplifiers performance, other topologies have a lower independence. The filter with *Bessel* answer for its characteristics at pulse like signal will be configured.

The operational amplifiers of the filter are differentially powered at ±5 V. the estimated consumption is of 1mA.

The filter cutting frequency is designed (through an attentive selection of the values of the passive elements, filter components) at 0.1 Hz to allow the weakening of any pulse signal.

3.3. Band Pass Filter

The band pass filter has a role in the weakening of the direct component (DC) of the signal and the *separation of the pulse component* (AC) that follows the systolic-diastolic cardiac system. This value will be amplified, processed and used in the determination of the value of the blood oxygen saturation.

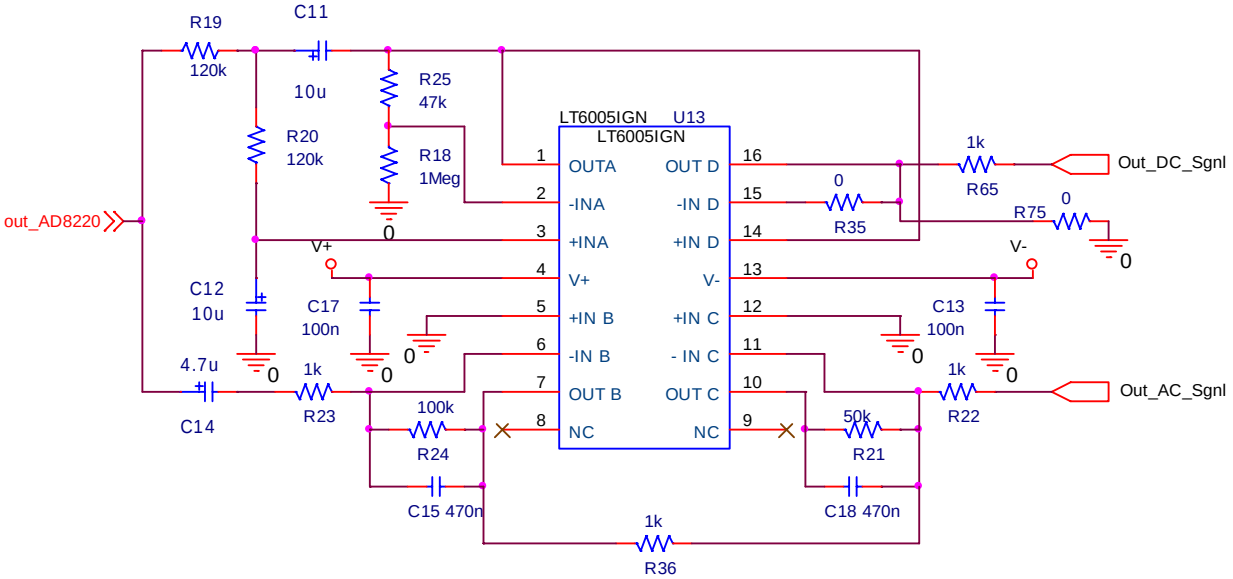

Fig.8. 4th order Low Pass Filter f_{cut}= 0.1Hz (OA A and D)
Band Pass Filter central F=1.12Hz (OA B and C)

A fourth order filter Sallen-Key, with a falling slope of 80 dB/decade will be used. The filter with *Bessel* answer for its characteristics at pulse like signal will be configured. The reasons for choosing this type of filter were presented in the Low Pass Filter.

To configure a fourth order filter, two second order filters will be serial connected. The operational amplifiers of the filter are differentially powered at ±5 V. the estimated consumption is of 1mAh.

3.4. Digital Analog Convertor

The Digital-to-analog converter has the role of converting the analogue signals, red and infrared. The digital signals will be used further by the microcontroller and passed trough the wireless module to the data centralizer (PDA). For this project the A/D converter AD1110 was used.

Samples / seccond	Bits
15	16
30	15
60	14
240	12

3.5. LEDs control and current source circuit

This circuit (Fig. 9) is realized with two complementary pairs of transistors configured in H-bridge which has a double role:

- Alternate command for the LEDs
- Constant current trough the LEDs

The supply of the current source is made unipolar with +5V. Current consumption of this block is 3mA.

3.6. Radio frequency circuit

Has the role of transmitting the data gathered from the pulse-oximeter sensor to the data centralizer of the entire system.

For this interface we have decided to use the CC1000 circuit because of its nice to have features: low power consumption, possibility of manual configuration and lack of low level stack implemented on the RF controller, and high enough data transfer rate (76.8kbps).

This circuit is supplied with 3.3V and it uses SPI interface for data communication (Fig. 10).

3.7. Control circuit

In order to be able to keep the power consumprion of this module as low as possible we have used an Atmel microcontroller from picoPower familly, which uses only 0.5mA.

This device has the role of handling the data taken from the ADCs and transmitt them trough the SPI interface to the wireless module, it also handles the power management of the entire system and process information comming from the centralisator of the system.

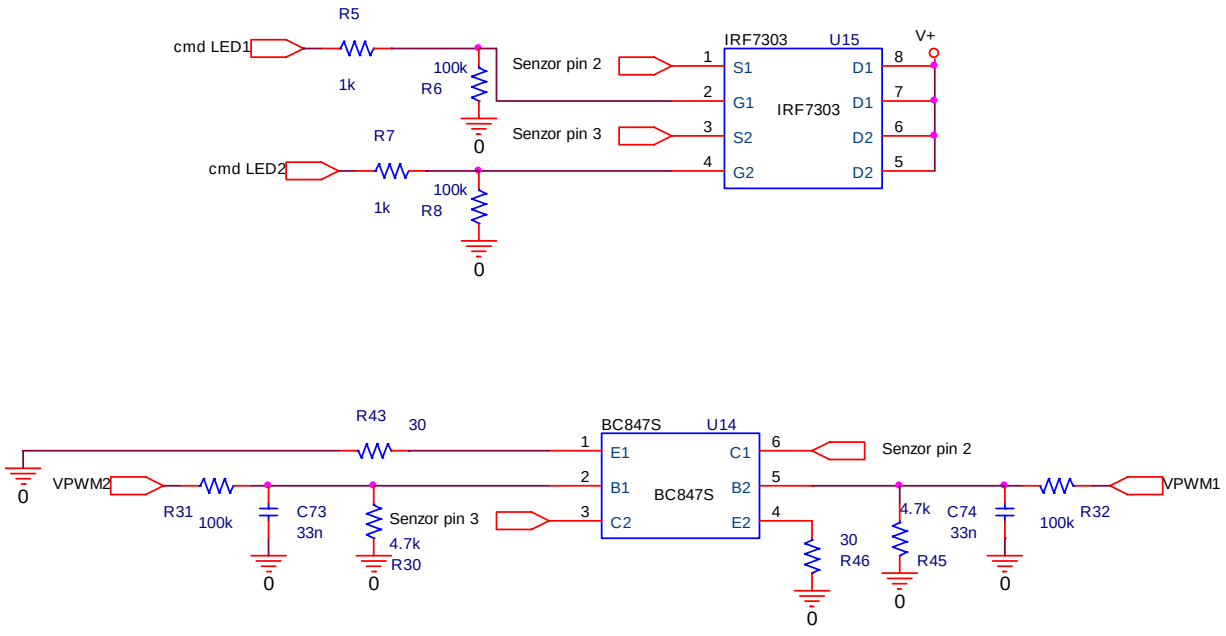

Fig.9. Structure of LEDs control circuit

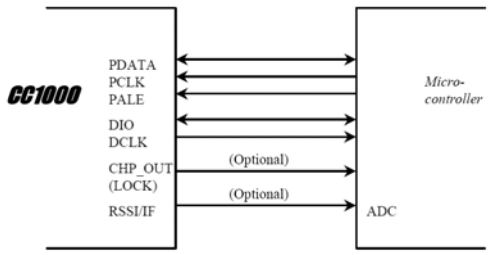

Fig.10. Interface MCU – CC1000

3.8. The supply circuit

The supply circuit (Fig. 11) converts the voltage from the two Li-Ion batteries.

In order to obtain the three voltages required for the entire system there were used switiching regulators, which have a greater efficiency than the linear regulators.

The two LT1615 are generating:

- +3,3V, efficiency 70-75%
- +5V, efficiency 75-80%

The LM2611A is generating:

- -5V, efficiency 75-80%.

The performace of this supply is remarcable also trough the low noise at the output of the regulators 1mVp-p.

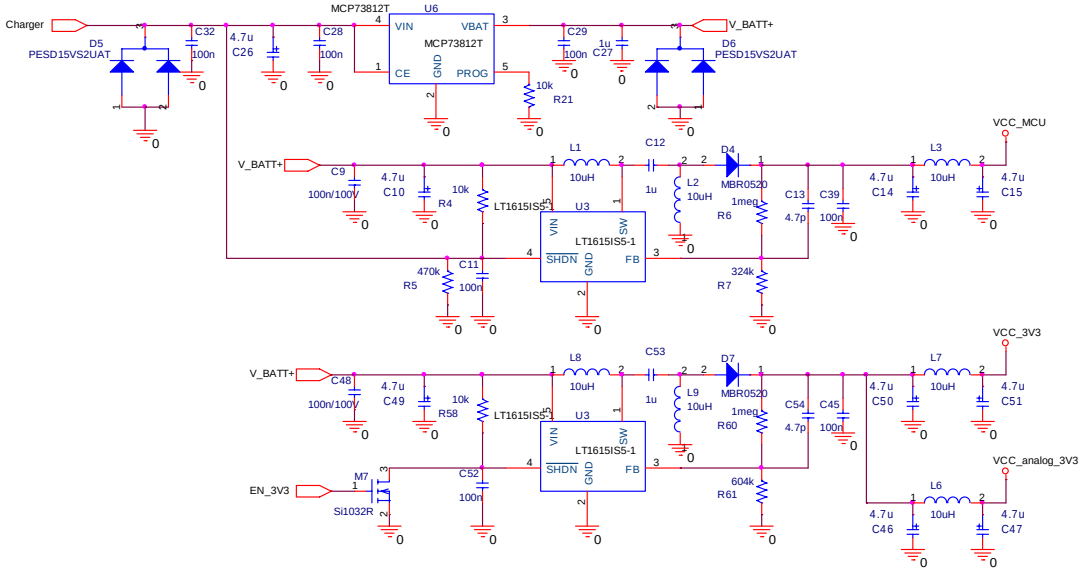

Fig.11. Supply circuit of the pulse-oximeter

4. CONCLUSION

This pulse-oximeter is a wireless solution embedded intro the BIOMED TEL research project, which will monitor along with this biomedical parameter other important characteristics of the patient and all of them will be centralized and will be available in real time to the medic in charge. This design will provide this information wirelessly giving flexibility to the patient. The modern product displays information in a straightforward manner to ease interpretation of the information by the users.

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FAULT MONITORING FOR INDUCTION MACHINE

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Abstract: *To obtain a high level in operational safety for induction machines, attention of researchers is directed at fault monitoring and evaluation of their reliability. Different methods have been developed to achieve this goal. To understand the connection between failure causes and their effects on induction machine, the paper proposes an analysis concept- Failure Analysis (FA). The method identifies possible defects and assesses their consequences on the functioning of a system. Using FA can identify weaknesses in the design phase induction machine, discover the potent faults of the induction machine and evaluate their gravity in the mode of operation.*
To show the validity of the approach, a case study in a Romanian company – producer of induction machines is carried out. A high number of induction machines in the assembly phase have been analyzed. The case study is useful for establishing the preventive maintenance procedures for induction machine and for highlighting the machine weaknesses in the manufacturing stage.

Keywords: *induction machine, fault analyses, monitoring, manufacturing stage, failure.*

1. INTRODUCTION

Although deemed to be classical, the induction machine still is a good solution for the various electric drives, such as compressors, pumps, household equipment, machine-tools. Electric machine designers and manufacturers have yielded continuous efforts for satisfying the ever-restrictive requirements, connected to: overall dimension diminishing, energy efficiency rise, environment condition satisfaction, design through feasibility, so that the predicted operation life of the induction machine should correspond to the one of the system wherein the machine is integrated.

So as to obtain a high safety level and high performance in exploiting these technical systems, the researchers' attention has focused upon fault monitoring and feasibility assessment during design, manufacturing and in exploitation [1,2,3,4,5,6]. Studies and researches have been developed in connection to developing new instruments for analyzing the quality and the feasibility, to the purpose of predicting the good functioning state [7,8,9].

So as to succeed in carrying out the qualitative analysis of the induction machine, the knowledge upon the main types of negative events which may occur in these equipments is necessary. As shown in [10], the moments when failures may come up within induction machines are: in the design stages, during the mounting process, during the setting up, because of functioning within unfit environments, because of the load nature. The paper herein submits a qualitative analysis of the induction machine feasibility, analysis that will be achieved by going through the following directions: identifying the weaknesses in the induction machine design phase and supplying data for the priority actions towards eliminating them: Qualitative feasibility analysis for the induction machine, resorting as analysis tools to FA - Fault Analysis.

2. FAULTS SOURCES

The faults in the induction machine are brought about by different sources.

In Fig. 1, the general scheme of the possible fault sources is presented [10].

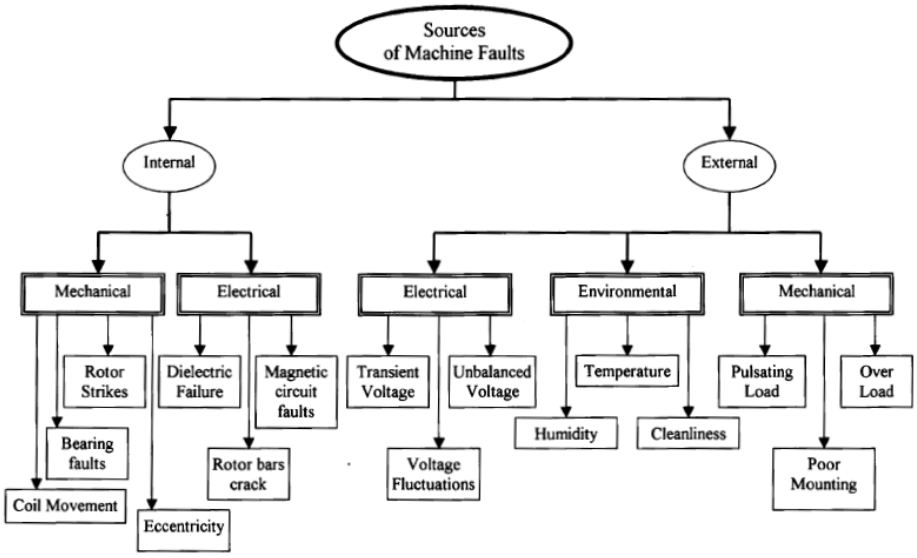

Fig. 1 Sources of induction machine faults [10]

The main sources entailing the induction machine failure are classified in *internal sources* – connected to internal mechanical, electric and thermal strains and *external sources* – connected to electric stresses at the feeding terminals, environmental strains and strains due to the mechanic load at the shaft.

The moments when faults may appear in the induction machines are: in the design stages, during the mounting process, during the setting up, because of the functioning within unfit environments, because of the load nature [10]. In Fig. 2, images with faults occurring within induction machine are shown.

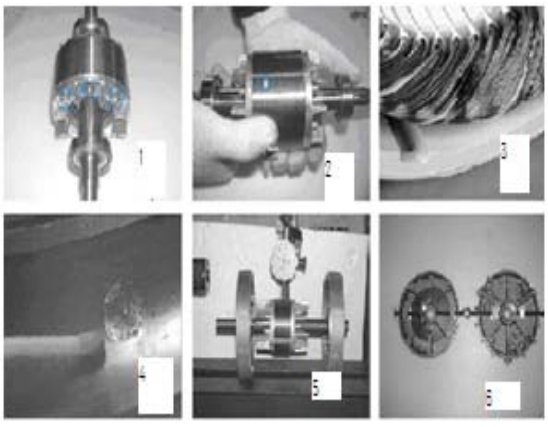

Fig. 2 Faults in the induction machines: 1-rotor unbalance, 2-broken rotor bars, 3-stator fault 4-faulty bearing, 5-bowed rotor; 6-eccentricity.

3. FAULT ANALYSIS

Induction machine is a technical system that may be decomposed in its components, with the equivalent scheme given in Fig. 3, with mixed structure (series-parallel). In a series grouping, a fault in one of the components generates the non-functionality of the entire grouping. In the parallel grouping, the analyzed system may even function with a faulted element.

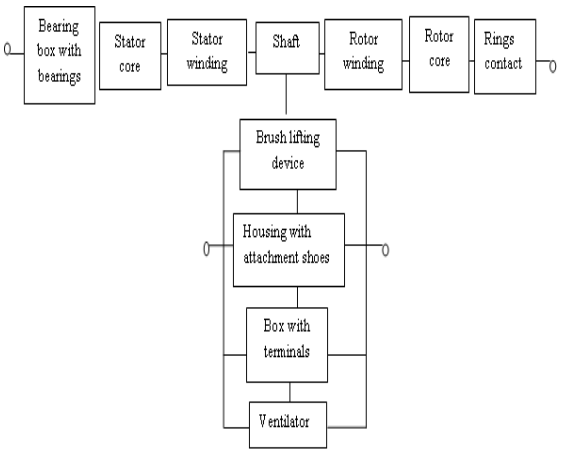

Fig. 3 Serial/parallel structure of elements.

The main elements entering into the machine equivalent scheme make up a grouping series 1 (bearing boxes with bearings, stator core, stator winding, shaft, rotor winding, rotor core, contact rings) and

a parallel grouping 1 (device of rings/brushes – if they exist, component elements of the machine housing, box with terminals, ventilator). For every element of the machine, an analysis was carried through upon the failure causes and their effects on the machine functioning (local, of system), as well as upon the failure modes. The data are consigned in Table 1.

Table 1. Fault analysis of induction machine

Element	Faults	Failure causes
Bearing boxes with bearings	Deviation from the bearing box coaxility; Loss of the bearing box lubrication; Incorrect feeding / loading Loss of lubrication	Deficient mounting Over-loading Incorrect connection Over-heating Loss of lubrication; Impure oil; Large clearance bearing / bearing box; Error of oil joint
Stator ferromag-netic core	Core clearance	Errors of connection Error of earthen electric contact
Stator winding	Winding interruption Connection interruption	Fault appearing since manufacturing stage Vibrations
Shaft	Inversed rotation sense Blocked axis Radial axial play	Fault appearing since manufacturing Inversely mounted axis Different forces
Rotor winding	Winding interruption Connection interruption	Fault appearing since manufacturing stage Vibrations
Rotor ferromag-netic core	Core clearance	Errors of connection Error of earthen electric contact
Ventila-tor	Thermocouple fault	High / low temperature High / low humidity Frequent starts Over-heating
Contact rings	Rotor mechanic unbalance	End ring shifting Asymmetrical blocking
Housing with mountin g shoes	Housing cracks Exceeded overall dimensions Lack of shoe holes	Faults appearing since the design stage Vibrations Thermal shock strain Over-torque
Brush lifting device	Fault of the brush lifting device	Faults appearing since the manufacturing stage
Box with terminals	Flaw at the box with terminals	Faults appearing since the manufacturing stage
Insula-tion	Insulation fault	Deficient setting-up Frequent starts Low/high temperatures Low/high humidity

There is a connection between the failure causes and faults. The monitoring of faults in manufacturing stage will drastically reduce the probability of induction machine failure in operation stage.

4. FAULTS MONITORING

A faults monitoring has been achieved during the manufactured mounting stage at a Romanian company, in the period 2007-2008. A number of 198,296.0 squirrel cage induction motors with powers ranging between 0.75 – 7.5 kW were studied.

In Table 2, the situation of faults is presented, according to the criterion of the failure gravity.

Table 2. Defects detected in the assembly stage

Category of faults	Symbol	Type of fault	Number of faults
Critical (25.35%)	A	Electrical breakdown of insulation	407
	B	Interrupted wires	153
	C	Blocked-rotor	9
	D	Erroneous connections	12
	E	Insufficient starting moment	29
	F	Smoke	1
Main (68.92%)	G	Different phase current, short-circuit current, no-load power	219
	H	Vibrations	4
	I	Internal frictions	923
	J	Bearing clearance	288
	K	Electromagnet clearance	215
	L	Reverse sense of rotation	12
Secondary (4.64%)	M	Faulted housing	1
	N	Inversed mounting	0
	O	Axial, radial free clearance	10
	P	Exceeded overall dimensions	0
	R	Lack of base holes	0
	S	Faults in shield, paint coat	1
Minor (1.07%)	T	Stand base defects	1
	U	Connections	1
	V	Bimetal	24

This way, the faults are divided in four categories, whereof critical faults and main faults are the serious ones, impeding the achievement of the function that the induction machine was destined for.

Along the analyzed period, a number of 2,410 faulted motors were signaled, every manufactured motor has on the average a number of 1.21 % faults (Fig.4).

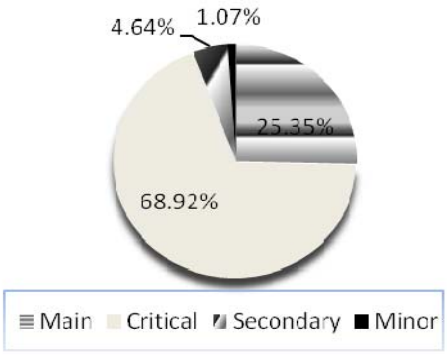

Fig. 4. Number of faults depending on their type

The critical defects have highest rate of occurrence, of 68.92 %. Defects with high severity of induction machine operation are: electric breakdowns, internal frictions, electromagnetic clearance, bearing clearance. Basically, most defects that affect the induction machine are mechanical.

On the basis of analyzing the possible failure modes of the induction machine components and emphasizing their consequences upon the machine functioning, fault analyses method may be applied.

5. CONCLUSIONS

It is important to study the induction machine faults since the design stage because in this way high reliability and safe operation of such electric device is ensured. It is proven that the largest source of failure of induction machine is mechanical. To obtain a prognosis for induction machine functioning one can achieve series-parallel groups which can be applied to fault analysis.

Fault analyses is a qualitative analyses upon reliability and it may be successfully used in the design and manufacturing stages of a product. Control and monitoring of faults in manufacturing stage drastically reduce the probability of induction machine failure in operation stage.

Acknowledgement

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A METHOD FOR POWER TRANSFER CONTROL TO DIRECT AC-AC PWM CONVERTERS

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Abstract—*This paper is concerned with modeling and predicting the power transfer in most of the AC-AC PWM converters. The commutation process is studied and the article presents a method to establish the mathematically model of the power transfer. The control methods of the power flowing are:*

1. *By adjusting the duty factor of pulses per cycle for the constant value of the load;*
2. *By the variation of the phase shifting angles φ for the constant value of the duty factor of pulses.*

It assumes η is the ratio between the voltamps of the load and the supplying source. It is wanted that η will become unity ratio. The circuit simulation and results prediction were carried out using specific computational tools such as MathCAD.
The study of the power flowing is made for three of the AC-AC PWM converters types: buck, boost and buck-boost. To verify the calculus uprightness, for the buck converter, the experimentations are made.

Keywords *– mathematically model of the power transfer, the duty factor of pulses, the phase shifting*

1. INTRODUCTION

The conventional PWM is one of methods to eliminate the content of harmonics of the output voltage by adjusting the number of pulses per cycle.

On each conduction period of switcher K_1 and K_2 power flowing is performed. The calculus of the currents and voltages on the circuit is very difficult. In this case the analytical expressions of these are impossible to use.

The load power value is dependent on the duty factor duty factor of pulses per cycle, γ and the phase shifting angles, φ. The power determining is based on different MathCAD routines [1]. It is determined:

1. The conduction periods of transistors;
2. The maximum and minimum values of the load current and voltage in steady state.
3. The Fourier coefficients of the circuit quantities.

The Fourier coefficients are determined in function of two variables: phase shifting angles and duty factor.

A proposed method of power calculus for all types of AC-AC PWM converters is brought into focus in this paper. In fig. 1, the power circuit of studied converters is presented.

2. CONTROL MODES OF LOAD CURRENT AND VOLTAGE

To determine the power transfer in AC-AC converters it is used the MathCAD functions. The calculus is based on frequency switching and duty factor functions. The switching frequency is 20kHz and number of switching commands is 200.

The algorithm is presented in fig.2.

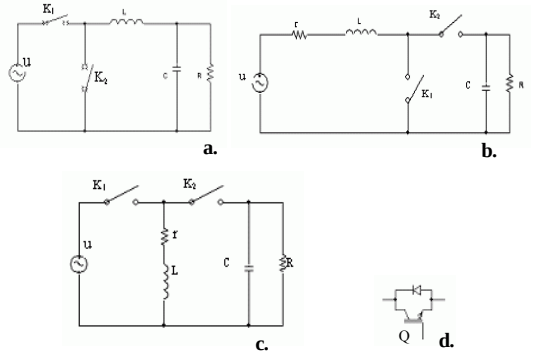

Fig. 1. The power circuit of: a. buck; b. boost; c. buck-boost; d. the prototype hardware of K.

The power transfer is studied in context of steady state [2]. A problem of the study is determination of threshold moment of steady state. This is not possible to determine. For this reason is necessary to realize a MathCAD routine which must offer the maximum and minimum values of the load current and voltage in steady state [3].

It assumed that α is the switch on moment and β is the switch off moment of transistors Q. The requirement for the steady state is:

$i(\omega t=\alpha)= i(\omega t=\alpha+2\pi) = I_\alpha$.

The routine build is the same for all types of AC-AC PWM converters, but the expression of the quantities of each type of converter in the conduction periods are different.

The expressions of current in the two conduction periods (turn on and turn off) are different too.

An example of calculus is realized for the circuit of Buck AC-C direct converter. In the two conduction periods (α, β) and (β, α) it is true the two systems:

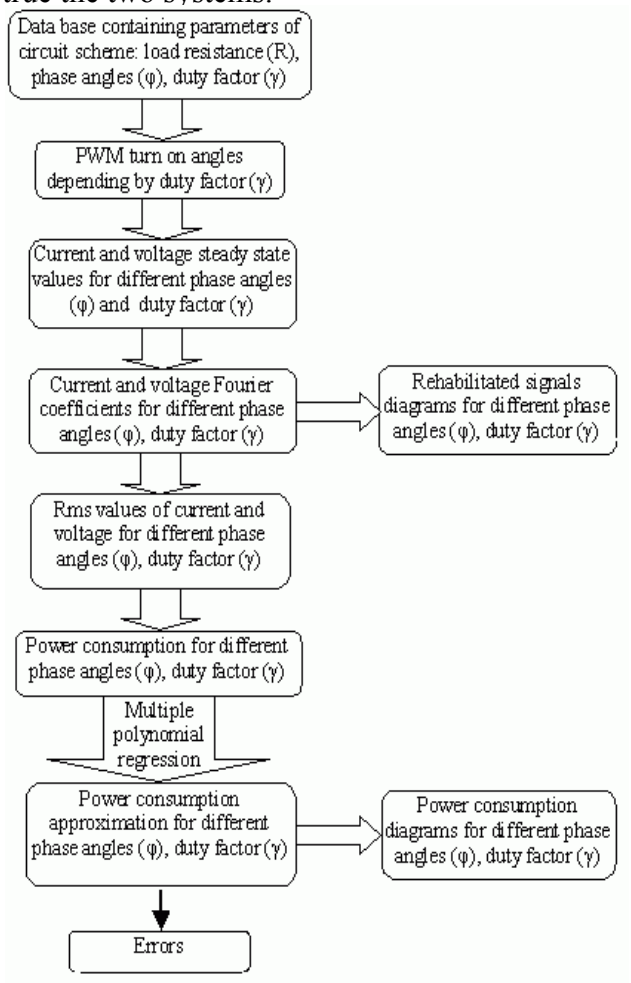

Fig.2. The calculus algorithm

The current expressions on the two conduction periods are:

1.The buck converter:

$$iR\alpha\beta(t,r,L,C,\phi,\alpha,I\alpha,U\alpha,S) := Re\left[\sum_{k=0}^{last(S)} \frac{\Delta IR\alpha\beta\left(r,L,C,\phi,\alpha,I\alpha,U\alpha,S_k\right)}{\Delta 1\alpha\beta\left(r,L,C,\phi,S_k\right)}\cdot e^{S_k\cdot\left(t-\frac{\alpha}{\omega}\right)}\right] \quad (1)$$

$$iR\beta\alpha(t,r,L,C,\phi,\beta,I\beta,U\beta,S) := Re\left[\sum_{k=0}^{last(S)} \frac{\Delta IR\beta\alpha\left(r,L,C,\phi,\beta,I\beta,U\beta,S_k\right)}{\Delta 1\beta\alpha\left(r,L,C,\phi,S_k\right)}\cdot e^{S_k\cdot\left(t-\frac{\beta}{\omega}\right)}\right] \quad (2)$$

2.The boost converter:

$$iR\alpha\beta(t,r,L,C,\phi,\alpha,I\alpha,U\alpha,S) := \frac{U\alpha}{R(\phi,C)}\cdot e^{-\frac{\omega t-\alpha}{\tan(\phi)}} \quad (3)$$

$$iR\beta\alpha(t,r,L,C,\phi,\beta,I\beta,U\beta,S) := Re\left[\sum_{k=0}^{last(S)} \frac{\Delta IR\beta\alpha\left(r,L,C,\phi,\beta,I\beta,U\beta,S_k\right)}{\Delta 1\beta\alpha\left(r,L,C,\phi,S_k\right)}\cdot e^{S_k\cdot\left(t-\frac{\beta}{\omega}\right)}\right] \quad (4)$$

3.The buck-boost converter:

$$iR\alpha\beta(t,r,L,C,\phi,\alpha,I\alpha,U\alpha) := \frac{U\alpha}{R(\phi,C)}\cdot e^{-\frac{\omega t-\alpha}{\tan(\phi)}} \quad (5)$$

$$iR\beta\alpha(t,r,L,C,\phi,\beta,I\beta,U\beta,S) := Re\left[\sum_{k=0}^{last(S)} \frac{\Delta IR\beta\alpha\left(r,L,C,\phi,\beta,I\beta,U\beta,S_k\right)}{\Delta 1\beta\alpha\left(r,L,C,\phi,S_k\right)}\cdot e^{S_k\cdot\left(t-\frac{\beta}{\omega}\right)}\right] \quad (6)$$

The currents have not sinusoidal forms. To determine the power are necessary the Fourier coefficients calculus for different quantities of circuit. In paper it's follow to determine an expression (function) with two variables (duty factor, phase angle) to approximation the values of different power (active, volt amps, reactive).

The start of power determining is the database with the values of duty factor (the matrix Γ), the phase angles (the matrix Φ) and values of source voltage and frequency.

Uc is the matrix of the turn on and turn off angles values.

The base of the power calculus will be the values of rehabilitated signals. To rehabilitate the signals is necessary the calculus for 100 harmonics. The result is a matrix, which contains all duty factors; all phase angles, all values of Fourier coefficients for voltage, currents of each component of circuit.

The real and rehabilitated signals are presented in fig. 3.

With the values of Fourier coefficients it obtains the power values on each component of the circuit. The result is another matrix with the values of power of each circuit component.

By this matrix it is made one MathCAD routine that determines a function with duty factors and phase angles like variables.

The power determining method is the same for all type of power and for all type of studied converters. In fact, the mathematical model of power allows an expression with those two variables without the retrace the all classical and difficult stage.

This mathematical model is an expression of one multiple polynomial regression, like

$$p(\Gamma,\Phi) = \sum_{i=1}^{n}\left(\Gamma^i \cdot \sum_{j=1}^{m} Coef_j \Phi^j\right) \quad (7)$$

In (7), "Coef" is a matrix of polynomial coefficients. The degrees of the polynomial function are "m" and "n", meaning number of columns and number of rows of matrix "Coef".

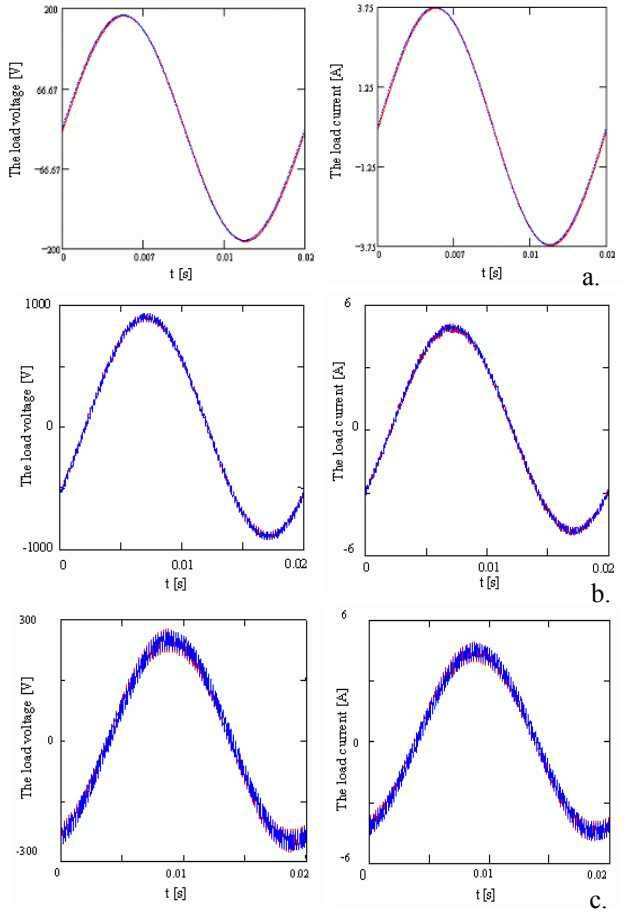

Fig.3. The rehabilitated signal of load current and voltage for: a. buck converter; b. boost converter; c. buck boost converter.

The matrixes "Coef" for the voltamps for all studied converters are present, like example, in the follow.

$$CoefSRBuck = \begin{bmatrix} 19.1771 & -93.5749 & 185.9676 & -38.6972 & -304.5333 & 253.6326 \\ -465.3423 & 2270.8347 & -4514.1272 & 943.915 & 7382.6841 & -6150.9426 \\ 6807.3714 & -38441.3818 & 107539.9414 & -146894.6445 & 81001.9961 & -6994.7168 \\ -19486.2644 & 95040.541 & -188624.3828 & 38226.3125 & 310997.9844 & -258519.3672 \\ 49003.5537 & -239161.2188 & 475584.0469 & -100093.3438 & -776463.7188 & 647231.8594 \\ -68355.4043 & 333968.1563 & -666259.0938 & 148800.6875 & 1.0701\cdot10^{6} & -896140.7813 \end{bmatrix}$$

$$CoefSRBoost = \begin{bmatrix} 7648.6016 & -249686.7742 & 2.622\cdot10^{6} & -1.1536\cdot10^{7} & 2.0936\cdot10^{7} & -1.3074\cdot10^{7} \\ -124652.7775 & 5.9927\cdot10^{6} & -6.6792\cdot10^{7} & 2.9998\cdot10^{8} & -5.4931\cdot10^{8} & 3.4459\cdot10^{8} \\ 1.1082\cdot10^{6} & -5.8315\cdot10^{7} & 6.6805\cdot10^{8} & -3.0482\cdot10^{9} & 5.6298\cdot10^{9} & -3.5484\cdot10^{9} \\ -4.9163\cdot10^{6} & 2.9538\cdot10^{8} & -3.487\cdot10^{9} & 1.6189\cdot10^{10} & -3.019\cdot10^{10} & 1.9131\cdot10^{10} \\ 1.0611\cdot10^{7} & -8.3397\cdot10^{8} & 1.0323\cdot10^{10} & -4.9158\cdot10^{10} & 9.2909\cdot10^{10} & -5.9307\cdot10^{10} \\ -9.5103\cdot10^{6} & 1.3567\cdot10^{9} & -1.7925\cdot10^{10} & 8.8213\cdot10^{10} & -1.6957\cdot10^{11} & 1.0922\cdot10^{11} \end{bmatrix}$$

$$CoefSRBuckBoost = \begin{bmatrix} -3402.5061 & 38069.4598 & -79644.1484 & -618387.5373 & 2.0674\cdot10^{6} & -1.5073\cdot10^{6} \\ 93909.7759 & -1.0925\cdot10^{6} & 2.7788\cdot10^{6} & 1.425\cdot10^{7} & -5.1928\cdot10^{7} & 3.8579\cdot10^{7} \\ -1.0277\cdot10^{6} & 1.2549\cdot10^{7} & -3.8513\cdot10^{7} & -1.1723\cdot10^{8} & 4.9852\cdot10^{8} & -3.8132\cdot10^{8} \\ 5.9586\cdot10^{6} & -7.6414\cdot10^{7} & 2.7589\cdot10^{8} & 4.2161\cdot10^{8} & -2.4196\cdot10^{9} & 1.9334\cdot10^{9} \\ -2.0048\cdot10^{7} & 2.7037\cdot10^{8} & -1.1167\cdot10^{9} & -5.1031\cdot10^{8} & 6.5072\cdot10^{9} & -5.5504\cdot10^{9} \\ 4.0178\cdot10^{7} & -5.6622\cdot10^{8} & 2.5962\cdot10^{9} & -6.9524\cdot10^{8} & -9.9912\cdot10^{9} & 9.3581\cdot10^{9} \\ -4.7101\cdot10^{7} & 6.8765\cdot10^{8} & -3.4129\cdot10^{9} & 2.6005\cdot10^{9} & 8.5684\cdot10^{9} & -9.1651\cdot10^{9} \\ 2.9739\cdot10^{7} & -4.4628\cdot10^{8} & 2.3521\cdot10^{9} & -2.6098\cdot10^{9} & -3.7126\cdot10^{9} & 4.8181\cdot10^{9} \\ -7.7971\cdot10^{6} & 1.1952\cdot10^{8} & -6.5963\cdot10^{8} & 8.9897\cdot10^{8} & 5.9744\cdot10^{8} & -1.0497\cdot10^{9} \end{bmatrix}$$

The degrees are:

1.For buck: n=5, m=5

2.For boost: n=5, m=5

3.For buck-boost: n=8, m=5

The voltamps (multiple polynomial regressions with line and the calculated power with point) are presented in fig.4.

The degrees of polynomial regression are different for each type of converter.

The precision of approximation with (7) is verified with the error calculus for all duty factors and all phase angles from database. The error is determined for all type of studied converters.

The error values are relative small. The method of power approximation provides errors that are, in absolute value, less 6%. The exception is the error of the small powers (few VA) from buck boost converter (small values of duty factor and big values of load resistance). From fig. 5. the errors are:

$-0.076\% \le \varepsilon \le 0.066\%$, for buck;

$-0.41\% \le \varepsilon \le 1.17\%$, for boost;

$-6\% \le \varepsilon \le 0.18\%$, for buck boost.

It's assumed that the power transfer is the ratio between load voltamps and source voltamps, relation (5):

$$\eta = \frac{\textbf{\textit{load power}}}{\textbf{\textit{source power}}} \qquad (8)$$

The power transfer, for all type of study converters, is presented in fig. 6.

The same approximation, with the multiple polynomial regressions, can be applied to the calculus power transfer. The obtained degrees (for all types of studied converters) are 6 and 7 for duty factor and phase angle (like variables).

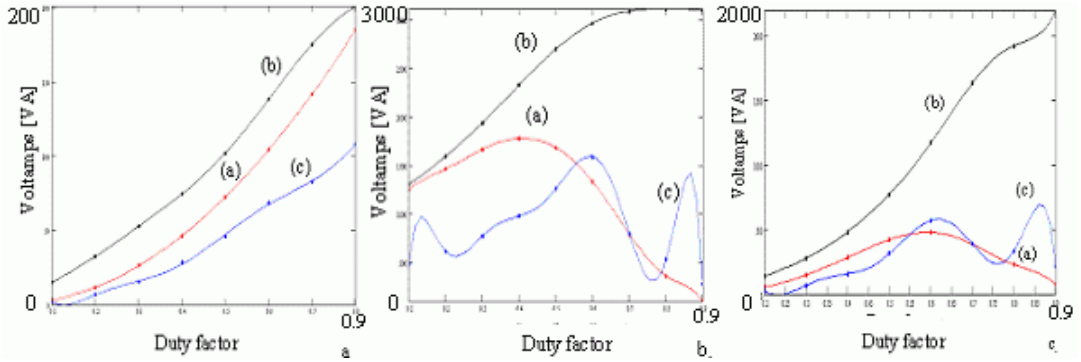

Fig.4. The load voltamps: a. buck converter; b. boost converter; c. buck boost converter.
(a) load resistance apparent power; (b) source apparent power; (c) capacitor apparent power

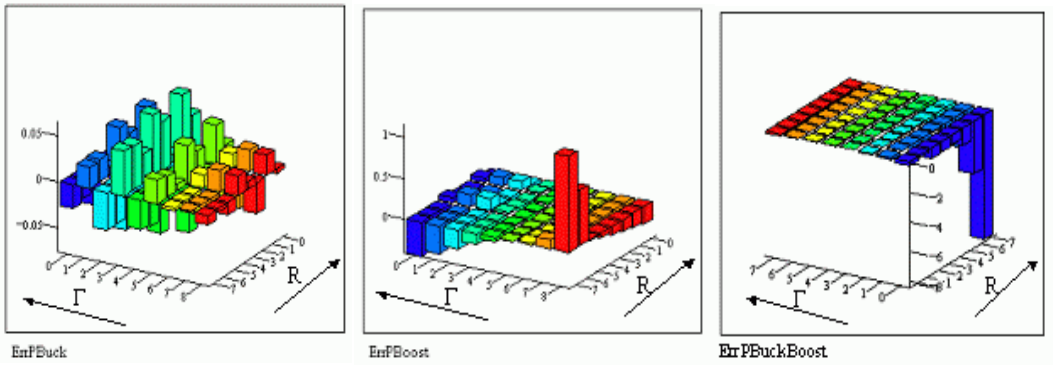

Fig.5. The errors between approximation and calculus values of power:
a. buck converter; b. boost converter; c. buck boost converter.

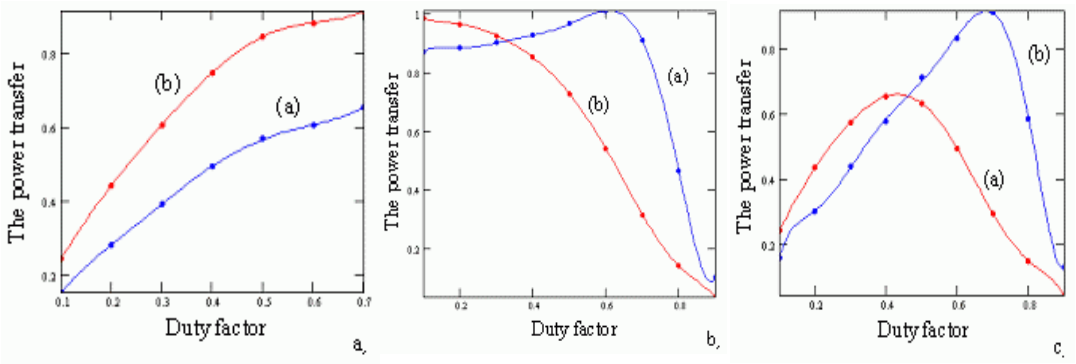

Fig.6. Power transfer values: (1) $\Phi = 6^{o}$; (2) $\Phi = 35^{o}$
a. buck converter; b. boost converter; c. buck boost converter.

3. EXPERIMENTAL RESULTS

The experiments are realized for buck converter. These allow obtaining the experimental waveforms of signals for circuit quantities.

All of these verify the uprightness of the performed algorithm.

To prove the previously discussion it uses the platform with buck converter and the control circuit, a digital oscilloscope (Hameg 305) and one PC.

The experiments are made for:

$$U_i = 220\sqrt{2}\sin \omega t \ [V]$$

$$R = 50 \ [\Omega]$$

$$L = 5 \cdot 10^{-3} \ [H]$$

$$C = 10 \cdot 10^{-6} [F]$$

$$\Gamma = \begin{pmatrix} 0.2 \\ 0.4 \\ 0.6 \end{pmatrix}$$

Parts of waveforms of the load voltage, the currents of capacitor and inductance are presented in fig.7, fig.8 and fig.9. The

presentation is made for two duty factors from matrix Γ

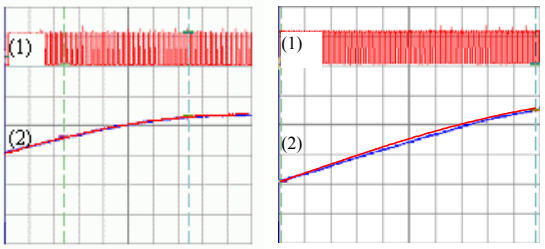

Fig.7. The load voltage: a) γ= 0.2; b) γ= 0.6.

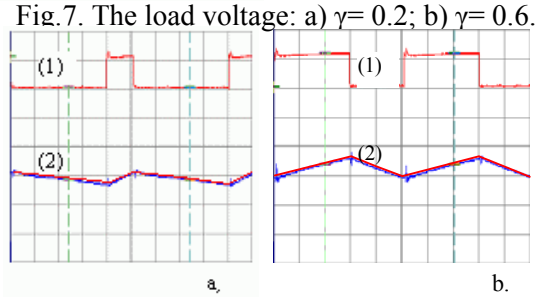

Fig.8. The capacitive current waveforms: a) γ= 0.2; b) γ= 0.6.

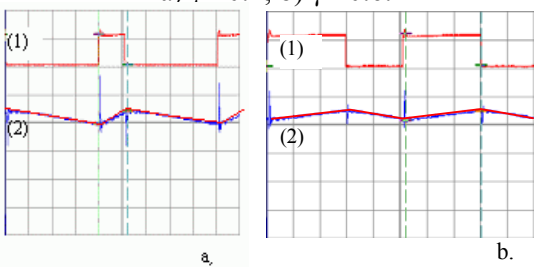

Fig.9. The inductance current waveforms: a) γ= 0.2; b) γ= 0.6. (experimental waveform; analitical determined waveform).

Fig.10. is a collation between the analitical and experimental load voltage waveform. The experimental waveform is realized with the digital oscilloscope ($100V \cdot div^{-1}$). The value (peak to peak) of load voltage is 348V. The load voltage value (peak to peak) with MathCAD modeling is 356V.

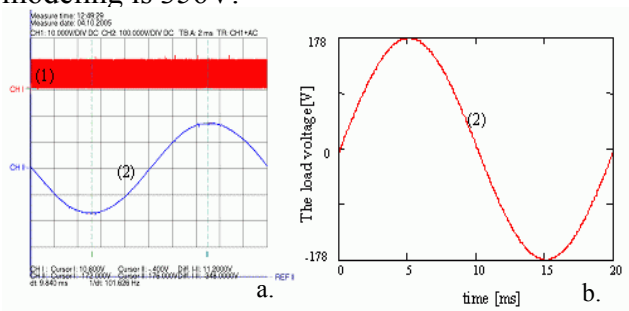

Fig.10. Load voltage waveforms collation (γ= 0.6) a. experimental waveform; b. analitical determined waveform.

In fig. 7, fig.8, fig.9 and fig.10 the waveform (1) are the control pulse and (2) are the voltage and current waveforms.

4. CONCLUSION

Beside, the prototype hardware circuit allows verifying the MathCAD modeling uprightness. In table 1 few load current values are presented.

TABLE 1
THE COLLATION BETWEEN CALCULUS AND EXPERIMENTAL LOAD CURRENT VALUES

Duty factor			
$\Gamma_{analitical}$ $\Gamma_{experimantal}$	0.2 0.22	0.4 0.4	0.6 0.6
Load current			
$I_{analitical}$ [A] $I_{experimental}$ [A]	0.97 1.0	1.59 1.65	2.37 2.45
The error			
ε [%]	3	3.7	3.2

The close agreement between the analytical and the experimental results proves the validity of the MathCAD modeling.

The errors level is owed by losses on different circuit components. The final errors are, in absolute value, less than 4%.

If the load power expression (4) is known, the designing process of the circuit of AC-AC direct converters is facilitated.

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SOME CONSIDERATIONS ABOUT INFRARED WIRELESS LINKS

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Abstract: *The next generation of wireless communication systems will not be based on a single access technique but it will encompass a number of different complementary access technologies. The ultimate goal is to provide ubiquitous connectivity, integrating seamlessly operations in most common scenarios, ranging from fixed and low-mobility indoor environments in one extreme to high-mobility cellular systems in the other extreme. Surprisingly, perhaps the largest installed base of short-range wireless communications links are optical, rather than RF, however. Indeed, 'point and shoot' links corresponding to the Infra-Red Data Association (IrDA) standard are installed in 100 million devices a year, mainly digital cameras and telephones. In this paper we argue that infrared optical wireless links has a part to play in the wireless communication vision.*
We present here some consideration about infrared wireless link design. We conclude the paper with a section on comparison to radio.
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Keywords: *wireless, infrared link, transmitter, receiver, eye safety*

1. INTRODUCTION

In the communication world, optical wireless communication (OWC) is the only area that remains to be comprehensively researched.

Wireless infrared communications refers to the use of free-space propagation of light waves in the near infrared band as a transmission medium for communication. It uses infrared radiation as a medium for high-speed, short-range wireless digital communication.

Future systems will not only connect users and their personal equipment but also access to independent (stand-alone) equipment will be provided. Ultimately one would expect that everybody and everything will be wirelessly connected. This vision places short-range communications in a position of preponderance, as one could argue that most of the wireless links in future wireless communication networks will be established over relatively short distances through infrared wireless links (IWL).

The communication can be between one portable communication device and another or between a portable device and a tethered device, called an access point or base station. Typical portable devices include laptop computers, personal digital assistants, and portable telephones, while the base stations are usually connected to a computer with other networked connections.

Applications. The primary commercial applications of an IWL are as follows[6]:

- short-term cable-less connectivity for information exchange (business cards, schedules, file sharing) between two users.
- wireless local area networks (WLANs) provide network connectivity inside buildings. This can either be an extension of existing LANs to facilitate mobility, or to establish "ad-hoc" networks where there is no LAN.
- building-to-building connections for high-speed network access or metropolitan or campus-area networks.
- wireless input and control devices, such as wireless mice, remote controls, wireless game controllers, and remote electronic keys.

Infrared transceivers usually operate in the presence of ambient light, which has significant power at infrared wavelengths. Even when optical filtering is used in the receiver to reject some of the out of band ambient light, the resulting D.C. photocurrent gives rise to shot noise which is the dominant noise source in a well designed receiver[1]. As

for radio-frequency systems, interference caused by other users is the dominant noise source.

The shot noise, path loss and dispersion associated with diffuse infrared systems drive the requirement for transceivers to have relatively high optical transmit powers. However, the average optical power emitted by an infrared transceiver is limited by eye safety regulations. Furthermore, electrical power consumption must be kept to a minimum in battery-powered portable devices, which is another constraining factor.

2. CLASSIFICATION OF INFRARED LINKS

Various configurations can be taken by infrared links, and classification can be carried out in terms of their directionality and whether or not the link requires a *line of sight* (LOS), as illustrated in figure 1[5]. Directed links maximise power efficiency by using directional transmitters and receivers, but must be aimed in order to establish a link. Non-directed links employ wide-angle transmitters and receivers, removing the need for pointing and thus making them more convenient.

LOS systems rely on an uninterrupted line of sight path between the transmitter and the receiver, whereas non-LOS systems rely on the reflection of light from the ceiling and walls of the room. Non-LOS link design increases link robustness and ease of use, allowing the link to operate even if for example a person is standing between the transmitter and receiver. The greatest robustness and ease of use are achieved by the non-directed-non-LOS design, referred to as a diffuse system. In this scheme reception is non-directional since the photodiode has a wide *field of view* (FOV). Hence there is no direct line of sight required between transmitter and receiver, and the optical transmission is very insensitive to interruption.

Directivity of the light source and the photodetector is very important parameter in non-directive optical communication. Wide FOV is highly desirable in order for a robust system. The FOV can be enlarged either by using a diffusion lens or by using an array of LEDs together with an array of photodetectors.

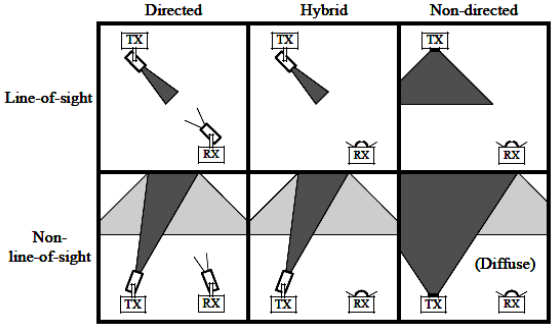

Figure 1: Classification of infrared links.

3. INFRARED LINK DESIGN

Modulation and demodulation. Most communication systems are based on phase, amplitude, or frequency modulation, or some combination of these techniques. However, it is dificult to detect such a signal following nondirected propagation, and more expensive narrow-linewidth sources are required[4]. An effective solution is to use intensity modulation, where the transmitted signal's intensity or power is proportional to the modulating signal. At the demodulator (usually referred to as a detector in optical systems) the modulation can be extracted by mixing the received signal with a carrier light wave. This coherent detection technique is best when the signal phase can be maintained. However, this can be difficult to implement and additionally, in nondirected propagation, it is difficult to achieve the required mixing effciency. Instead, one can use direct detection using a photodetector. The photodetector current is proportional to the received optical signal intensity, which for intensity modulation, is also the original modulating signal. Hence, most systems use intensity modulation with direct detection (IM/DD)[1] to achieve optical modulation and demodulation.

In a free-space infrared communication system, the detector is illuminated by sources of light energy other than the source. These can include ambient lighting sources, such as natural sunlight, fluores cent lamp light, and incandescent lamp light. These sources cause variation in the received photocurrent that is

unrelated to the transmitted signal, resulting in an additive noise component at the receiver.

We can write the photocurrent at the receiver as

$$Y(t) = X(t) \times R \cdot h(t) + N(t), \qquad (1)$$

where: - R is the responsivity of the receiving photodiode [A/W];

- h(t) is the optical impulse response[1].

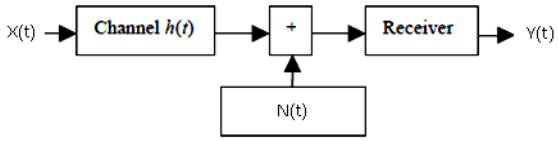

Figure 2: Channel model.

Transmitters and Receivers. The transmitter consists of a single, or a number of sources that converts an electrical signal to an infrared signal, and an optical element to shape the beam. The two most appropriate types of device are the light-emitting diode (LED) and semiconductor laser diode (LD). LEDs have a naturally wide transmission pattern, and so are suited to nondirected links.

The principal advantages of laser diodes are their high energy-conversion efficiency, their high modulation bandwidth, and their relatively narrow spectral width. Although laser diodes offer several advantages over LEDs that could be exploited, most short-range commercial systems currently use LEDs. In the near IR region (between the visible and 1400nm) the limit for point sources is less than 1mW. Much higher powers are available by diffusing the sources, thus increasing their apparent emitted areas. Most systems use laser diodes, due to their higher modulation bandwidth and efficiency. IrLEDs are also important optical sources being considered for establishing optical links.

A typical infrared receiver consists of an optical system to collect and concentrate incoming radiation, an optical filter to reject ambient illumination, and a photodetector to convert radiation to photocurrent. Further amplification, filtering and data recovery are then required.

Silicon *pin* photodiodes are ideal for wireless infrared communications as they have good quantum efficiency in this band and are inexpensive[1]. Avalanche photodiodes are not used here since the dominant noise source is back-ground light-induced shot noise rather than thermal circuit noise.

Receiver can be characterised in terms of their angular Field of View (FOV) and their collection area. These are linked to the detection area by the *constant radiance theorem*. This states that

$$A_{coll} \sin^2(FOV/2) \le A_{det}, \qquad (2)$$

where: - A_{coll} is the collection area;

- A_{det} is the photodetector area.

This is important as it limits the collection area that is available for a given FOV and photodetector. For a truly diffuse channel the detector area sets how much power will be received. Any collection optical system changes the balance between field of view and collection area subject to the constraints above; however if the system is receiving light from a Lambertian source such as a wall or ceiling the amount of optical power that is collected remains approximately constant for a given detector area.

Recent designs of optical antenna show good performance in compact form, although this cannot exceed that predicted by constant radiance.

Figures 3 shows the schematic of a digital transmitter and figure 4 shows the schematic of a digital receiver.

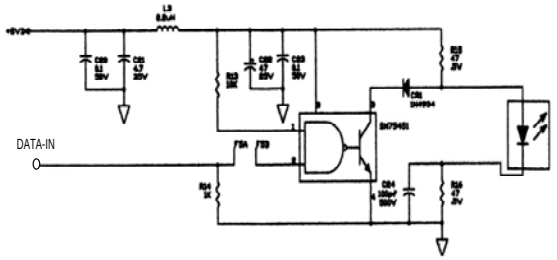

Figure 3: The schematic of the digital transmiter.

The infrared light source used has a peak wavelength of 820nm; its typical spectral bandwidth is 45nm. Due to the typical rise time of the IrLED of 3ns, the maximum bandwidth is about 1GHz.

The receiver passband is limited to 5MHz to increase the signal-to-noise ratio at the output of the receiver. To reduce noise at the input to the digital receiver output circuit, RC filters are used.

The preamplifier of the digital receiver output circuit increases sensitivity. The voltage comparator uses positive feedback and provides hysteresis.

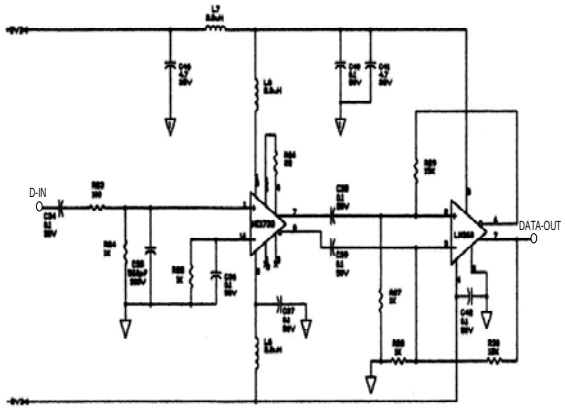

Figure 4: The schematic of the digital receiver.

Optical filtering. Ambient light is the most important source of interference and it may greatly deteriorate link performance. Constant ambient illumination will generate a DC photocurrent, and this will normally be blocked by the AC coupling of the receiver. However the shot noise from the detection of this illumination cannot be filtered and can be large when compared with the noise from the preamplifier. Artificial illumination, particularly modern high frequency fluorescent illumination induces electrical harmonics in the received signal, with components up to 1MHz and this can greatly effect link performance. Optical filtering can be used to reject out of band ambient radiation and reduce the intensity reaching the detector. A longpass filter in combination with a silicon detector provides a natural narrowing of the bandwidth and absorbtion filters can be used to reject solar and illumination. Bandpass interference filters can be used, although care has to be taken to allow sufficient bandwidth to allow for passband shifting with the varying angle of incidence. It is also possible to filter by incorporating appropriate layers into the photodetector.

Transmission Wavelength and Noise. The most important factor to consider when choosing a transmission wavelength is the availability of effective, low-cost sources and detectors. The availability of LEDs and silicon photodiodes operating in the 800 nm to 1000 nm range is the primary reason for the use of this band. Another important consideration is the spectral distribution of the dominant noise source: background lighting. The noise N(t) can be broken into four components: photon noise or shot noise, gain noise, receiver circuit or thermal noise, and periodic noise.

Gain noise is only present in avalanche-type devices, so we will not consider it here. Photon noise is the result of the discreteness of photon arrivals. It is due to background light sources, such as sun light, fluorescent lamp light, and incandescent lamp light, as well as the signal dependent source X(t) - c(t). Since the background light striking the photodetector is normally much stronger than the signal light, we can neglect the dependency of N(t) on X(t) and consider the photon noise to be additive white Gaussian noise with two sided power spectral density $S(f) = qRP_n$ where q is the electron charge, R is the responsivity, and P_n is the optical power of the noise (background light).

Receiver noise is due to thermal effects in the receiver circuitry, and is particularly dependent on the type of preamplier used. With careful circuit design, it can be made insignificant relative to the photon noise[2]. Periodic noise is the result of the variation of fluorescent lighting due to the method of driving the lamp using the ballast. This generates an extraneous periodic signal with a fundamental frequency of 44 kHz with significant harmonics to several MHz. Mitigating the effect of periodic noise can be done using high-pass filtering in combination with baseline restoration[3], or by careful selection of the modulation type, as previously discussed.

The three main sources of ambient light are sunlight, incandescent lamps and fluorescent lamps, see figure 5[5]. Sunlight represents an unmodulated source of ambient light with a very wide spectral width and a maximum power spectral density located at ~0.5µm, producing a D.C. photocurrent in the photodetector. Incandescent lamps are modulated at 100Hz from the mains supply, with a maximum power spectral density

around 1nm, but their slow response time means that few higher harmonics are present. Fluorescent lamps come in two varieties. The traditional type are driven by the mains frequency and the electrical spectrum contains harmonics into the tens of kHz. In the last few years, newer more energy efficient fluorescent lamps have been introduced, driven by high frequency electronic ballasts, with switching frequencies in the 20 – 40 kHz range. Their detected electrical spectrum can contain harmonics into the MHz range. Thus, along with contributing to shot noise, fluorescent light sources also produce a periodic interference signal in the receiver.

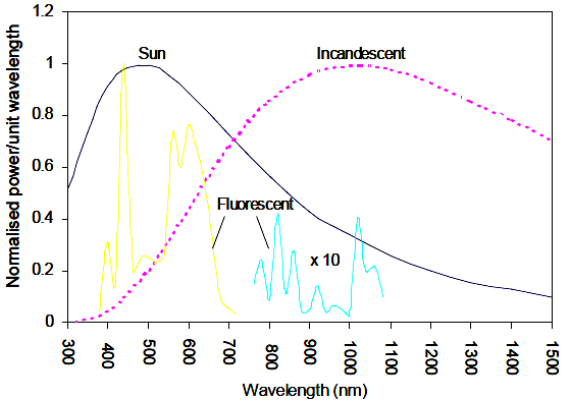

Figure 5: Optical power spectrum of common ambient infrared sources.

4. SAFETY

There are two safety concerns when dealing with infrared communication systems. Eye safety is a concern because of a combination of two effects: the cornea is transparent from the near violet to the near IR. Hence, the retina is sensitive to damage from light sources transmitting in these bands. However, the near IR is outside the visible range of light, and so the eye does not protect itself from damage by closing the iris or closing the eyelid. Eye safety can be ensured by restricting the transmit beam strength according to IEC or ANSI standards[7],[8]. The IEC document IEC 825-1 defines the maximum exposure limits. This standard does not distinguish between the laser and LED emission level. The following formulae were established by the ANSI as a guideline for the safe use of lasers[8].

The *maximum permissible exposure* (MPE) values of intrabeam viewing for a nearly point source are:

$$MPE = 1.8C_A\, t^{-0.25} [mW/cm^2] \qquad (3)$$

for $50\mu < t < 1k$, and

$$MPE = 0.32C_A [mW/cm^2] \qquad (4)$$

for $1k < t < 30k$,

where t is in seconds, $C_A = 10^{0.002(\lambda - 700)}$ for $\lambda = 0.7\mu m \div 1.05\mu m$ and $C_A = 5$ for $\lambda = 1.05\mu m \div 1.4\mu m$.

The eye retina is safe up to 560 mW/cm^2 for one second exposure and up to 100 mW/cm^2 for 100 seconds or longer exposure when operating at λ>1400nm , as shown in figure 6[5]. This sharp increase of safety threshold is due to water absorption in the cornea preventing laser power from reaching the retina. Eye safety is much simpler to achieve for an LED than for a laser diode, which usually have very narrow transmit beams.

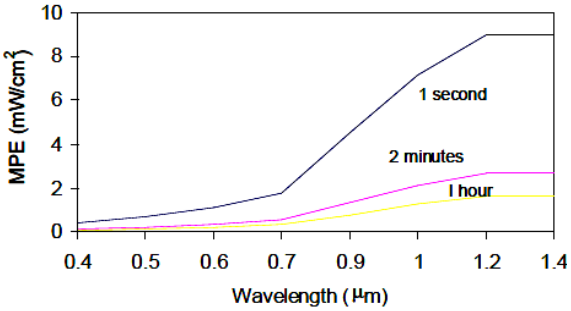

Figure 6: Maximum permissible exposure value vs. wavelength for various intrabeam viewing exposure times.

Skin safety is also a possible concern. Possible short-term effects such as heating of the skin are accounted for by eye safety regulations (since the eye requires lower power levels than the skin). Long-term exposure to IR light is not a concern, as the ambient light sources are constantly submitting our bodies to much higher radiation levels than these communication systems do.

5. COMPARISON TO RADIO

Wireless infrared communication systems enjoy significant advantages over radio systems in certain environments. First, there is an abundance of unregulated optical spectrum

available. This advantage is shrinking somewhat as the spectrum available for licensed and unlicensed radio systems increases due to modernization of spectrum allocation policies. Radio systems must make great efforts to overcome or avoid the effects of multipath fading, typically through the use of diversity. Infrared systems do not suffer from time-varying fades due to the inherent diversity in the receiver. This simplifies design and increases operational reliability. Infrared systems provide a natural resistance to eavesdropping, as the signals are confined within the walls of the room. This also reduces the potential for neighboring wireless communication systems to interfere with each other, which is a significant issue for radio-based communication systems. Inband interference is a significant problem for both types of systems. A variety of electronic and electrical equipment radiates in transmission bands of current radio systems; microwave ovens are a good example. For infrared systems, ambient light, either man-made or natural, is a dominant source of noise.

The primary limiting factor of infrared systems is their limited range, particularly when no good optical path can be made available. For example, wireless communication between conventional rooms with opaque walls and doors cannot be accomplished; one must resort to using either a radio-based or a wireline network to bypass the obstruction. The comparison between radio and infrared for indoor wireless communications is shown in table 1[4].

Property	Radio	Infrared	Implication for infrared
Bandwidth regulated ?	Yes	No	Approval not required World-wide compatibility
Passes through walls ?	Yes	No	Inherently secure Carrier reuse in adjacent rooms
Multipath fading	Yes	No	Simple link design
Multipath dispersion	Yes	Yes	Problematic at high data rates
Dominant noise	Other users	Background light	Short range

Table 1: Comparison between radio and infrared for indoor wireless communications

6. CONCLUSIONS

Wireless infrared communication systems provide a useful complement to radio-based systems, particularly for systems requiring low cost, light weight, moderate data rates, and only requiring short ranges. When LOS paths can be assured, range can be dramatically improved to provide longer links.

Short-range wireless networks are poised for tremendous market growth in the next decade, and wireless infrared communications systems will compete in a number of arenas. Infrared systems have already proven their effectiveness for short-range temporary communications and in high data rate longer range point-to-point systems.

The design of an infrared link involves a series of tradeoffs among the many performance variables of each component based on the system operating requirements. Since performance and cost constraints are very important factors in a communication link, the designer must choose the components carefully to ensure that the link meets the operational specifications over the expected system lifetime without overstating the component requirements.

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ODVA INDUSTRIAL BUSES INTEGRATION WITH ACTIVE DIRECTORY

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Abstrac:t *the goal of this article is to provide a solution for interaction between ODVA industrial buses and Microsoft Active Directory infrastructure. Our purpose is to inform automation equipments manufacturers about Microsoft Active Directory and Internet technology potential for their products.*

Keywords: *ODVA, Common Industrial Protocol (CIP), DeviceNet, CAN, Microsoft Active Directory*

1. ODVA BUSES

ODVA is an international association that adds in most important automation equipment manufacturers. All ODVA's members support network technologies base on Common Industrial Protocol (CIP). CIP is a collection of protocols that comprise: DeviceNet, ControlNet, Ethernet/IP, CompoNet, CIP Motion, CIP Safty and CIP Sync. ODVA hold development of this open standards, and provide training for manufactures and customers. Most important protocols we focus on is DeviceNet.

2. DeviceNet

DeviceNet is a industrial standard protocol since middle of 1990. It solved a lot of problems and is part of CIP family protocols. DeviceNet adapt CIP family to CAN protocol also.

The Communications and Information Protocol (CIP) is a communications protocol for transferring automation data between two devices. DeviceNet is a mixture of the CIP Protocol and the CAN Physical Layer and each device represents itself as a sequence of objects. Every object is simply a combination of the interconnected data values in a device. All CIP devices are required to make an identity object available to the network and the identity object contains related identity data values called attributes. Attributes for the identity object include the vendor ID, date of manufacture, device serial number and other identity data. CIP standard does not detail at all how this object data is implemented, only what data values, usually called attributes, must be supported and that these attributes must be accessible to other CIP devices. The Identity object is an example of a required object. There are three types of objects defined by the CIP protocol:

a) Required objects are claimed by the design to be integrated in every CIP device. These objects include the Identity object, a Message Router object and a Network object.

- **IDENTITY OBJECT -** The identity object contains attributes that character the DeviceNet device. Attributes for the identity object embrace the vendor ID, date of manufacturer, device serial number and other identity data.
- **MESSAGE ROUTER OBJECT -** The Message Router is an object that route explicit messages and precise responses to and from the Connection Object and for example, an Explicit Message request is received by the Connection Object and sent to the Router Object. The Router opens the DeviceNet (CIP) package and identifies the target object, the message

is accepted to the target object for processing and response from the target object pursues the identical itinerary in reverse, this is only the external operating behavior of the Message Router Object and the realization of this object can and does follow a much more concise and efficient mechanism.

- **DEVICENET OBJECT** - The DeviceNet object contains attributes that bind the Port, Baud Rate, Mac ID (DeviceNet Address), vendor ID and other physical operating parameters.
- **CONNECTION OBJECT** - The Connection object contains the attributes that control the processing of explicit and I/O messages. Most importantly, the attributes for the I/O Path and Connection Type control how often the DeviceNet devices produces data and the path where the connection object "finds" the data to produce.
- **APPLICATION OBJECTS** - Application objects are the define the data encapsulated by the device. These objects are specific to the device type and function, for example, a Motor object on a Drive System has attributes describing the frequency, current rating and motor size or an Analog Input object on an I/O device has attributes that define the type, resolution and current value for the analog input. These application layer objects are predefined for a large number of common device types. All CIP devices with the same device type (Drive Systems, Motion Control, Valve Transducer…etc) must include the identical series of application objects. The series of application objects for a particular device type is known as the device profile. A large number of profiles for many device types have been defined. Supporting a device profile allows a user to easily understand and switch from a vendor of one device type to another vendor with that same device type. A device vendor can also group Application Layer Objects into assembly objects. These super objects hold attributes of one or more Application Layer Objects. Assembly objects form a convenient package for transferring data between devices, for example, a vendor of a Temperature Controller with multiple temperature loops may define assemblies for each of the temperature loops and an assembly with data from both temperature loops. The user can than select the assembly that is most suited for the application and how often to access each assembly. For example, one temperature assembly may be configured to report every time it changes state while the second may be configured to report every one-second despite of a change in state. Assemblies are usually predefined by the vendor but CIP also defines a mechanism in which the user can dynamically create an assembly from application layer object attributes. Dynamic assemblies are rather rare, as most end users wouldn't want to bother defining their own assemblies.
- **VENDOR SPECIFIC OBJECTS** - Objects not found in the profile for a device class are termed Vendor Specific. The vendor includes these objects as additional features of the device. The CIP protocol provides access to these vendor extension objects in exactly the same method as either application or required objects. This data is strictly of the vendors choosing and is organized in whatever method makes sense to the device vendor. In addition to specifying how device data is represented to the network, the CIP protocol specifies a number of different ways in which that data can be accessed such as cyclic, polled and change-of-state.

DeviceNet accept up to 64 nodes and baud rates of 500Kb/s, robust physical layer and data transmission with flexible network architecture with rage of data rates of 125Kb/s, 250Kb/s, 500kb/s. It support trunk line

distances up to 500m. The electric power is compound 24V dc and 8A, with signal on same wire with capacity to replace a node under power and power taps at any point of the network.

DeviceNet is a open architecture that accept many kind of equipments connected at its nodes like in Figure 1.

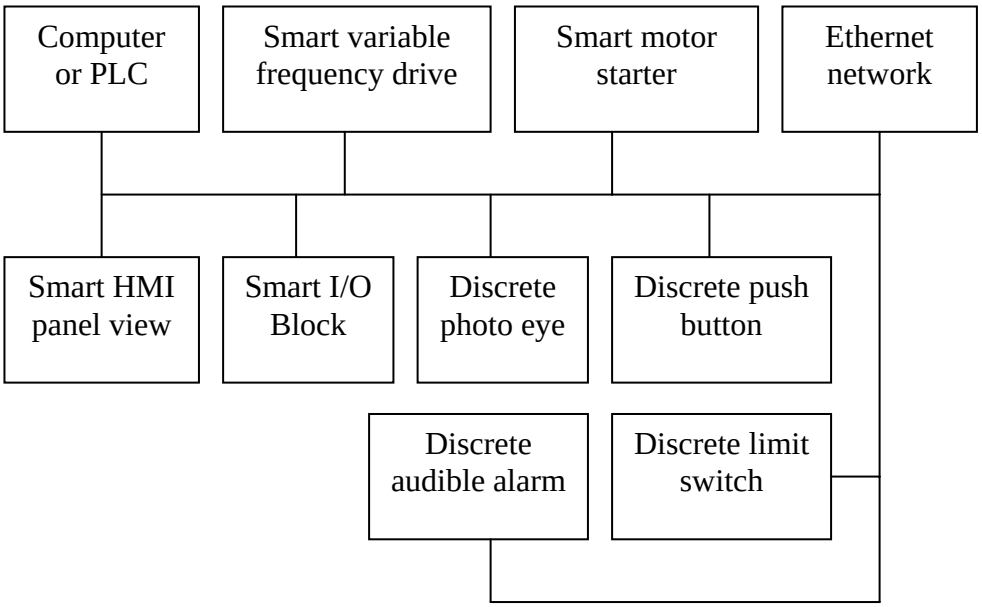

Fig. 1. The equipments accepted by the DeviceNet architecture

Computer or PLC is the brain of the DeviceNet bus and use various kind of equipments like smart sensors, human interfaces, actuators, etc. We are focus on Ethernet interface node, this is most important for our research. Nodes are independent of location; DeviceNet chain is passive and has endurance for lost nodes. Message transfer and power transfer are over same cable, and if one node is lost do not matter for all circuit. DeviceNet claim on single point of connection for control and configuration. It accepts multiple hierarchical communication message prioritizations, also. It is more effective in communication than source-destination model network and it could be configured to operate in master-slave mode or distributed control architecture using peer-to-peer communication.

DeviceNet includes trunkline and dropline items that allows separated twisted pair for power and signal (Figure 2). Nodes could be inserted or removed from network and taps could add in any spot facilitate the use of redundant power supplies and DeviceNet accept three types of data rates and five cable option, you may see in table 1 and end-to-end network distance as function of data rate and cable type.

The maximum cable distance is the distance between any two devices (see above table). This is between terminal resistors as usual too, and if the distance from the tap to the farthest device connected to the trunkline is greater than the distance from the tap to the nearest terminating resistor, then you must include the dropline as part of the cable.

The cumulative drop line length is the sum of all drop lines, thick, thin, or mid cable, in cable system, and this sum cannot exceed the maximum cumulative length allowed for the data rate used. For 125kb/s is no more than 156m, for 250kb/s limited at 78m, and 500kb/s is 39m.

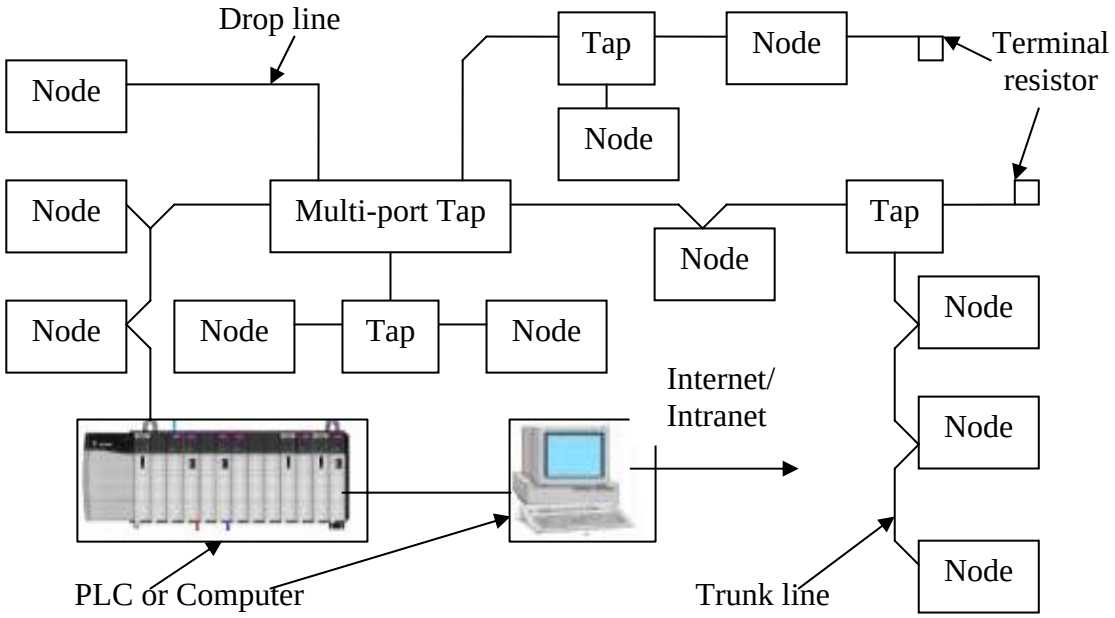

Fig. 2. The DeviceNet architecture

Table 1

Cable Type	125Kb/s	250Kb/s	500Kb/s
Thick Round Cable	500 m	250 m	100 m
Thin Round Cable	100 m	100 m	100 m
Flat Cable	420 m	200 m	75 m
Maximum Drop Length	6 m	6 m	6 m
Cumulative Drop Length	156 m	78 m	39 m

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DeviceNet is a connection-based network similar to Ethernet's TCP/IP. When two devices establish a connection they exchange Connection ID Numbers. For most DeviceNet Messaging, messaging between a Master Device and a Slave device, the Connection IDs are predefined enabling low resource devices to optimize processing of these messages. Using the filters provided in a lot of CAN controllers, these messages are easily identified and processed while all other messages are quickly discarded.

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controllers, these messages are easily identified and processed while all other messages are quickly discarded.

For all but a few types of connections, two connection IDs are allocated. One, the produced Connection ID is allocated for the message transmitted by the device. The second is the consumed Connection ID, the Connection ID used in the message consumed by the device. The Connection IDs are an integral part of DeviceNet messaging and are a part of the message prioritization scheme.

The CAN Identifier in every DeviceNet message is composed in part of the DeviceNet Address and the Connection ID for the message. The lower the Connection ID/DeviceNet address combination the higher the priority of the message on the network. In some networks with certain types of messaging schemes using lower Mac ID addresses for higher priority devices is a valid optimization strategy.

3. MICROSOFT ACTIVE DIRECTORY

Microsoft Acticve Directory (AD) is a networkwide database that stores resource information about a LDAP directory services, Kerberos-based authentication, DNS-based naming and other network information, central location for network administration and delegation of authority, information security and single sign-on for user access to networked based resources, the ability to scale up or down easily, central storage location for application data, synchronization of directory updates amongst several servers.

3.1. AD Structure

Active Directory allows you to systematize your network resources in a hierarchical, object-oriented, and in a manner that fits the way in which you supervise those resources. Replication between domain controllers has been redesigned, from the single master model used in Windows NT to a multimaster model in which all domain controllers are equal (or *peers*, to use the proper terminology) there are no more primary domain controller (PDC) and backup domain controller (BDC) issues. This means much more efficient replication process and ensuring that no single point of failure exists within a domain.

Probably the most interesting, and potentially prevailing, feature of Active Directory is your skill to organize resources to fit the IT management philosophy used in your company. This hierarchy, or tree, structure is the backbone of an Active Directory. As shown in Figure 3, a graphical representation of an AD tree looks much like a graphical representation of a file system directory structure.

AD uses *objects* correspond to network resources such as users, printers, or share points. *Containers* are specialized objects necessary to organize network resources along. In above figure for instance, the company has three offices: Brasov, Sibiu, and Cluj. Given that most users will utilize resources located physically near them, it makes sense to create containers that represent physical sites. Within the Brasov office, the network resources (notice that users are nothing more than another resource on the network) are departmental, so the AD design reflects this through the creation of departmental containers.

The best analogy for the AD tree structure is to look at the file system. You could create folders and subfolders to organize your files; folders were created for easier access (it’s much easier to find your spreadsheets if they are all stored in a single directory) and to ease management (if all of your data is within a folder, you can easily configure your backup software to back up your critical data).

AD containers bring together objects that have similar fields. You could to apply a specific group policy to all manufacturing users, and get same type of management in your environment. Active Directory supervises the relationships between objects within the tree, by default creates the appropriate trust relationships between domains, and shows you with a regular view of your network.

You will notice that each object represents some “manageable” feature of the network. Each container represents a grouping of resources, and each individual resource is represented by a unique AD object. Each of

these object classes (container, user, printer, etc.) is assigned a set of fields that describe the individual resource. User objects, for instance, have fields that are pertinent to users: names, passwords, addresses, telephone numbers, and so on. There are two major benefits of this type of object-oriented design.

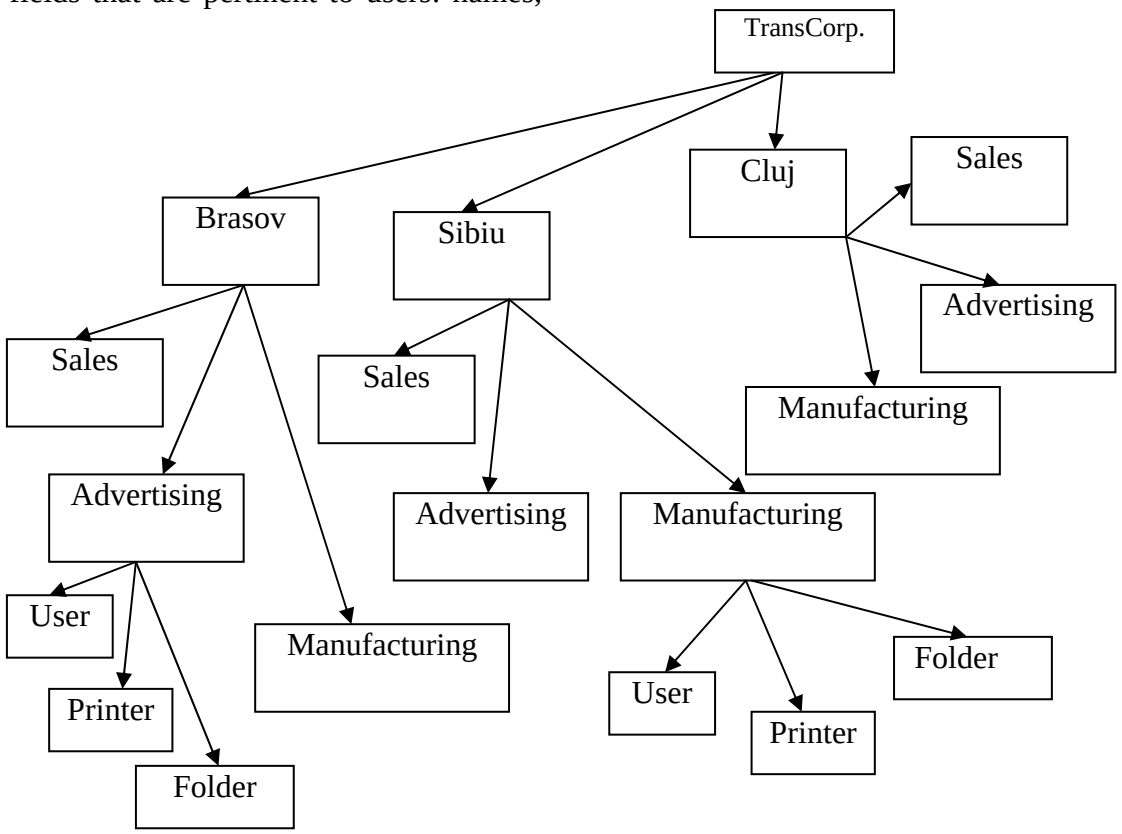

Fig. 3. The Active Directory hierarchy

First, since each object within AD is really only a record in a database that could describe the needs of the company. For instance, a DeviceNet object integrated in AD could be explained throught next fields: REQUIRED OBJECTS, APPLICATION OBJECTS, and VENDOR SPECIFIC OBJECTS. And APPLICATION OBJECTS could keep the fields: IDENTITY OBJECT, MESSAGE ROUTER OBJECT, DEVICENET OBJECT and CONNECTION OBJECT.

The second benefit of an object-oriented design is that each object represents an individual resource same as APPLICATION OBJECTS, and each attribute (IDENTITY OBJECT, MESSAGE ROUTER OBJECT, DEVICENET OBJECT and CONNECTION OBJECT) represents a unique aspect of that resource. This means the system can include an inherent security mechanism. In the case of AD, each object has an ACL that describes who has been given permissions to access the object. For example, you might want to allow somebody to check a DeviceNet state , but not to perform any other administrative tasks over the device.

Active Directory is breake up into network forests, followed by domains, followed by Organizational Units, or OUs. The top-level Active Directory container is the forest, and each forest can contain one or more domains. Each AD domain can likewise contain one or more OUs. Above figure has just one forest with a domain www.transcorp.com, three subdomains:

www.brasov.transcorp.com,
www.sibiu.transcorp.com,
www.cluj.transcorp.com,

and nine sub-subdomains, for example:

www.sales.brasov.transcorp.com,
www.brasov.accounting.transcorp.com

and 27 OU (organisational units) User, Printer, Folder, etc. OUs form logical administrative units that can be used to delegate administrative privileges within a domain. Rather than add another domain to an existing structure, it is often more advantageous to just create another OU to organize objects. Organizational units can contain the following types of objects: Users, Computers, Groups, Printers, Applications, Security policies, File shares, Other OUs. There are various *models* of good OU structures. A model defines categories of OUs and the relationships between them. The model you create for your tree should follow the business practices of your company. More than in any other form of network, a directory-based network demands that administrators understand the business practices and workflow of their company before designing the system. Creating an OU model can be a difficult task, especially on your first attempt. Since a good design makes your life (and the lives of your fellow administrators) easier in the long run, you would like to come up with a good, stable design the first time! With this in mind, some "cookie-cutter" models have been designed to act as guides during the planning stage of your own design. Microsoft suggests seven different basic models for OU structures: Geographic, Object-based, Cost center, Project-based, Division or business unit, Administration, Hybrid or mixed.

CONCLUSIONS

For example for a manufacturing company a design of OU unit could be in project-based method, or mixed method. In tree domain of AD a DeviceNet chain could be connected using a industrial 104 PC, a Single Board Computer or a PLC all of them with Ethernet plug. For a PC OU, AD allow to do a lot of operations:

- The Anatomy of a computer Object
- Creating a Computer
- Creating a Computer for a Specific User or Group
- Deleting a Computer
- Joining a Computer to a Domain
- Moving a Computer Within the Same Domain
- Moving a Computer to a New Domain
- Renaming a Computer
- Adding or Removing a Computer Account from a Group
- Testing the Secure Channel for a Computer
- Resetting a Computer Account
- Finding Inactive or Unused Computers
- Changing the Maximum Number of Computers a User Can Join to the Domain
- Modifying the Attributes of a computer Object
- Finding Computers with a Particular OS
- Binding to the Default Container for Computers
- Changing the Default Container for Computers
- Listing All the Computer Accounts in a Domain
- Identifying a Computer Role
- Protecting a Computer Against Accidental Deletion
- Viewing the RODCs That Have Cached a Computer's Password
- in graphical interface, command prompt or VBScript. Using this kind of proprieties we coul set up Group Policy Objects (GPO) for DeviceNet bus administration. GPO could be the object which remote access trought CIP Objects Protocol. We could treat CIP Object Protocol like object with three attributes REQUIRED OBJECTS, APPLICATION OBJECTS (DEVICENET OBJECT connect Actice Directory to any equipment), VENDOR SPECIFIC OBJECTS. Any PLC or industrial computer could be remote accessed through PC OU, and set up a GPO.

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ELECTRICAL HEATING DEVICES FOR VEHICLES

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Abstract: *As modern vehicles are getting more efficient, the internal combustion engines offer improved efficiency and dissipate less heat to the cooling system of the engine. The waste heat is often insufficient, especially on cold days, either for the fast heating of the passenger compartment or for obtaining comfortable temperatures. To eliminate the heating deficit, auxiliary heating devices are required.*

The paper is focused on characterizing the PTC heaters used in vehicles. A test bench was developed to determine the thermal characteristic of the PTC heater. Based on experimental results, a model and simulation are proposed. The thermal uniformity of the PTC heater is analyzed by using the thermograph method.

The obtained data will be used for establishing the thermal behavior of the PTC heater at high currents and for controlling the temperature in order to properly design the heater and, therefore, to improve the thermal comfort of the passengers.

Key words*: thermal comfort, positive temperature coefficient heater, thermal characteristic, heating, vehicle, thermal uniformity.*

1. INTRODUCTION

In the last years, along with the trends of reducing costs, weight and of improving vehicle safety, the interest in ensuring an optimal thermal comfort for the passengers inside the vehicle has increased [1].

Generally, the thermal comfort is ensured by using the conventional heating system of the vehicle. The conventional heating system uses the heat loss produced by the internal combustion engines, which is transferred to the cooling system of the engine. Since modern vehicles are getting more efficient, the internal combustion engines offer improved efficiency and dissipate less heat to the cooling system of the engine. The waste heat is often insufficient, especially on cold days and in the city driving, either for the fast heating of the passenger compartment or for obtaining comfortable temperatures [2, 22]. To eliminate the heating deficit, auxiliary heating devices are required.

The positive temperatures coefficient heaters (called PTC heater) are used in vehicles as auxiliary heating devices. These devices are adequate for ensuring the passengers' thermal comfort, due to the capacity of thermal self-regulation and high response time. The PTC heaters increase the performance and spontaneity of the conventional heating system, especially in winter time and cover the necessary heat during the starting regime of the vehicles until the engine reaches its operating temperature. They are also necessary for quickly removing the condensed drops from the windscreen and therefore for improving the visibility through it [3, 4].

The paper is focused on the characterization of the PTC heater used in vehicles as an auxiliary heating device. A test bench was developed to determine the thermal characteristic of the PTC heater. The thermal characteristic is obtained within the temperature range of -50 °C ÷ +210 °C. Based on experimental results, a model and simulation of the PTC heater are proposed.

The final aim is to simulate the overall heating process inside the vehicle. In order to

do that, a flow diagram for switching progressively the PTC heater power stages is made. The integration of the PTC heater model in the vehicle heating flow diagram for overall heating process will allow the optimization of the heating ventilation and air conditioning system.

The thermal uniformity of the PTC heater is analyzed by using the thermograph method [5]. The thermal maps have been obtained, indicating the minimal and maximal values of the temperatures and showing the temperature distribution on the entire PTC heater geometry.

The obtained data will be used for establishing the thermal behavior of the PTC heater at high currents and for controlling the temperature in order to properly design the PTC heater and, therefore, to improve the thermal comfort of the passengers inside the vehicles.

2. PTC HEATER

The PTC heater is an auxiliary heating device which was developed to increase the efficiency of the conventional heating system, especially in winter-time and therefore to control the passenger's thermal comfort inside the vehicle. There have been some difficulties as regards the fact that the PTC heaters demand a large quantity of energy and thus they function only when the engine is running.

After the increase in the fuel prices in 2006, research has shown renewed interest in fuel efficient vehicles. Various vehicles from the manufacturers around the world are equipped with PTC heaters. For example, in 2007, in Europe, 65 % of the diesel vehicles were equipped with PTC heater and this is expected to rise to 90 % by 2010 [3], [4].

Research is currently conducted on the PTC heaters, in which new materials and structures are analyzed and proposed [5], [6], [7]. However, the design method related to the general development of the thermal comfort systems is still missing.

The most important manufactures such as Denso, Behr, Eberspaecher and Valeo are carrying out researches and developing new concepts for heating systems. For example, Denso developed a heating system equipped with two layer flow function. The two-layer system halves that loss by recirculating warm air in the lower half of the passenger compartment and routing fresh air through the upper half. It thus prevents window fogging while keeping passengers comfortably warm. Behr is developing three kinds of auxiliary heaters: electric PTC heaters and CO2 heat pumps for spontaneous heating of the supply air and exhaust gas heat exchangers for faster heating of the coolant. Eberspaecher developed booster heaters supplied by fuel. The coolant picks up the heat from the combustion chamber of the booster heater and the heated air is blown inside the vehicle.

Commonly used PTC materials include high density polyethylene and titanate ceramic materials [6, 7, 8]. The barium titanate ceramic material is mostly used in automotive industry because of its high resistance and power-dissipation characteristics. Several authors have studied the resistance – temperature dependency of PTC heater [9, 10, 11]. Over the years, various theoretical and experimental models have been developed to describe the thermal behavior of the PTC heaters, such as Jonker, Wang and Gagge [6, 8, 9, 10]. The most accepted model is developed by Heywang [7, 10].

PTC heaters use the PTC thermistor principle. The PTC thermistor has a low value of electrical resistance at low temperatures. When a voltage is applied to the cold elements, a high current is generated and the value of resistance rises with the temperature. As soon as the current flows through the device, the elements warm up by electrical dissipation until a steady state is reached and the resistive elements have reached their working temperature. This triggers the reduction of the electric current because the electric charge is unable to cross the boundaries of the tiny crystals at high temperatures. For this reason, the manufacturers of auxiliary heaters require the use of the PTC thermistor principle [12-16].

PTC thermistors have specific features: thermal self-regulation and efficient energy consumption, no excess temperature protection required, no smell, no radiation and oxidation,

fast thermal response time, temperature setting from +50 °C to + 320 °C, compact design and long life service [3, 17].

The PTC heater is mounted inside the heating ventilating and air conditioning system (HVAC), after the heat exchanger, placed under the dashboard in the passenger compartment. In Fig. 1, there is shown the air flow inside a HVAC system with PTC heater.

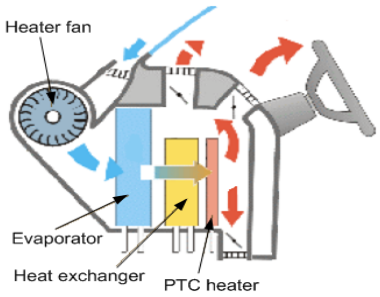

Fig. 1 Air flow inside the HVAC system with PTC heater

The PTC heater is connected to the vehicle electrical system and it is controlled by the Electronic Control Module of the vehicle, HVAC front control panel and relays. The control depends on the current available, the auxiliary heating need and the desired temperature [17, 18].

In Fig. 2, there is shown the heating system diagram with PTC heater.

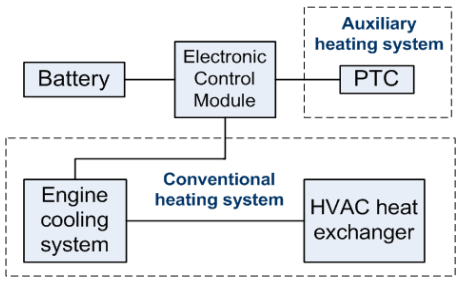

Fig. 2 Heating system diagram with PTC heater

In Fig. 3, there is illustrated a PTC heater structure, which consists of an electrical connector with pins "1" and the resistive heating elements "2", which are held together in a frame by plastic spring elements "3" [2].

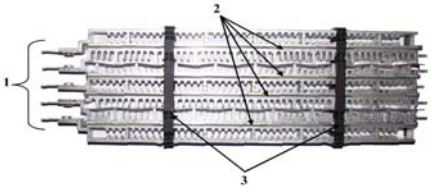

Fig. 3 PTC heater structure

In Fig. 4, there is shown the PTC resistive heating element structure, which consists of small metalized ceramic plates "1", layered alternately along the unit core with aluminum radiator elements "2". The aluminum elements ensure the electrical contacts and transfer the heat to the passing heater air flow [2, 3].

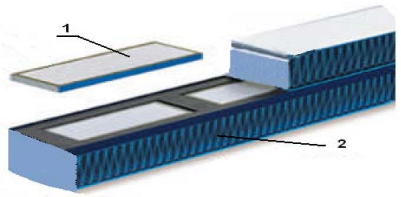

Fig. 4 PTC resistive heating elements

The heating resistive elements are separated in different heating circuits (or power stages) in order to adapt the heating power to different requirements and they act as positive temperature coefficient resistors. The maximum value of the temperature at the surface of the elements is around 165 °C, and the temperature of the metal frame around 110 °C, if no air flows through the heating system [2, 3].

The power stages are switched progressively in order to reduce the demand factor of the generator, to prevent load dumps and ECM problems caused by high currents. Generally, a PTC heater is composed of 3÷6 power stages (200 W, 300 W or 400 W), controlled separately by relays. Each power stage can be composed of 1÷4 small resistive heating elements.

The PTC heater operates only: (i) at low external temperatures; (ii) when insufficient heat is supplied by the engine cooling system; (iii) and at reduced loads of the generator.

Generally, the PTC heaters demand a large quantity of energy. The total electrical power consumption for a PTC heater ranges between 900 W ÷ 2000 W, depending on the air volume of the vehicle interior. Vehicles equipped with PTC heater are fitted with a more powerful generator. This fact leads to increasing the fuel consumption and pollution.

The thermal resistance characteristic prevents the PTC heater from overheating. Moreover, the PTC heater has a reduced response time and high spontaneity. It

generates heat after the vehicle is started and it is also necessary for the quick removal of the condensed drops from the windscreen and therefore for the improvement of the visibility through it.

3. EXPERIMENTS AND RESULTS

A. Thermal characteristic of a PTC heater

To model simulates a process which takes place inside the HVAC system with PTC heater; the thermal – resistance characteristic of the auxiliary heating system is required.

In order to measure and obtain the thermal – resistance characteristic, R = f (T), a test bench was developed. The test bench consists of a heating camera type Carbolite PF/200, a cooling camera type Derby DK 9620 and two temperature sensors placed inside the heating/cooling camera. The obtained data are processed using adequate software, by means of MatLab/Simulink tools.

In Fig. 5, there is shown the proposed test bench.

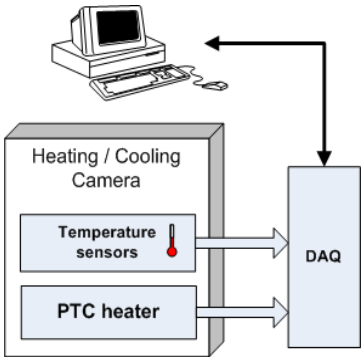

Fig. 5 Test bench for determining the PTC thermal characteristic

To make the experiments, a Denso type - 1000 W / 13.5 V PTC heater sample was used. This sample consists of four power stages, in order to adapt the heating power to different requirements. The power stages are switched progressively in order to reduce the demand factor of the generator and to adapt the demand of the interior air temperature.

In Fig. 6, there is illustrated the PTC heater sample electrical diagram with four power stages.

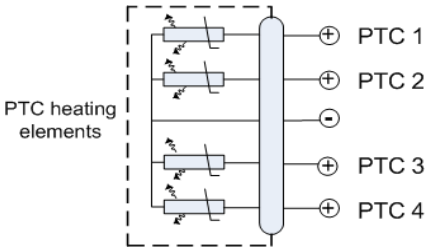

Fig. 6 Electrical diagram of the PTC heater sample

The performance characteristics of the PTC heater sample used in the experiment are illustrated in Table 1.

Table 1 PTC Heater performance characteristics

PTC element	1	2	3	4
Steady state current [A]	22,2	29,6	22,2	29,6
Peak current [A]	26,8	35,7	26,8	35,7
Steady state power [W]	333,3	166,6	333,3	166,6

In Fig. 7 there are illustrated the typical thermal resistance characteristics $R = f(T)$ for a PTC heater. This typical thermal characteristic will be the basis of the experiments.

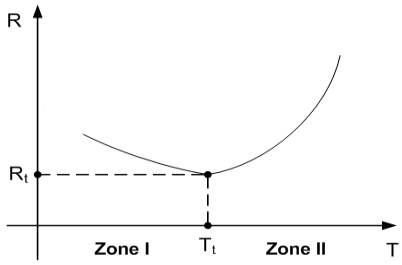

Fig. 7 PTC thermal resistance characteristic

The experimental results representing the thermal resistance characteristics $R = f(T)$, for PTC heater are illustrated in Fig. 8.

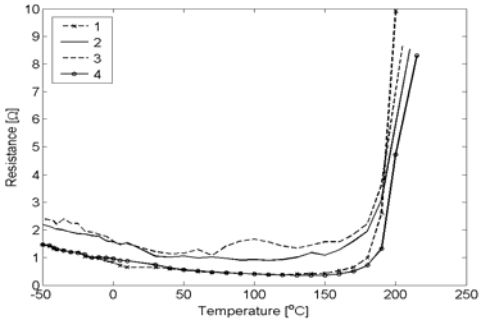

Fig. 8 R=f(T) characteristic

As it can be seen in Fig. 8, the obtained data show that the resistance initially decreases once with the increase in temperature, until a threshold temperature (T_t) is reached. In this region, the resistance curve has a negative temperature coefficient. At a minimal value of the resistance and specific threshold temperatures, the resistance increases and the resistance curve changes in a positive temperature coefficient.

The experiments were made in the temperature range of -50 °C ÷ +210 °C, the threshold temperatures (T_t) being in the range of 110 °C ÷ 130 °C. The slope of the linear dependences has reduced values and practically the resistance values are approximately constant in range -50 °C ÷ T_t. After the threshold temperature is reached, the slope of the exponential dependences rapidly increases in the range of temperature T_t ÷ 210 °C.

The minimal values of the resistance (R_t) obtained at specific threshold temperatures (T_t) and the calculated values for the temperature coefficient of the resistance α_R (for the negative and positive slope), for each power stage are given in Table 2.

Table 2 $R(T)$ characteristic parameters

PTC element	R_t [Ω]	T_t [°C]	α_{R-} [K^{-1}]	α_{R+} [K^{-1}]
1	0,36	120	- 0,0044	+ 0,937
4	0,35	130	- 0,0042	+ 0,984
2	0,89	110	- 0,0037	+ 0,285
3	1,34	130	- 0,0024	+ 0,211

The values of the resistance require specific thermal regulating process characteristics of the PTC heater. The thermal resistance characteristics are appropriate for preventing the PTC heater overheating. Based on these coefficients, the PTC heaters can be properly designed.

A mathematical model was obtained by interpreting the experimental data from the thermal resistance characteristics of the PTC heating power stages. The thermal resistance characteristics can be described by the following two dependences:

a.) for $T \in [T_{\min}, T_t] \rightarrow$ linear dependences:

$$R(T) = R_{01} - m \cdot T \quad (01)$$

b.) for $T \in [T_t, T_{\max}] \rightarrow$exponential dependences:

$$R(T) = R_{02} \cdot e^{b \cdot T} \quad (02)$$

Both of the equations can be approximated with a linear dependence and an exponential dependence. In Fig. 9, there is illustrated the mathematical model described by these two equations (1) and (2).

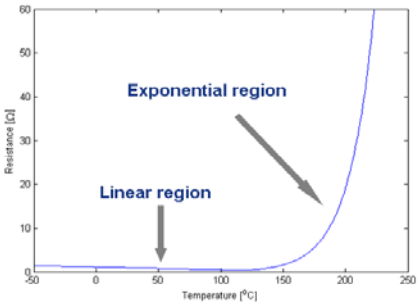

Fig. 9 PTC heater model

By using MatLab/Simulink tools, the data are processed and the simulation results for thermal resistance characteristics for PTC heating power stages are shown in Fig. 10.

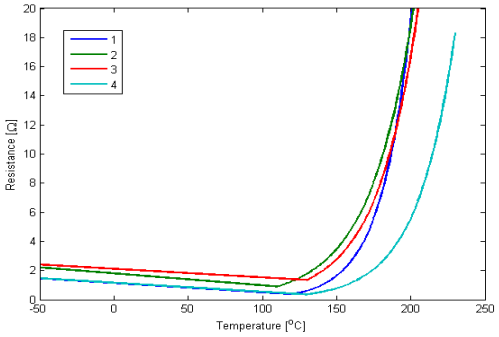

Fig. 10 Simulation results for thermal resistance characteristic

Error analysis was made in order to validate the experimental results. The deviation (δx) and relative error (εx) are calculated between measured (xexp) and simulated (xsim) values, as following:

1.) for deviation: $\delta_x = x_{exp} - x_{sim}$

2.) for relative error: $\dfrac{|x_{exp} - x_{sim}|}{x_{exp}} = \dfrac{\delta_x}{x_{exp}} = \varepsilon_x$

The results are given in Table 3, (where: RE – relative error; DR – deviation range; MD – maximal deviation; TMD – temperature at maximal deviation).

Table 3 Relative error and deviations

PTC	1	4	2	3
RE [%]	0,78	0,64	0,65	1,50
DR [°C]	150÷200	150÷200	150÷200	150÷200
MD [Ω]	2,95	2,30	4,93	5,05
TMD [K^{-1}]	+ 190	+ 190	+ 190	+ 190

In Fig. 11, there is shown the graphical analysis between measurements and simulation results.

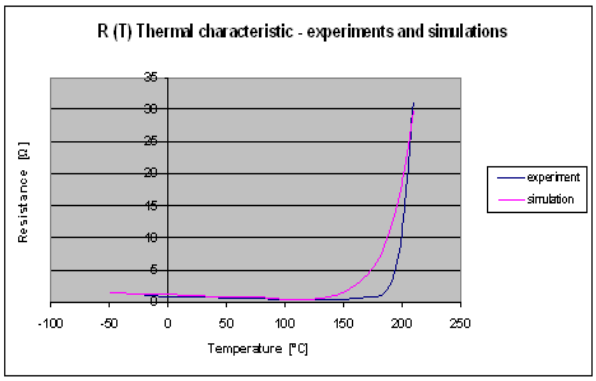

Fig. 11 Simulation results for thermal resistance characteristic

As it can be seen in Fig. 11, the deviation ranges between 150÷200 ºC and the temperature at the maximal deviation is 190 ºC.

The obtained values of the parameters and the characteristics can be compared with those from specialized literature. The PTC heater tested above proved to have the same characteristics with those from a typical PTC thermistor model. The developed test bench allows testing these characteristics rapidly, efficiently and accurately.

The final aim is to simulate the overall heating process, illustrated in Fig. 12 and consisting of: CP – control panel; HVAC – heating ventilation and air conditioning system; PTC – positive temperature coefficient; MVPR – power resistive variation module; GMV – group motor-heater fan; BAT – battery; ECU – electronic control unit; REL – relays module.

In order to simulate the entire vehicle heating process the model and simulation of the PTC heater presented above will be used.

The electronic control unit (ECU) permanently monitors and compares the values of the outside and inside temperature. Based on this information and depending on the heating need and the desired temperature set on the control panel, the switches module is enabled and controls the PTC heating circuits.

In Fig. 12, there is shown the PTC heater control process.

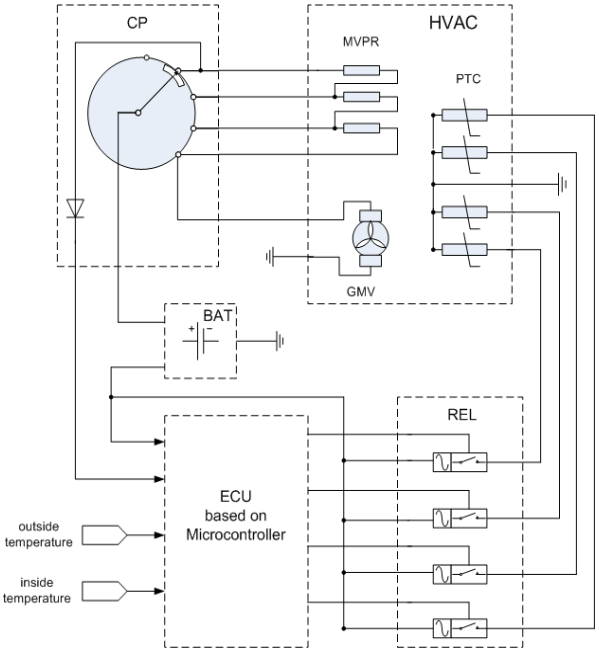

Fig. 12 PTC heater control process

The integration of this PTC heater control process in the vehicle heating flow diagram will improve the heating ventilation and air conditioning system by using a specific algorithm for controlling the thermal comfort.

B. Thermal uniformity of the PTC heater

In the process of designing and manufacturing the PTC heater, thermal uniformity is essential. Temperature measurement and control is one of the significant variables for thermal uniformity across these processes [19].

The analysis of the thermal uniformity of the PTC heater is made by using the thermographic method [5, 19].

The thermographic method is useful to determine the thermograms, to indicate the minimal and maximal values of the temperatures and it also shows the temperature distribution on the entire PTC heater surface.

There are two types of thermographic methods, depending on the activation of the thermal object: passive and active. In passive thermography, there are no interferences in recording temperature states and temperature changes on surfaces. Active thermography evokes thermal processes and then records surface temperature distribution and temperature processes [20].

The thermographic method has the following advantages: (i) it shows a visual picture so that temperatures over a large area might be compared; (ii) it is able to identify bad electrical connections, imbalances, overloads and other impending electrical equipment failures; (iii) it can be used to find defects in shafts, pipes and other metal or plastic parts; (iv) it can be used to see better in dark areas.

The disadvantages of the thermographic method are the following: (i) the images can be difficult to interpret accurately when based upon certain objects, the accuracy being ±2 %; (ii) due to the low volume of thermal cameras, the quality cameras often have high prices; (iii) accurate temperature measurements are hindered by varying emissivity and reflections from other surfaces.

The heating process of the PTC heater sample was analyzed as function of power variation by alternatively switching the PTC heating power stages. In this sense, the thermal uniformity of the PTC heater was studied and analyzed by using the thermographic method.

Temperature in thermographic methods is measured using sensitive and very quick thermal imaging cameras [21].

To determine the PTC heater thermogram, the voltage-current method was implemented. The test bench consists of a DC power supply, an ammeter, a voltmeter, the PTC heater sample described above and a thermal imaging camera type Fluke Ti9.

Several experimental determinations of the thermal distribution on the PTC heater surface were made, by supplying the PTC heater with the following currents: I = 1 A; 3 A; 5 A; 10 A; 15 A; 20 A. The experiments were made without air flow through the PTC heating system. The thermal maps have been obtained, indicating the minimal and maximal values of the temperatures and showing the temperature distribution on the entire positive temperature coefficient heater geometry.

In Fig. 13, there is shown the obtained thermogram, when all four heating power stages of the PTC heater are supplied with a current I = 15 A.

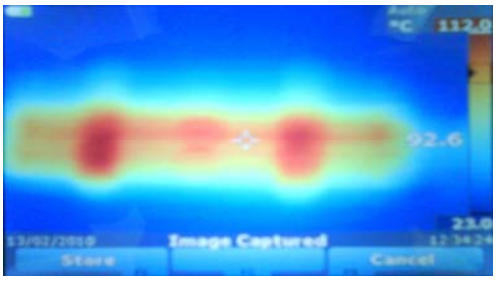

Fig. 13 PTC heater thermography by supplying with I = 15 A

The thermal analysis of the obtained thermography allows the following comments: (i) the heat is dispersed on the entire surface of the PTC heater; (ii) higher temperature values are registered in the region of the PTC heating elements; (iii) the maximum value of the temperature is around 112 °C, obtained at the surface of the PTC heater; (iv) the temperature values measured between the heating elements are around 92 °C; (v) and, at the edges of the PTC heater, the temperature is lower.

Achieving a uniform temperature on the surface of a PTC heater can be limited because of the thermal conductivity of the construction materials. The geometry of the heater can have a significant impact on asymmetric losses and aggravates the thermal non-uniformity. The thermography is used for the PTC heater design, in order to obtain the most effective distribution. Even with the most effective heater layout, the thermal uniformity may need improvement. For researchers, improving the thermal uniformity becomes also a main problem.

4. CONCLUSIONS

The PTC heater is a solution for increasing the passenger thermal comfort, especially in winter time.

Because of the high response time, the PTC heater is useful after the vehicle is started: till the engine reaches its operating temperature, the conventional heating system does not supply the necessary heat for the interior air. This additional heat can practically be accounted to the PTC heater.

The proposed test bench allows a rapid and efficient measurement of the thermal characteristics of the PTC resistive heating elements.

The experimental determination of the thermal characteristics allows the development of the PTC model, which is useful in auxiliary heating design.

The thermal uniformity is essential in the process of designing and manufacturing the PTC heater, in order to measure and control the temperature and therefore to achieve the optimal thermal comfort.

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COMPARISON OF ELECTRIC SOURCES IN THE CZECH REPUBLIC AND AFRICA WITH THE INTENTION OF SOLAR ENERGY

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ABSTRACT: *The focus of this article is utilizing solar cells to reduce the dependence of military logistical support on traditional energy requirements. The paper compares two different countries – Czech Republic and Chad, which could be next place of military operation for the Czech armed forces. Cut down the dependence of military forces on traditional energy supplies could positively and significantly influenced logistic support of battle troops.*

KEYWORDS: *Czech Republic, Chad, solar cell, solar energy, solar radiation.*

1 INTRODUCTION

The Earth captures only about one two-billionth of the total Sun power. Specific energy flow reaches the surface in strenght around **1360 W/m²**. In the Earth's energy balance is assumed that the radiation coming from the sun occurs in about 1/3 to direct reflection from clouds, dust and particles from the surface, the remaining 2/3 is reshaping than eventually the Earth radiation is sending back into space. Part of radiation energy is concentrated into watercourses and other part into wind energy during these transformations. Biosphere processes about 1 ‰ (or 0.1%) of solar radiation. [1].

Solar radiation is strongly influenced by the current weather, atmospheric pollution (city, industrial area), Sun location in the sky during the day and year (height above the horizon and azimuth), shade, temperature and other local conditions [2]. For weather it can be simply stated that because of clouds cover the Sun reaches the surface only 5 to 30% of radiation, in small clouds 30 - 60% compared with 100% during absolutely clear sky.

2 CONDITIONS IN THE CZECH REPUBLIC

There are relatively good conditions for the solar energy utilization in the Czech Republic, in spite of fluctuant amount of solar radiation within year. The highest amount of solar radiation reaches the Earth atmosphere in phase, when the heat and electricity consumption is the lowest.

It falls **800 – 1250 kWh** yearly per 1 m^2. Total sun radiation time moves around **1400 – 1800 hours**, in the mountain regions **1 600 hours** and in the south Moravian lowland regions **2 000 hours** per year [3].

The Czech Republic is becoming central European big power in the solar power stations area despite of consideration the solar electricity production inexpedience. Its competitiveness is based on generous endowment policy and energy redemption value, which exceed severalfold classic sources price.

Month	Irradiation at inclination: (Wh/m2/day)
	0 deg
Jan	730
Feb	1401
Mar	2423
Apr	3747
May	4922
Jun	4944
Jul	5121
Aug	4352
Sep	2851
Oct	1922
Nov	813
Dec	539
Year	**2822**

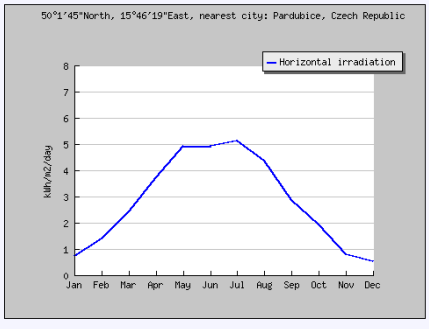

Table 1 Solar radiation in the Czech Republic (Pardubice) monthly [4]

It is obvious from the table 1 that the most solar radiation is reaching this region within summer months.

3 CONDITIONS IN THE CHAD

Africa is the third largest continent, which major part lies on the eastern hemisphere. In the solar energy utilization point of view it is one of the best places for solar system installation. Solar energy flow is more uniform and very often **3 times higher** than in the Czech Republic.

African continent for the comparison was not picked randomly, but because of multinational operations of European Union battle groups (EU BG). These operations could be the main initiator of solar cells massive using for the military purposes.

Opposite high solar radiation in Africa it is necessary to consider high temperature. Photovoltaic cell, which is warmed up, decreases its efficiency. The second main disadvantage to consider is risk of faster physical degradation and efficiency degradation by reason of drift sand.

Month	Irradiation at inclination: (Wh/m2/day)
	0 deg.
Jan	6019
Feb	6483
Mar	6848
Apr	6985
May	6804
Jun	6438
Jul	5605
Aug	5348
Sep	6148
Oct	6609
Nov	6256
Dec	5856
Year	**6280**

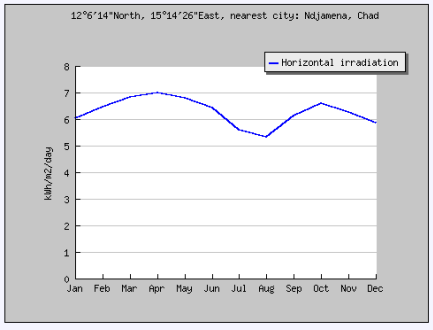

Table 2 Solar radiation in the Chad (Ndjamena) monthly [4]

In the case of African continent, more precisely Ndjamena city in Chad, the amount of solar energy is **2.25** times higher then in Pardubice. Estimated profit of solar cells utilization should be higher also. Solar radiation is the lowest during the summer months.

4 CONCLUSION

African continent provide significant amount of solar energy in comparison with the Czech Republic. Huge solar potential is cut by high ambient temperatures. Total energy profit could be 1.7 times higher. It means **3,251 – 4,334 kWh** per year for **17 m²** photovoltaic surface. In the Czech Republic it is only **2,015 – 2,492 kWh** on equal footing.

Solar energy could bring significant breakthrough in military field and Czech armed forces operations in Africa.

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MODULUS FUNCTIONS OF NOISE MARGINS FOR TTL INTEGRATED CIRCUITS

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Abstract: *This paper presents the modulus functions of present-day TTL integrated circuits. There are illustrated both the general and peculiar modulus functions of the noise margins for TTL integrated circuits.*

Keywords: logic integrated circuit, TTL, logic level, noise voltage, noise margin

1. Introduction

The TTL integrated circuits have evolved fastly towards high performances and increased complexity, becoming the logic integrated circuits with the largest utilization [1] – [4].

There is a diversity of functional parameters which must be considered for their using in apparatus and equipment destined to various applications. The noise margins have a distinct importance for the appreciation of functioning in the presence of electromagnetic disturbances [5] - [36].
The paper is organized as follows. The theoretic considerations regarding the definition of noise margins are presented in Section 2. The noise margins functions are developed in Section 3. Finally, conclusions are provided in Section 4.

2. Definition of noise margins

Considering the NAND Gates connected as shown in Fig. 1, the input voltage VI of the NAND Gate Load is equal with the output voltage V0 from the NAND Gate Driver, so that

$$V_I=V_0 \ (1)$$

If an unwanted voltage called as "noise voltage VN" is induced into conductors between the NAND Gate Driver and the NAND Gate Load, from adjacent current-carrying conductors, as seen in Fig. 2, the input voltage VI becomes

$$V_I=V_0 \pm V_N . \ (2)$$

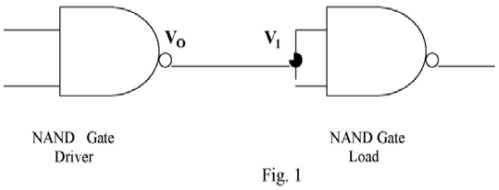

Fig. 1

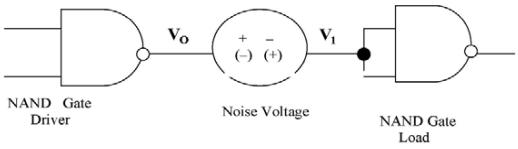

Fig.2

Corresponding to the logic levels low (L) and high (H), we have the input voltages :

$$V_{IL}=V_{OL} \pm V_{NL} \ (3)$$

and

$$V_{IH}=V_{OH} \pm V_{NH} \ (4)$$

respectively.
The worst case values are:

$$V_{IL}=V_{OL}+V_{NL} \ (5)$$

and

$$V_{IH}=V_{OH}-V_{NH} \ (6)$$

From (5) and (6), we obtain:

$$V_{NL} = V_{IL}-V_{OL} \ (7)$$

and

$$V_{NH} = V_{OH} - V_{IH} \ (8)$$

respectively.

The noise voltages VN_L and VN_H are known as"direct current noise margins", being denoted by NM_L and NM_H, respectively.

With (7) and (8), the noise margins NM_L and NM_H can be expressed as

$$NM_L = V_{IL}-V_{OL} \quad (9)$$

and

$$NM_H = V_{OH}-V_{IH} \quad (10)$$

respectively.

The noise margins NM_L and NM_H represent the maximum values of the noise voltages that assure the functioning of the TTL integrated circuits without destroying them and without degradation of L and H voltage levels.

3. Modulus functions of noise margins

We can write the modulus functions of the noise margins NM_L and NM_H in the forms

$$f(V_{IL},V_{OL})=|V_{IL}-V_{OL}|=\begin{cases} V_{IL}-V_{OL} & if \quad V_{IL}>V_{IL}\geq 0 \\ 0 & if \quad V_{IL}=V_{OL} \\ V_{OL}-V_{IL} & if \quad V_{OL}>V_{OH}\geq 0 \end{cases} \quad (11)$$

and

$$f(V_{OH},V_{IH})=|V_{OH}-V_{IH}|=\begin{cases} V_{OH}-V_{IH} & if \quad V_{OH}>V_{IH}\geq 0 \\ 0 & if \quad V_{OH}=V_{IH} \\ V_{IH}-V_{OH} & if \quad V_{IH}>V_{OH}\geq 0 \end{cases} \quad (12)$$

respectively.

In a general form we have

$$f(V_1,V_0)=|V_1-V_0|=\begin{cases} V_1-V_0 & if \quad V_1>V_0\geq 0 \\ 0 & if \quad V_1=V_0 \\ V_0-V_1 & if \quad V_0>V_1\geq 0 \end{cases} \quad (13)$$

Using (11)-(13) we find

$$f(V_{IL},V_{OL})=f(V_1,V_0) \quad if \quad V_1=V_{IL},V_0=V_{0L} \quad (14)$$

$$f(V_{OH},V_{IH})=f(V_1,V_0) \quad if \quad V_0=V_{OH},V_1=V_{IH} \quad (15)$$

$$|V_{IL}-V_{OL}|=|V_1-V_0| \quad if \quad V_1=V_{IL},V_0=V_{0L} \quad (16)$$

$$|V_{OH}-V_{IH}|=|V_1-V_0| \quad if \quad V_0=V_{OH},V_1=V_{IH} \quad (17)$$

The function given by (13) can be called as general modulus function and those of (11) and (12), as peculiar modulus functions.

4. CONCLUSIONS

The noise margins have a distinct importance for logic integrated circuits with the propose of appreciation the functioning in the presence of electromagnetic disturbances. Their values must be considered both in the choosing as in the using of TTL integrated circuits in apparatus and equipment destined for various applications.

The paper has presented the general and peculiar modulus functions of noise margins for the present-day TTL integrated circuits.

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EXPERIMENTAL SAMPLING OF THE GENERATOR MODULE FOR THE CONVERSION OF WAVE ENERGY INTO ELECTRIC ENERGY

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Abstract: *The objective, the scientific and technologic outcome of the paper reside on the research project regarding the setting-up a hydro-pneumatic station, starting from innovative elements, for the fruitful exploitation of the waves on the Black Sea and for the production of electric energy. In the paper we present the experimental sampling of the generator module for the conversion of wave energy into electric energy*

1. INTRODUCTION

The multi-annual regime of waves, as shown by the semi-instrumented measurements and recorded with an automatic gear along the coast of the Black Sea, has the following characteristics:

- Maximal value of the representative height 8.2 m
- Multi-annual average of the representative height 1.03 m
- Maximal value of the average period 9.8 s
- Multi-annual average of the average period 3.9 s

The calculation has been made taking into account the average wave specific to the Romanian seaside area with the following values:

- Average of the maximal heights 1.6 m
- Average period of the wave field 4.58

The wave energy is calculated as sum of the kinetic energy of waves and of their potential energy.

Potential energy can be calculated using the formula [1]:

$$PE = m \cdot g \cdot \frac{y(x,t)}{2}, \qquad (1)$$

in which:

- $m = w \cdot \rho \cdot y$, [kg],: wave weight;
- ρ: water density, [kg/m3];
- w: wave width, [m], considered equal to the room breadth;
- $y = y(x,t) = a \cdot \sin(kx - \omega t)$, [m]: wave equation, considered synusoidal waves;
- $a = h/2$, [m]: wave amplitude;
- h: wave height;
- $k = \frac{2\pi}{\lambda}$: wave number;
- λ, [m]: wave length;
- $\omega = \frac{2\pi}{T}$, [rad/sec]: wave pulsation;
- T: wave period.

Potential energy may be written as:

$$PE = w \cdot \rho \cdot g \cdot \frac{y^2}{2} = w \cdot \rho \cdot g \cdot \frac{a^2}{2} \cdot \sin^2(kx - \omega t)$$

Considering that $k=\frac{2\pi}{\lambda}$ and $\omega=\frac{2\pi}{T}$, we obtain $PE=\frac{1}{4}\cdot w\cdot\rho\cdot g\cdot a^2\cdot\lambda$.

The pneumatic turbine was coupled to the cam shaft of a cc electric generator with disk rotor and excitation by permanent magnets (tarred in the power range 0…3000 rot/min). The charging of the latter was adjusted by means of the electric resistance connected to the output clinch.

For the testing of the experimental module of hydro-pneumatic electric power plant powered by waves we need to experiment the turbine module within the exhaust pipe system.

After performing the assembly operations of the exhaust pipe system sections and a thorough check-up of their seal-proof quality we have determined of the working tire of the exhaust pipe system.

To this aim we have made use of the wind turbine existing with the national Institute of COMOTI turbo-engines of Research and Development. The experiment resided in varying the rotation speed of the cooling fan starting from a zero value to the maximal value- n = 1.500 rot./min. Measuring the speed of the air when entering the turbine was performed starting with a value of 30% of the rotation speed value, gradually raising the rotation speed with 10% for every new determination.

The determination of the air speed was determined with a Pilot tube, according to the chart.

Crt Nr	% of the engine rotation speed	Rotation speed of the cooling fan [rot. /min.]	Air speed [m/s]
1	30	450	5,40
2	40	600	6,81
3	50	750	8,76
4	60	900	10,276
5	70	1050	12,2
6	80	1200	13,97
7	90	1350	15,75
8	100	1500	17,25

The fitting for experiments of the turbine module is made of the following elements:

- pilot tube for measuring the air speed when entering the turbine;
- probe of air static pressure when exiting the turbine;
- temperature probe of the air when entering the turbine;
- force gauge for couple determination;
- for gauge for the determination of the axial force inside the turbine;
- optical display for measuring the rotation speed of the turbine

The generator module for the conversion of wave energy into electric energy (alternator module) is part of the column set which comprises the following basic sub-assemblies: superior section; alternator module; interior section.

The generator module (alternator), is the practical goal of all works and mainly resides as a constructive element in a one-way turbine with alternating mobile blades, blades which maintain their sense of rotation by adjusting their angle depending on the air current.

The turbine blades of an aerodynamic shape, and an interior cleft aimed at reaching a mechanical balance are made of stainless steel by cutting technology with wire electroerosion.

The turbine shell is sustaind by the main shaft by measn fo inferior and superiror ball-bearing subassemblies and is placed inside the protection shell of the turbine.

The entire construction of the generator is protected in a protection shell.

Fig. 1 – Turbine with partially set-up blades(axis blades, clinches and balancing counter-weights)

Fig. 2 – Protection section, alternation module

The air speed operating the turbine was determined following the pressure measurements from the upward section next to the turbine entrance (for a 600 mm diameter- by setting up a Pilot tube).

Based on the reports from the above-mentioned section and the section form the turbine entrance (for a 450 mm diameter) considering a constant flow-we have obtained flowing speed values of the air inside the turbine section of up to 35 m/s, taking into account the charge losses along the tunnel path.

The proper experiments were performed for one single air speed in the turbine of 35 m/s, taking into account the high energy consumption and the preparation for experimentation.

By varying the charge at the output marks enabled us to measure 6 points of proper functioning related to the exit power of the turbine, as well as the corresponding rotation speed.

In conformity with the measured values we have augmented the power characteristic of the pneumatic turbine for the value of 35 m/s of the air speed. (Fig. 3)

Starting form the classic formula $P = M \times \omega = M \times (\pi \times n)/ 30$, we calculate the cam shaft momentum for all the values resulted form the measurements (fig. 4).

The proper experiments were made for one single air speed inside the turbine of taking into account the elevated energy consumption and the preparation for experimentation.

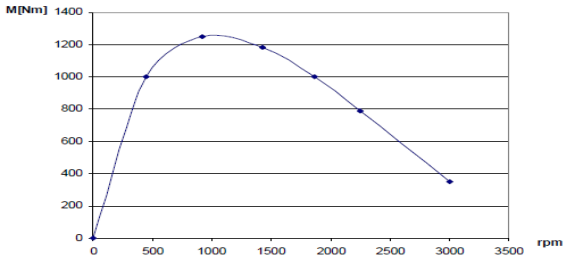

Fig. 3 - Power characteristic of the turbine depending on the cam shaft rotation speed

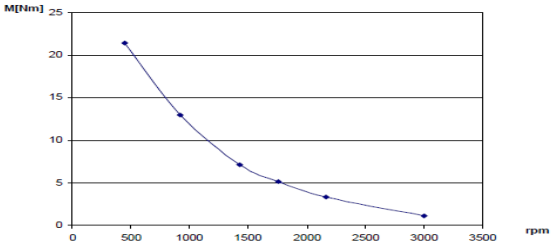

Fig. 4 Momentum characteristic depending on the cam shaft rotation speed

2. EXPERIMENTAL SAMPLING OF THE GENERATOR MODULE

With a view to checking the constructive solution of the multi-blade turbine we have performed numerical simulations in a CFD environment (Computational Fluid Dynamics).

For the achievement of the 3D model of the turbine module we have used the documentation drawn-up by the coordinating partner INCDIE ICPE CA.

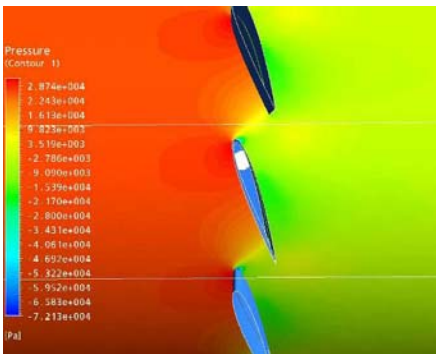

Fig.5 – Field of relative pressure values

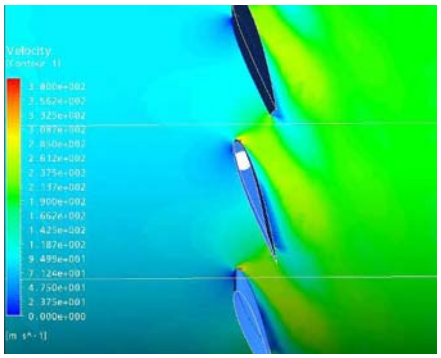

Fig.6 – Speed field

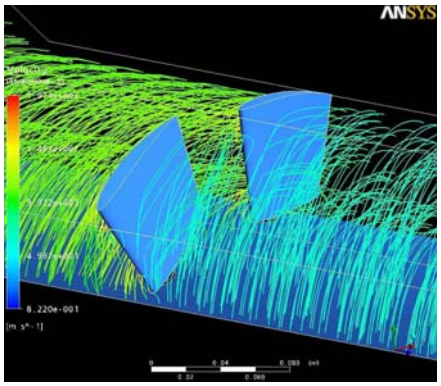

Fig.7 – Power lines

In figure 7 we can notice the power lines indicating the circulation of air within the multi-blade turbine.

3. GENERAL CONCLUSIONS

We have built and have experimented a generator module for the conversion of wave energy into electric energy. The experiments performed on the pneumatic turbine have been achieved within the aerodynamic tunnel from INCD COMOTI.

The engine for powering the blower blade is a tri-phase electric engine with a 37 kW power, having a maximal rotation speed of 1500rot. /min. For the setting-up of the turbine in the experimental stall we have built a support which allows the placing in the air flux, being able to adjust the position so that the rotation axis of the turbine rotor is in the center of the current tube.

The constructive solution of the pneumatic turbine was achieved by means of numerical simulations in a CDF environment (Computational Fluid Dynamics) by INCD COMOTI. For the achievement of the 3D model of the turbine we have used the documentation drawn-up by the coordinating partner INCDIE ICPE CA providing representations of the relative pressure field and the speed field.

The proper experiments were performed for a single speed of air inside the turbine of 35m/s. The calculation for the useful power was made by means of measurements for electric power and the rotation speed for the shaft.

We have elevated the power and shaft couple curves of the turbine for the air speed of 35m/s. For this speed we have noticed a compatibility of the turbine, extracting a maximal mechanical power of approx. 1.25kW. This observation leads to the conclusion that the pneumatic turbine will be able to extract at an air speed of 54m/s of the power within the range 4.5 – 5kW.

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THE ANALYSIS OF THE ELECTRO-ENERGETIC SYSTEM OF A SHIP HAVING ELECTRIC PROPULSION

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Abstract: *The introduction of the hydro-energetic systems in propulsion systems has a contribution in the improvement of the quality level of the electric energy. The main disadvantage of the electric propulsion systems is represented by the sensibility of the insulation and a qualified exploitation of the machinery. The advantage of the electric propulsion system is that in order to minimize the losses by the decrease of speed of the ship while maneuvering, the generators and the electric engines that are not used are electric released. In any electrical system function we must distinct between steady phenomena – characterizing the permanent functioning regime, and, the non-steady phenomena – a consequence of different operations of switching on or off different electric equipment, or other similar modifications of the state of the system*

Key words*: electro-energetic system, electrical propulsion, engine, generator*

1. THE ADVANTAGES OF USING THE ELECTRICAL PROPULSION SYSTEMS

Taking into consideration the qualities while exploitation, the electrical propulsion systems [6, 7, 8]:

- have a high level of security and reliability – at the electrical release of a propulsion electrical engine, the speed of the ship decreases only up to 13 %, permitting to continue the movement or the maneuver, the electrical engines are functioning constantly and the usage of variable pitch propellers simplifies its functioning;
- increase the maneuvering characteristics by reducing the time to bring the equipments in steady functioning regimes and by increasing the moments of rotation of the propeller axes. The maximum overload admitted for the turbines is 40 – 50%, for the diesel engines is 10 – 15% and, for the synchronous electrical engines is 150%. In the quick gear reversing, the brake moments of the propellers may go up to 300% making the electrical propulsion engines to resist at overload moments of up to 200%, applicable for the direct current electrical engines;
- have wide possibilities to realize the remote control – the commands initiated in the conn are rapidly fulfilled, using simplified electrical schemes that eliminate the errors that may occur in processing the chadbourn commands; the introduction of the automation leads to simpler commands, increasing the speed in fulfilling them;
- have reduced expenditure of electrical energy – in the case of functioning in intermediate and maneuvering regimes this feature is significant because of the absence of the rigid transmission allows the switching off of different propulsion engines. The number of the cruising days is up to 20% bigger for ships using electrical propulsion than for ships using classical diesel propulsion, and the machinery can be changed without influencing other installations, using the modal method;
- allow the power supply of auxiliary electrical systems by the generators of the ship and the transfer of energy between different

ships, consequently reducing the fuel consumption;
- usage of time is improved by the reduced fuel consumption, especially when the load of the ship is different from cruise to cruise. The electrical propulsion used at the dynamic positioning ships represents an advantage because it is possible to split the electrical energy according to the requirements: for the cruise or for the maneuvers. This action is impossible for the ships using classical propulsion;
- vulnerability is decreased for singular system malfunctions and the possibility of optimizing the loading of the main engines (gas or oil fueled) is increased;
- use light diesel engines with smaller couple and medium or high speed;
- have an installation that needs less space and is very flexible making its positioning possible all over the ship;
- have an installation that generates less noise and less vibration because of the electrical propulsion that needs shorter shaft propeller, because the main engines function at constant frequency, and the usage of variable pitch propellers decreases the effect of the cavitation by the regularization of the water flow towards it.

The electrical propulsion has the following advantages [2, 5, 9]:
- the command of the system is possible from all over the ship by the usage of a remote control;
- the reduction of the vibrations of the ship;
- speed adjustment and more precise maneuvering with easily inversion of the sense of rotation of the propeller by the inversions of the sense of rotation of the electrical power engines;
- the reduction of the size of different components of the equipments;
- the electrical feeding of the electrical propulsion engines by several generators and a more rational usage of the engines;
- optimal efficiency between different characters of service (maneuvering, mooring, loading - unloading);
- the electrical feeding in direct or alternative current depending of the type or power of the ship

All these modifications are shown by a series of perturbations determined by the variation of the quantity of energy in different parts of the system.

The increase of the value and of the density of the energy in different parts of the modern electrical systems led to the growth of the importance conferred to the transitory, electrical and mechanic phenomena, subdued by a corresponding instrumentation, in electrical systems.

Any switching operation is accompanied by a voltage and current variation in the network or by the frequency variation of the connected machinery. If this energy is focused in only one component, for example in the magnetic field of a generator, or in the electrical field of a capacitor, or in the inertial mass of the impeller of an engine – the variation of the energy reserves affects simultaneously all the system, after the switch.

The variation of the currents or of the voltages following a switching operation can not affect simultaneously all the elements of the circuit, because the variation of the current and of the voltage has a certain speed of propagation, very high but limited, in the shape of waves spreading from the point of switching in all the network.

2. THE DEMANDS IMPOSED IN PRODUCING, DISTRIBUTING AND CONSUMPTION OF THE ELECTRICAL ENERGY

In the production, distribution and consumption of the electrical energy, the followings are needed [1, 4, 7]:
- to ensure the safety in functioning of the machinery for the continuous electrical feeding of the equipments and electrical installations;
- to ensure the economic usage of the diesel engines, turbines, batteries and receivers of electrical energy;
- to ensure the quality of the electrical energy and the safety of the crew onboard the ship;
- to ensure the functioning of the automated surveillance, control, protection and alerting system;

The maritime electro energetic system must ensure:

- independent and parallel functioning of the generators;
- interconnection of the blocks of the main distribution panel;
- automated switching on or off of the equipments in stand-by state;
- protection of the generators, electrical engines and other consumers when abnormal functioning regimes;
- the functioning of the measurement and control equipment in case of overloading, short circuit, super or sub frequency, inversed power.

An electrical propulsion installation is made of:

- diesel engine or turbine to drive the generator;
- electrical generator;
- electrical propulsion engine

During the exploitation of the electro energetic system all the demands of the classification registers must be fulfilled and all the usage instructions of the equipments must be followed.

The electrical equipments must have usage safety, related to the conditions of exploitation. They must have high insulation properties, in order to resist to the conditions aboard the ship, to ensure normal functioning at high temperatures and humidity conditions, to preserve their mechanical and dielectric characteristics, to have a minimum price, high reliability, simple exploitation, reduced noise, to resist to electromagnetic influences that can appear aboard the ship.

The entire equipment used onboard ship must ensure the normal functioning of all the consumers and eliminate the apparition of disturbing factors.

The electrical propulsion of the ship is used worldwide both in direct or alternative current.

The usage of synchronous engines, and asynchronous engines with high power levels led to a cruise speed of medium tonnage vessels bigger than 38 knots.

The electrical driven propulsion systems for the ships are made by using the cicloconvertors and asynchronous engines. The used frequency used is 400 Hz and has a big importance in the economic functioning of all the receivers. The decrease of the frequency leads to the decrease of the rotation speed of the engines that determines the failure in achieving the parameters of the maritime installations. Maintaining the frequency and the voltage at constant levels is possible due to the automated regulators.

The functioning of the entire propulsion system is realized with computers that surveilles and generates reference signals both of frequency or voltage based on specialized software.

The introduction of modern equipment, of new tipes of synchronous generators, of synchronous and asynchronous engines, of automated devices and new maritime machinery will lead to the development of the electrical maritime propulsion,

The engineering of variable speed devices, first of direct/alternative current rectifiers and of direct/alternative current convertors, became the background of the propulsion systems based on the electrical power plants that were characteristic to the second generation of the electrical propellers. The integrated propulsion was introduced in the early 1990s, where the electrical engine is installed directly on the axis of the propeller becoming a submersed azipod system. This concept was designed to increase the performance of the ice breakers, and, after that were improved from the point of view of maneuovering and hydrodynamic efficiency [3, 4].

The electrical propulsion is permanently the subject of the research and evaluation for the usage in different applications.

The electrical propulsion is mostly present in the construction of: ice breakers, cruise ships, supply ships, stranding and maritime constructions.

The commercial ships usually have both the electrical installation of generators and the distribution system in alternative current. The generators are synchronous engines, with the magnetic winding of the impeller in direct current and a magnetic 3- phase stator, where the magnetic field created by the impeller induces a sinusoidal 3- phase voltage when the impeller is driven by the axis of the main

diesel engine. The frequency f [Hz] of the induced voltage is proportional to the speed of rotation n [rot/min] and the number of poles of the synchronous engine.

$$f=\frac{p}{2}\cdot\frac{n}{60}$$

The direct current is transferred to the magnetic winding of the impeller through brushes or sliding rings. The modern generators are equipped with excitation brushes as to reduce the cost of the maintenance and to increase the time of the usage.

The excitation brushes engine is an inverted synchronous engine with the magnetization of the winding of the impeller and of the stator in direct current and with revolutionary rectifier diode.

The rectified current feeds the magnetic winding The excitation is controlled by a voltage stabilizer that records the value of the final voltage on the generator and compares it with the reference value. In more simple words, the controller has specific characteristics, with steady effect that creates a voltage with a value depending by the electrical load of the generator. The voltage provides the equal distribution of the reactive power on the generators in parallel connection. The variation of the steady voltage must not exceed ±2.5% of the nominal voltage. The biggest variation of the transitory regime must not exceed the limits -15…+20% of the value of the nominal voltage. As to obtain these conditions for the transitory regime, the voltage stabilizer is equipped with a function of voltage control and measuring the current on the stator.

Completing the magnetic winding, the impeller is equipped with a winding dumper consisting of axial copper bars wrapped on the external edge of the poles of the impeller, and short circuited by a copper ring on both ends. The main reason for this winding is to introduce an electromagnetic dumper on both the impeller and the stator. A synchronous engine without dumper will generate frequency oscillations for any variation of the electrical load.

3. CONCLUSIONS

The maritime electro energetic system is a unitary complex that includes the production, the distribution and the consumption of the electrical energy.

The advantage of the electrical propulsion system is that in order to minimize the losses due to the decrease of the speed of the ship in maneuvers, the unloaded generators and electrical engines are electrically released.

The wide range of power installations, propulsion installations and of safety and automation systems represents the main factors in obtaining the maximum usage time for the ships. The safety and automation systems necessary to monitor, protect and control the electrical propulsion power plant and the electrical propeller systems became more and more important for an optimal and reliable usage of the installation.

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Design of Asynchronous Digital Systems With Locally Clock Method

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Abstract: *In present paper, the authors propose a method for synthesis of the asynchronous digital systems using locally clock method.*

Keywords: *Digital logic, FSM, Fluence Graph, D Flip-Flop Latch, Transition Table, Logic Gates.*

1. INTRODUCTION

Driving an asynchronous digital system is a such complex task instead synchronous systems. The authors propose a method for synthesis of the asynchronous digital systems using Verilog HDL, and implement themintoFPGA devices, [1,2,3]. The proposed method presented in this paper has many features like:

- execution speed much better;
- maximize the combinational/sequential digital logic
- maximize the design performances (speed, low power, size)

A such of system is presented in figure 1. It contains the combinational logic modules, D type latches, input signals named input1,input2...inputN, output signals named output1,output2.....outputM, state variables named s1,s2...sk. The combinational system which implements an internal drive in signal, it is used for controll the states of the digital system, disposal the hazard phenomenon from the digital systems. The entire system transit into a new state driving by the input signals which need to be stabile a period of time before changed and by the present states of the system.

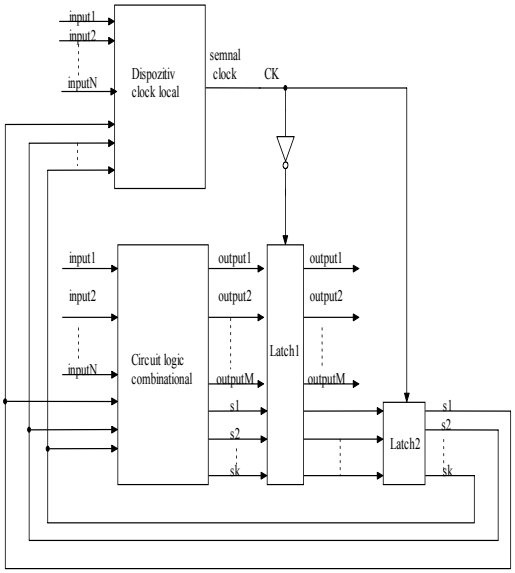

Fig.1. Digital Asynchronous System

In figure 1 it's shown the consist modules of the digital system:

- drive in signal device;
- combinational system who implements the system states equation ;
- D type latch1, latch2 are used to memorise the state of the system and also the outputs of the system;

The drive in signal (1) depends by the system's states notated with Q_i, input signals notated with X_j, where i=1,2,…n-1, j=1,2,…m-1; (n- states number variables, m-input number variables).

$$CK = F(Q_i, X_j) \qquad (1)$$

If signal CK=1 the system will go onto a new state, if CK=0 the system will stay in present state, it will can read the output values signals. While the states and outpus signals are computed, the input signals will not be changed, the system will work in fundamental mode.

2. DESIGN OF ASYNCHRONOUS DIGITAL SYSTEM WITH LOCALLY CLOCK METHOD

Let's consider an asynchronous digital system with functionality described by the fluence graph, figure 2:

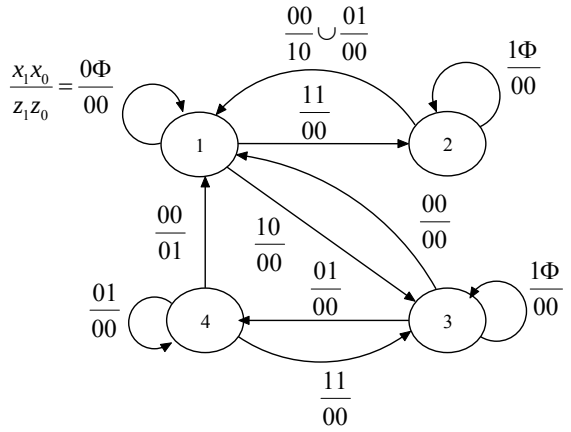

Figure 2. Graph table

The fluence table is described in figure 3.

Q_{n+1}/z_1z_0

$(x_1x_0)_n$ / Q_n	00	01	11	10
1	1/00	1/00	2/00	3/00
2	1/10	1/00	2/00	2/00
3	1/00	4/00	3/00	3/00
4	1/01	4/00	3/00	-/--

Fig.3. Fluence graph table

The equations are like, (2):

$$D_1 = y_{1,n+1} = [y_1(x_0 + x_1) + \overline{y_0}\,x_1\,\overline{x_0}]_n$$
$$D_0 = y_{0,n+1} = x_{1,n}$$
$$z_{1,n} = (\overline{y_1}\,y_0\,\overline{x_1}\,\overline{x_0})_n \qquad (2)$$
$$z_{0,n} = (y_1\,\overline{y_0}\,\overline{x_0})_n$$

The CK truth table is deducted from fig.3, like in fig.4:

y_1y_0 / $(x_1x_0)_n$	00	01	11	10
00	0	0	1	1
01	1	1	0	0
11	1	1	0	0
10	1	0	1	-

Fig. 4. CK truth table

Using the Veitch-Karnaugh, method it will compute the CK's equation (3):

$$CK = \overline{x_1}\,y_0 + x_1\,\overline{y_0} + \overline{x_0}\,y_1\,\overline{y_0} \qquad (3)$$

The D flip-flop circuits are described in fig.5:

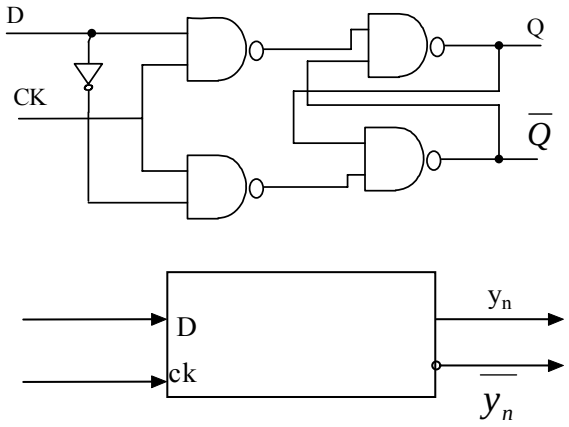

Fig.5. D flip-flop

z_1, z_0 - represents the outputs of the system
y_1, y_0 – represents the state of the system

The output signals z_1, z_0 and state signals y_1, y_0, has attached a D flil-flop latch. The D flip-flop latch1 stores the output signals while the latch2 stores the states signals. They are triggered on the positive clock signal – CK.
After a delay time, the CK signal is reseted who let the latch1 to be triggered.
The design of the proposed system is like in fig. 6.

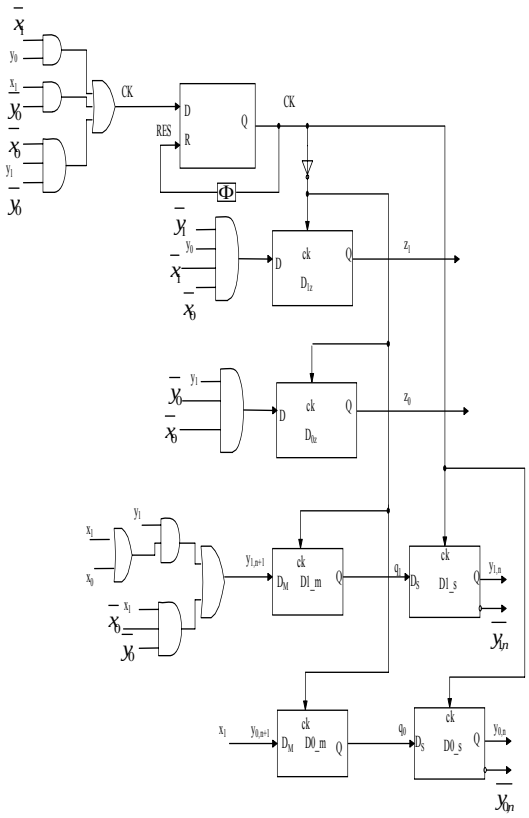

Fig 6. Design with D flip-flop

The entire digital system must meet the following restrictions:

- The minimum propagation delay of CK signal through the combinational system must be greater than the maximum propagation delay for every logic circuit which implements the input/output signals.

- Once the CK signal is triggered it can be reseted without digital hazard.

- Usign the improoved design described above, the entire asynchronous digital system will work concordant with the specifications.

3. CONCLUSIONS

- The CK signal and the output signals must be free of logic hazard inorder to met the system run concordant with the specifications;
- The minimum propagation delay of CK signal through the combinational system must be greater than the maximum propagation delay for every logic circuit which implements the input/output signals.

- Once the CK signal is triggered it can be reseted without digital hazard.

- Usign the improoved design described above, the entire asynchronous digital system will work concordant with the specifications.

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TARGET THERMAL SIGNATURE IN IR IMAGES

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Abstract: *Each target has got a unique thermal signature which is, with some reservation, possible to identify and classify. By analyzing thermal signature the decisionmaker can react in an advantageous manner to his interests or objectives. By analyzing the thermal signature a target can be recognized and one could tell if it is a real or a decoy target.*

Key words: *thermal signature, target, IR image.*

1. INTRODUCTION

Thermal Imaging uses infrared technology to detect small differences in temperature. Every material has a unique thermal signature and when moisture, heat, cold or material failure are introduced the thermal signature changes. The changes can be subtle or dramatic but with a trained inspector and this technology they are detectable where they wouldn't be able to be seen with the naked eye. This is used in conjunction with other technology and experience to help identify issues and concerns during the inspection process.

In today's advanced military operations, the concern for protection and survivability has increased, due to the increasingly diverse and asymmetric environments in which these operations take place. In the past, armored vehicle survivability has relied largely on penetration avoidance. Today, we are addressing the survivability technologies developed, to meet the objectives of detection avoidance, hit avoidance, penetration avoidance and advanced situational awareness.

Thermal imaging (TI) systems can indicate the presence of, or recent presence of enemy forces. Even an empty airfield can show signs of recently departed aircraft due to the heat generated by their engines: the heated tarmac showing up as a TI signature quite clearly.

For observation with thermal imagers it is the difference in target and background temperature that causes the contrast. Different from visual (reflective) contrast the difference in temperature is not caused by the properties of the surfaces alone, but rather a number of properties of the bulk material as well as the influences from the environment, the weather conditions. The temperatures in the nature vary fast with the weather conditions and time of day, and different materials like rock and grass changes temperature differently. This causes the temperature differences (the contrast) also to change fast.

2. THERMAL SIGNATURE COMPONENTS

Each of the equipment items, if not protected, emits a set of signatures because of its design and configuration. Although this set of signatures is unique to the equipment type, each of signatures can be described generically to assist in devising protective techniques.

A first component of the thermal signature is that caused by internally generated. Engine exhaust gases are led through a muffler system to open air. In all cases there is a resulting exhaust gas "plume" whose size and temperature varies with the size of the engine. In most cases the muffler system is exposed to the air and is in itself a detectable signature. Radiators by their nature are exposed to the air and thus also present detectable signatures, although not of the magnitude of the engine or exhaust.

Most tacked vehicle and many communications systems are equipped with

small power units auxiliary to the main engine, to permit low-power operation of communications equipment. Such auxiliary power units do generate thermal signature, but they are of concern primarily at night, when all other elements of the system are quiet and cool.

A second component of the thermal signature is that caused by exposure to the sun. The effects are solar heat loading and diurnal variations. The solar heating phenomenon begins with the fact that most mobile tactical equipment is first, made of metal, and second, is dark in color for camouflage reasons. As a result, when such equipment is exposed to the sun, it absorbs heat quickly and retains the heat throughout exposure. The speed and degree of heating are directly related to the construction of the specific equipment.

A third component of the overall thermal signature of a military unit is influence of equipment on the adjacent ground and air. Ground tracks, exhaust emissions, and dust clouds are the major considerations.

As the mobile equipment items transit their area of operations, wheels and tracks impinge upon the ground and disturb the ground surface. This action results in a heated ground track, which can be detected by thermal sensors after the passage of the equipment, in addition to its availability as a classic visual cue to military activity.

When the transit is made under dry condition, it is also common that the movement action generates dust, which is thrown up into the exhaust cloud and floats with it. Depending on air temperature and wind conditions, this exhaust gas/dust cloud can linger in the area and present a thermal signature after passage of the equipment.

Fig.1 – Examples of thermal signatures (helicopters, helicopter on the ground, truck)

Thermal signature almost always results from the difference, or contrast, between the target and its immediate background. Imaging sensors see internal target detail and external shape detail. Therefore, target signatures are defined by their pattern features. Those features are unique only to the extent that their proprieties differ from those in the background. Thus, resolved target signatures depend on background intensity mean values as well as on clutter intensity variations on a size scale comparable to internal target detail. Background spatial, spectral, and intensity characteristics are key to target signature generation and signature suppression.

3. EQUIPMENT

For the measurements and analysis presented in this paper it was used a system specially developed for heat transfer analysis.

The system has the following capabilities:

- target detection, recognition and identification;
- radiometric parameters analysis;
- high speed image recording;
- thermal signature evaluation in 3 ÷ 5 μm and 8 ÷12 μm spectral domains.

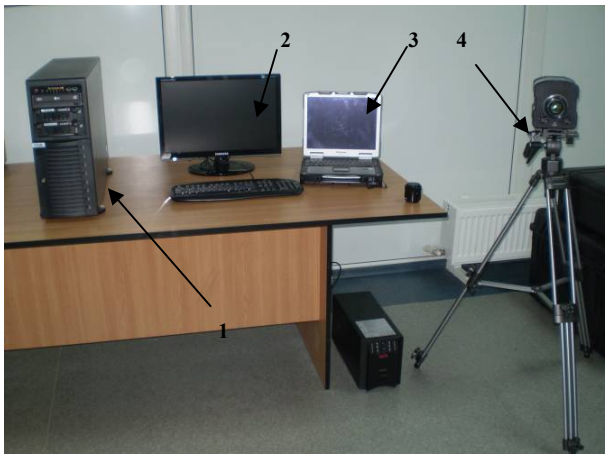

Fig.2 – Thermal signature analyzing system

The main components of the system are:

1. High speed data recorder with RTools Software for real time data analysis. The RTools software is a modular software package developed for engineers and scientists to acquire, radiometrically calibrate, process, and analyze data from various digital infrared camera systems.
2. Monitor;
3. Fully ruggedized Laptop for field data acquisition;
4. FLIR SC6000QWIP and FLIR SC 4000HS thermal imagers with 25 and 50 mm/ 13 and 100mm lens.

4. ANALYSIS

The detection represents the first level of observation and assumes that something is seen in the visual field of the optoelectronic device, something that is different from background and shows interest for the observer. Detection range represents the measured value from observation point to target in the visual field of optoelectronic device.

The observation stages are: detection, recognition and identification.

The detection process can be separated into four independent primary areas, which can be characterized as follows:

- Target-to-background radiation contrast
- Attenuation processes
- IR systems
- Countermeasures (camouflage and smokescreens)

Information on parameters related to targets, backgrounds, sensor systems, and atmosphere must be obtained:

- to validate model calculations,
- to determine detection and especially identification clues on the target,
- to train automatic target recognizers,
- to develop countermeasures, for design purposes and as input for simulation models (operational research).

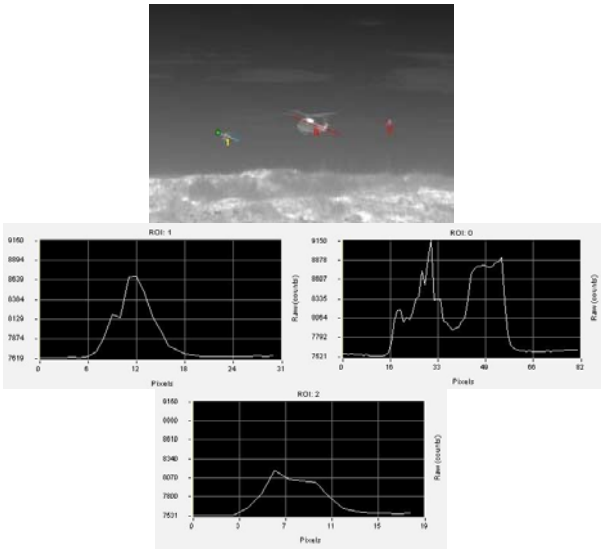

Fig.3 – Thermal signature for three helicopters at different ranges (1-100m, 2-300m, 3-500m)

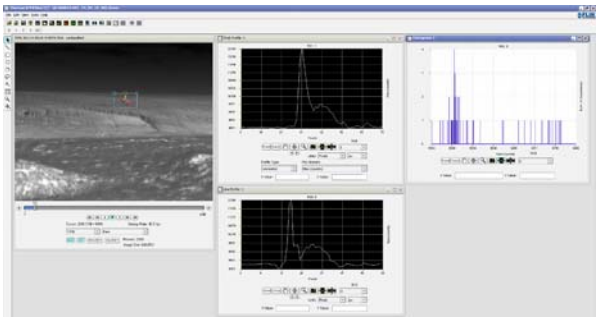

Fig.4 – Analysis of a helicopter at low altitude

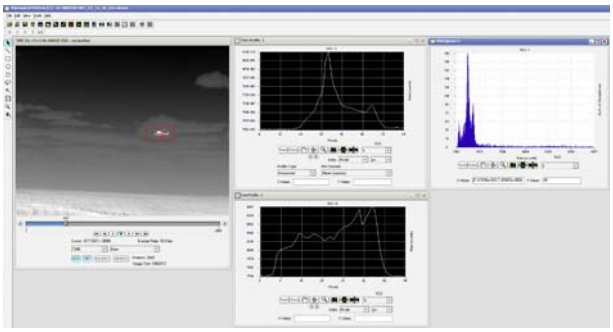

Fig.5 – Analysis of a helicopter at high altitude

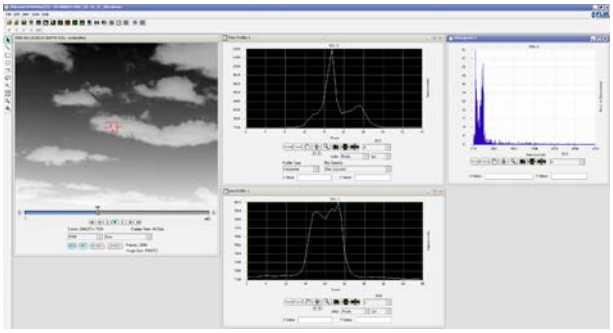

Fig.6 – Analysis of a helicopter at high altitude with cloudy background

The outcomes from the analysis allowed to identify the following issues:

- The detectability of the helicopter in look-up and, at high altitude, near horizon sensor view is mainly driven by the helicopter flight conditions due to the generally cold background radiance generated by the sky.
- The detectability of the helicopter in look-down and, at low altitude, near horizon sensor view is driven by the specific scenario condition and by the helicopter flight conditions due to the generally warmer background radiance generated by the surface.
- The cloudy sky background condition can modify these general findings due to the increase of average radiance values and increase of clutter content caused by the scattered sun radiation.

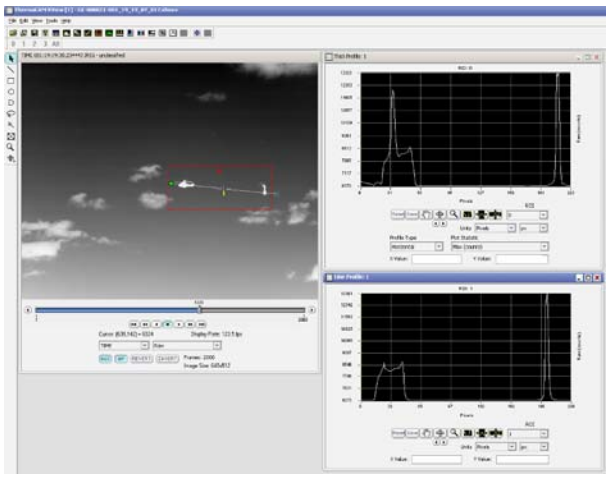

Fig.7 – Analysis of a countermeasure effectiveness

In fig.7 it is analyzed the effectiveness of a countermeasure used by the helicopter. In the graphics we can see that the countermeasure temperature is higher than helicopter temperature. Also the burning time allows the pilot to take a maneuver for hit avoidance.

5. CONCLUSION AND RECOMMENDATIONS

The following conclusions must be considered:

- Simple techniques and innovative tactics are effective in countering the use of sophisticated sensors and precision weapons.
- The technologies and tactics used by an adversary are numerous, commercially available, and deserve constant attention.
- Adversaries are exchanging signature modification information, technologies, and tactics.
- Absolute belief in technological dominance is risky.

It is essential that NATO commanders and tacticians understand the potential threat provided by the presence of the countermeasures during conflicts. Also, those NATO precision weapons designers consider the effects of the countermeasures during operational testing.

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LIDAR, SATELLITE IMAGES AND TRAJECTORY MODELS FOR INVESTIGATING LAYERS OF AEROSOLS AND DUST DANGEROUS FOR AIRCRAFTS

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Abstract: *Lidar data helps us to investigate and identify the type and height for layers of aerosols and dust. Satellite image gives us a better view of the phenomenon that created that layer as well as its dynamics in Earth's atmosphere. Trajectory modeling gives us additional information about a layer's height evolution in time.*

Key words: *Lidar, Satellite data, trajectory*

1. INTRODUCTION

In the last decades it has become more and more obvious, that mankind is endangering the habitability of its own biosphere. Most of the potential risks for our environment are produced by human activities and are mediated through the chemistry and physics of the atmosphere:

- air pollution resulting from industrial combustion and biomass burning;
- changes in the oxidation capacity of the lower atmosphere due to anthropogenic and changing biogenic emissions;
- global warming as a consequence of the increasing emissions for greenhouse gases;
- acidic precipitation;
- changes in precipitation and cloud coverage;
- climatic impact of changes in land use (e.g. tropical deforestation).

Another very important source of aerosol and dust are volcanic eruption that put huge quantities of ash, SO_2 and dust.

We hear very often the word "aerosol", but what is it?

Aerosols are a minor component of the atmosphere, a trace constituent, but their role is amplified by their ubiquity and interaction with the atmospheric radiation. Typical sizes of aerosol vary from 10-4 μm to tens of micrometers. They can be found in concentrations ranging from about 10^7 to 10^{-6} cm^{-3}, depending upon their size, origin, and location. The study of the atmospheric aerosols is important for a variety of reasons, from which we will consider the following:

- Aerosols influence the climate directly and indirectly by altering the radiative energy transfer through their optical properties;
- By serving as cloud condensation nuclei, they influence cloud - microphysical processes and therefore the development of clouds and precipitation which are important for weather and climate prediction and earth's hydrological cycle;
- Aerosols influence air, environmental pollution and often cause severe health-hazardous problems in human and any other animals [1].

2. EXPERIMENTAL

As a consequence of the changes in the climate and the strong pollution problems,

atmospheric science was intensively subsidized to develop new observational platforms, for modeling the future behavior of the atmosphere, to understand the historic development of climate, to monitor anthropogenic and natural emissions as well as to collect knowledge for policy makers to facilitate their decisions. The Lidar observation system and satellite technology has evolved and not only for military purpose but also for air pollution analysis.

The knowledge of aerosols is important for surveillance from air or satellite. To get better signals for all communication and observation through the troposphere, the knowledge of aerosols is important. If the aerosol distribution in the atmosphere is known, the researchers believe that predictions of mist can be done. This means, that an airport can receive information of when mist is coming, and send out warnings in case no airplanes should land or take off. Also on the sea, the knowledge of mist in advance can improve the daily life for transport companies. It can also be used as a detector in warning systems for bush fires, industrial smoke or smog since these are made of aerosols in most of their composition.

Lidar is an instrument for active remote sensing of various atmospheric variables. Lidar can be used to observe atmospheric trace gases, aerosols and clouds. There is a lack of knowledge about the distribution of these gases in the atmosphere and lidar measurements can contribute to increase the knowledge.

The lidar provides measurements of atmospheric components in the troposphere with high spatial and temporal resolution at day and night.

Molecules and aerosols are responsible for scattering and absorption of the incident light. Scattering by molecules include elastic and inelastic scattering processes whereas aerosols usually cause only elastic scattering. A telescope collects the backscattered light which then can be analyzed in a polychromator by one or several detectors. The height information is derived from the detection time taking into account that the laser pulse travels with the speed of light through the atmosphere.

Optical remote sensing has been extensively used to study the atmospheric aerosol pollutants. These techniques fall into two categories: active and passive remote sensing techniques. Remote sensors can be classified into three different types on the basis of the used platform: ground-based, airborne, and satellite borne [2].

For this paper there were used Lidar measurements, Range Corrected Signal image, that were made in Magurele, near Bucharest.

3. RESULTS AND DISCUSSION

The measurements were made in 22.07.2008 and are shown in Figure 1.

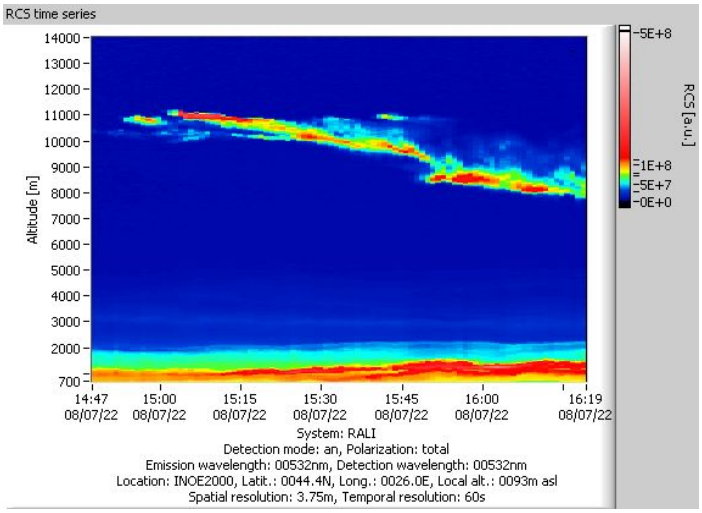

Fig. 1 RCS signal from LIDAR data in 22.07.2008 at INOE location

We can clearly see the aerosol intrusion and also the height of the layer. With the Lidar measurement there can be investigated the height and aerosol characteristics, but very important is the source and the dynamics for the layers of aerosols. In the case of volcanic eruptions where layers of ash and dust are formed, those kinds of clouds are very dangerous for aircraft because the engine will be damaged.

With the help of trajectory-models the dynamics of aerosols clouds can be investigated.

In the paper are used HYSPLIT model (collaboration between NOAA-National Oceanic and Atmospheric Administration and the Bureau of Meteorology from Australia). Meteorological data are used in the models to track the trajectory of the aerosol particles. In the HYSPLIT – "Hybrid Single Particle Lagrangian Integrated Trajectory" – model, a fixed number of particles are advected about the model domain by the main wind field and a turbulent component [3].

For this analyze, 9000 m, 10000 m and 11000 m altitude was used. These values were chosen from the RCS image analysis and are presented in Figure 2. The back-trajectories for the particles are calculated for 6 days period, 48 hours calculation time, specified in the input of the model.

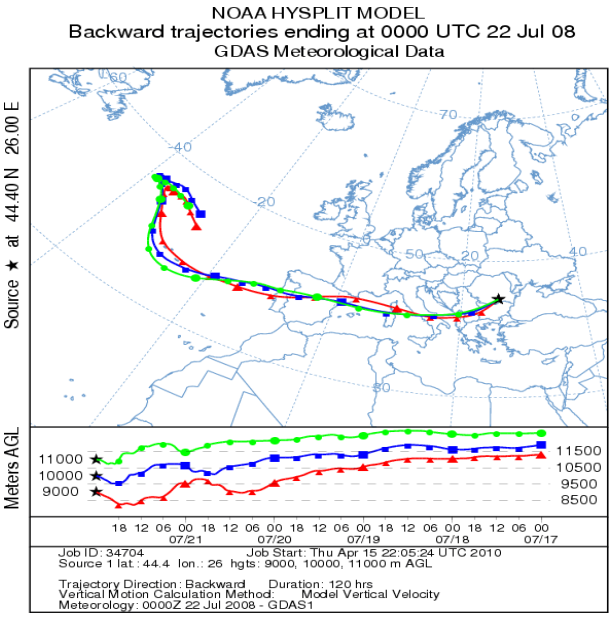

Fig. 2 Backward trajectories from NOAA HYSPLIT MODEL for 22 July 2008 [3]

The air masses that are over Magurele-Bucharest in the 22 of July came from the over the ocean at high altitude, over 10000 m, passing several countries from Europe and there is no indication of anthropogenic pollution mixed in from lower latitudes.

Satellite data can give us additional information related to the air masses and aerosols layers [4], [5]. For this specific evaluation of the Lidar measurements, satellite data from NASA/GSFC - TOMS integrated in NAAPS/TOMS model, for the 22 July 2008 is represented in Figure 3. For a better visualization of the trajectory also a satellite data from 19.07.2008 it is presented in Figure 4.

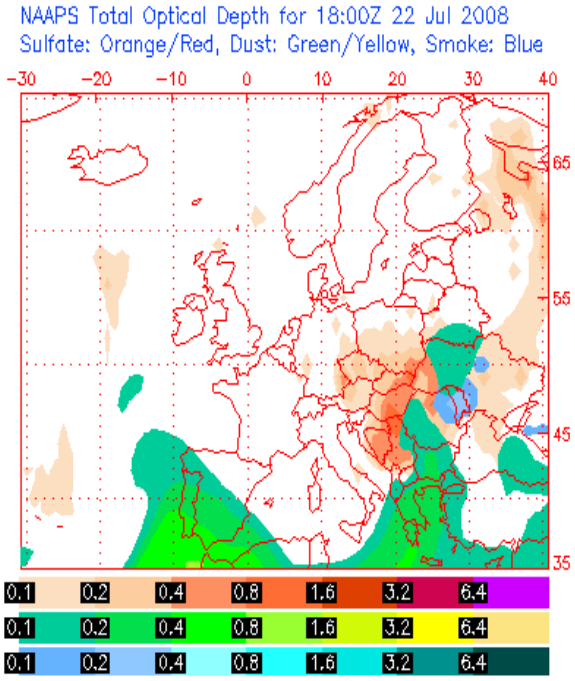

Fig. 3 NAAPS/TOMS measurements (Navy Aerosol Analysis and Prediction System) from 22 July 2008 obtained from satellite data and integrated in global model [6]

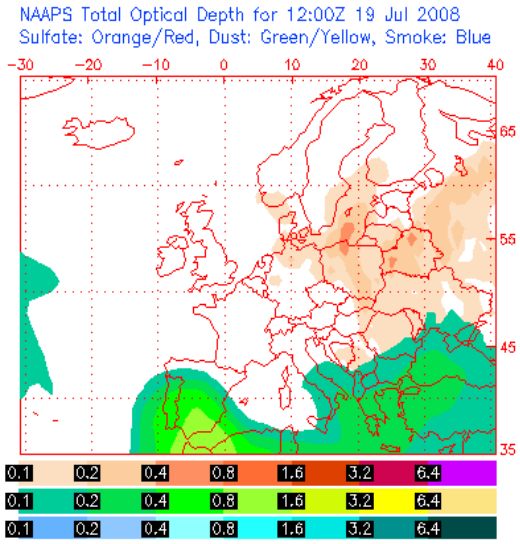

Fig. 4 NAAPS/TOMS measurements (Navy Aerosol Analysis and Prediction System) from 19 July 2008 obtained from satellite data and integrated in global model [6]

From what it can be seen, the predominant pollutant that is over the investigated area is dust (green/yellow colours), but also a big concentration of sulphates.

4. CONCLUSIONS

If we superpose the satellite images with the back-trajectory model we can observe that the dust mass coincide with the layers detected by the LIDAR and represented in the Figure 2 and 3. The use of remotely sensed data and satellite investigation for the mapping of pollutants over a city brings a better spatialisation of the phenomena under study.

The digital analysis of satellite images proved to be a valuable tool for accurate detection of environmental pollution.

This method can be automated, because with today's technology we have access to satellite images in real time and thus can detect aerosol masses, ash clouds or other pollutants.

According to the obtained results one can conclude that satellite image proved to be one of the most important tools for global environmental monitoring

Current weather models are becoming better every day and so we have access to wind profiles and turbulence. They may be linked to satellite imagery and it can be obtained a very good warning system about dust or aerosol clouds, which are dangerous for aircraft, while realising also predictions regarding the evolution in real time of the air masses.

ACKNOWLEDGMENT

This work was partially supported by the strategic grant POSDRU 6/1.5/S/13, (2008) of the Ministry of Labour, Family and Social Protection, Romania, co-financed by the European Social Fund – Investing in People.

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ABOUT AERODYNAMIC CALCULUS OF IMPELLERS USING THE NUMERICAL METHODS

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Abstract: *An algorithm for aerodynamic calculus of impeller using numerical methods (Computational Fluid Dynamics) is presented. The geometry of the impeller was analytically determined and the main objective is to compare the analytical solutions of lift with the numerical solutions.*

Key words: *impeller, numerical solution, analytical solution, propeller.*

1. INTRODUCTION

A Hovercraft is also sometime called an Air Cushion Vehicle or ACV. This is a vehicle that can drive on land like a car but will traverse ditches and small gullies like it is flat terrain. The Hovercraft is a unique method of transportation.

Modern Hovercraft are used for many applications where people or equipment need to travel at speed over water but be able to load and unload on land. The hovercraft engine provides the power to drive fans that blow air under the craft. The air is retained by a rubber 'skirt' that enables the craft to travel over a wide range of terrain. The skirt simply gives way when an obstacle is encountered.

The engine also supplies power to a thrust propeller that pushes the craft forward on its 'bubble' of air. Rudders, like on an airplane, steer the direction of the craft. The propeller used to impeller for to drive the hovercraft along is usually an aircraft type with fixed or variable pitch blades.

For the analytical solution of thrust many hypotheses are made. Aerodynamic calculus of impeller's propeller using numerical methods (Computational Fluid Dynamics - CFD) can give us more accurate solutions for thrust. Also the distribution for the parameters of aerodynamic field is determined.

2. PROBLEM DESCRIPTION

The problem consists in the flow through a hovercraft fan with 6 blades. Due to cyclic periodicity only one blade will be modeled.

For geometric model was used GAMBIT software. For each aerodynamic profile were introduced 33 points (10 sections). The geometry of the impeller's propeller is the one determined in the analytical calculus. Figure 1 present the geometry of the fan and the boundary conditions.

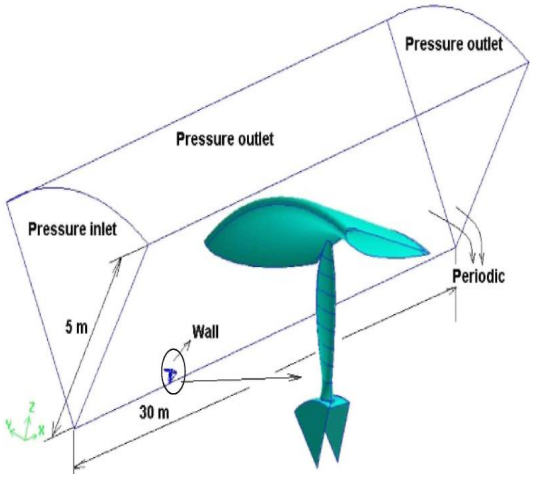

Fig. 1 Geometry and boundary conditions

As shown in figure 1, domain's extremities were chosen far enough from the fan.

For the lateral faces of the domain cyclic periodicity condition was applied.

The domain is rotating at the corresponding speed (fan speed – different values for each case considered) and because of this the ring wall has only the no-slip condition (implicit for turbulent flows) and the speed of the blade wall was set to 0 m/s.

For operating conditions the pressure was set to 101325 Pa. In consequence, the boundary conditions are:

-"wall" for blade – Stationary Wall;

-"wall" for ring – Moving Wall – Relative to adjacent cell zone – Speed 0 rot/sec – Rotational – Direction (1,0,0) (x axis);

-"fluid"– Moving reference frame - Speed n rot/sec – Rotational – Direction (1,0,0) (x axis)

-"pressure outlet" – Gauge pressure 0 Pa – Backflow turbulence intensity 0,05% - Backflow turbulence viscosity ratio 1;

-"pressure inlet" – Gauge pressure 0 Pa – Turbulence intensity 0,05% -Turbulence viscosity ratio 1;

-"periodic" – rotational.

3. NUMERICAL SOLUTION

The discretisation of the domain was made considering a finer mesh around the blade and the ring, where the gradients are bigger and a coarse mesh at extremities. The final mesh with 524 000 tetrahedral cells is presented in figure 2.

The lateral faces of the domain were link-meshed for mesh correspondence in cyclic periodicity.

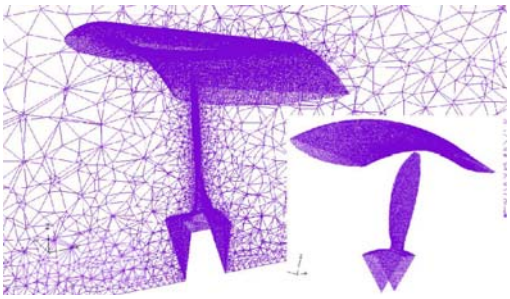

Fig. 2 Unstructured grid – 524 000 tetrahedral cells

The working fluid is air with standard proprieties. The solutions were determined using the segregated solver, implicit formulation. The implicit formulation has a faster convergence but needs more computational resources. The segregated method solves Navier-Stokes equations separated using the algorithm presented in figure 3.

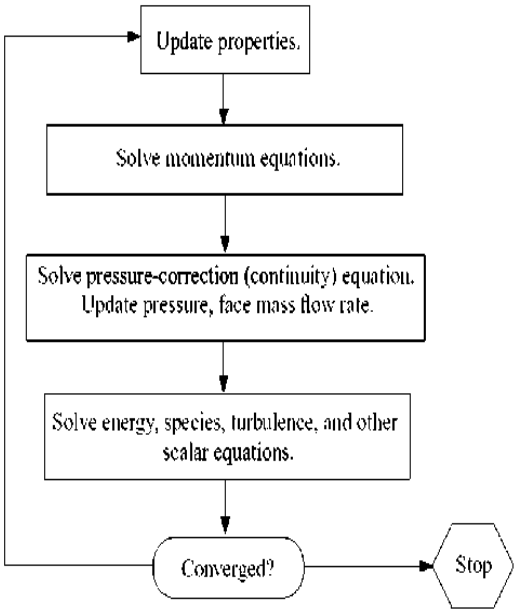

Fig. 3 Segregated method

The turbulence model is k-ε standard model and for each solution (rotational speed of the fan) were made 1000 - 1500 iterations until convergence.

The numerical solution was calculated for:

Z = 6 – number of rotor blades;

D = 1,15 m – diameter of rotor;

P = 20 kW; 30 kW; 40 kW; 50 kW; 60 kW – engine power;

n = 2000 rot/min; 2500 rot/min; 3000 rot/min; 3500 rot/min; 4000 rot/min – rotational speed of rotor.

In figure 4 is presented the distribution of static pressure for P = 60 kW, n = 3500 rot/min. As was mentioned before, the reference pressure is 101 325 Pa.

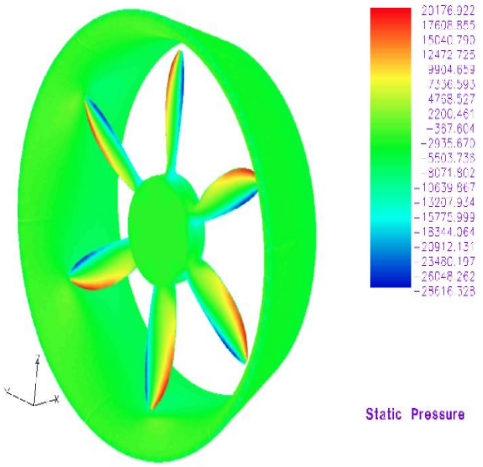

Fig. 4 Distribution of static pressure

In figure 5 is presented the distribution of velocity for P = 60 kW, n = 3500 rot/min.

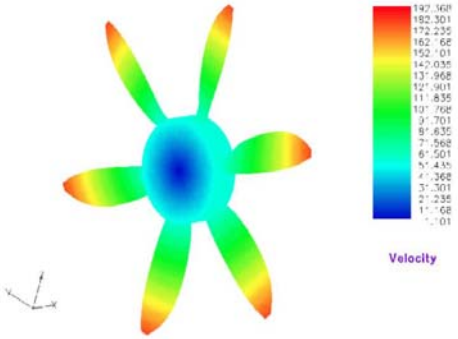

Fig. 5 Distribution of velocity

4. RESULTS AND DISCUSSIONS

The blade geometrical parameters listed in table I and II were determined in the analytical calculus.

In tables III and IV are listed the analytical and numerical values calculated for thrust. There are also calculated the relative errors between analytical and numerical solutions.

Relative error = (numerical value – analytical value)/analytical value

Table 1 – Distribution of chord length (c) and airfoil width (b) along R

Type	I	
r b/c	b	c
30%	46,1	87,41
40%	18,99	109,1
50%	14,84	121,55
60%	13,02	128,58
70%	11,82	128,49
80%	10,22	117,55
90%	7,39	87,91
100%	3,73	45,16

Table 2 Reference angle at r = 0,75 (D/2) [°]

n(rot/min) P(W)	2000	2500	3000	3500	4000
20000	16.06	10.17	6.62	4.20	2.41
30000	20.86	13.49	9.17	6.29	4.22
40000	25.09	16.31	11.29	8.01	5.68
50000	29.00	18.84	13.16	9.50	6.93
60000	32.74	21.18	14.86	10.85	8.04

Table 3 Relative errors between analytical and numerical solutions. Thrust [N]

P\n	2000 rpm			2500 rpm			3000 rpm		
	Analytic	Numeric	Relative error	Analytic	Numeric	Relative error	Analytic	Numeric	Relative error
20000	837.3	874.26	+ 4.4 %	803.2	851.3	+ 5.9 %	721.4	789.2	+ 9.4 %
30000	1096.2	1250.2	+ 14 %	1088.5	1245.6	+ 14.4	1034.5	1215.2	+ 17.5 %
40000	1316.5	1489.1	+ 13.1	1329.5	1426.1	+ 7.2 %	1295.3	1425.6	+ 10 %
50000	1510.6	1725.3	+ 14.2	1543.5	1759.5	+ 13.9	1526	1746.1	+ 14.4 %
60000	1686.7	1856.8	+ 10 %	1739.4	1902.7	+ 9.3 %	1735.5	1923.1	+ 10.8 %

Table 4 Relative errors between analytical and numerical solutions. Thrust [N]

P\n	3500 rpm			4000 rpm		
	Analytic	Numeric	Relative error	Analytic	Numeric	Relative error
20000	578	642.8	+ 11 %	358.7	425.6	+ 18.7 %
30000	925.5	1098.4	+18.7 %	758.4	889.4	+ 17.2 %
40000	1213.3	1459.3	+ 20.2 %	1078.2	1215.3	+ 12.7 %
50000	1462.2	1614.1	+ 10.3 %	1350.2	1498.7	+ 10.9 %
60000	1690.1	1923.2	+ 13.8 %	1591	1775.2	+ 11.5 %

5. CONCLUSIONS

The model was generated using the coordinates determined from analytical solution and respects exactly the aerodynamic surface. The accuracy of aerodynamic surfaces is mandatory for CFD analyses.

Parametrical definition of geometry allows us to change very easy the problem.

The numerical values are bigger than the analytical values because in calculus of the numerical solution the flow is turbulent and the propeller is placed inside the ring.

The thrust of tubed propellers can't be calculated exactly with analytical algorithms. There are experimentally determined coefficients witch multiplies the thrust of free propeller. In some references the increasing in thrust is maximum 30 %, depending of the shape of the rings.

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THE DESIGN OF AXIAL PUMP ROTORS USING THE NUMERICAL METHODS

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Abstract *The researches in rotor theory, the increasing use of computers and the connection between design and manufacturing of rotors, have determined the revaluation and completion of classical rotor geometry. This paper presents practical applications of mathematical description of rotor geometry. A program has been created to describe the rotor geometry for arbitrary shape of the blade. The results can be imported by GAMBIT - a processor for geometry modeling and mesh generations, to create a mesh needed in hydrodynamics analysis of rotor with CFD. The results obtained are applicable in numerical methods and are functionally convenient for CAD/CAM systems.*

Key words*: Rotor geometry, equations of blade surface.*

1. INTRODUCTION

The researches in rotor theory, the increasing use of computers and the connection between design and manufacturing of propellers, have determined the revaluation and completion of classical rotor geometry.

The rotor geometry is defined by diameter, number of blade, radial distributions of pitch, skew and rake, radial distribution of chord length - which together with skew gives the contour of the blade, type of camber and thickness distribution, radial distribution of maximum thickness and camber, hub shape.

The rotor blade shape is defined by a series of cylindrical blade sections, each of which is positioned relative to pitch line and rake line.

Knowing the geometrical parameters of rotor blade is important for numerical calculations, drawings and manufacturing work. This paper presents practical applications of mathematical description of rotor geometry. A program has been created to describe the rotor geometry for arbitrary shape of the blade. The coordinates of cylindrical sections in rotor blade are given in Cartesian and Cylindrical coordinates. The results can be imported by GAMBIT - a processor for geometry modeling and mesh generations, to create a mesh needed in hydrodynamics analysis of rotor with CFD.

The results obtained are applicable in numerical methods and are functionally convenient for CAD/CAM systems.

2. THEORETICAL ASPECTS REGARD ROTOR GEOMETRY

A screw rotor has a complex geometry, given in technical drawings following a special convention. The rotor geometry is usually characterized by: rotor diameter, hub diameter, number of blade, rotor pitch, expanded blade area, skew, rake, and profile shape.

The classical screw drawing comprises four parts: a developed blade, the blade sections, a blade sweep and boss shape, together with a table of dimensions. The blade shape is defined by a series of cylindrical blade sections, positioned relative to pitch line and rake line.

During the last years there have been a considerable change in rotor design and manufacturing. The increasing use of computers and modern milling machines, the connection between design and manufacturing

of rotors, has determined the revaluation and completion of classical rotor geometry.

The complex rotor geometry is given in thousand of offset points or spline surface descriptions. When the radial distribution of pitch, skew, rake, chord lengths, chamber, thickness and profile shape have been fixed numerical interpolation tools can be used to compute the coordinates of any point of the blade.

A Cartesian (x_0,y_0,z_0) and a cylindrical (x_0,r_0,e_0) coordinate system are fixed to the ship and a Cartesian (x,y,z) and a cylindrical (x,r,θ) are fixed to the reference blade (fig.1).

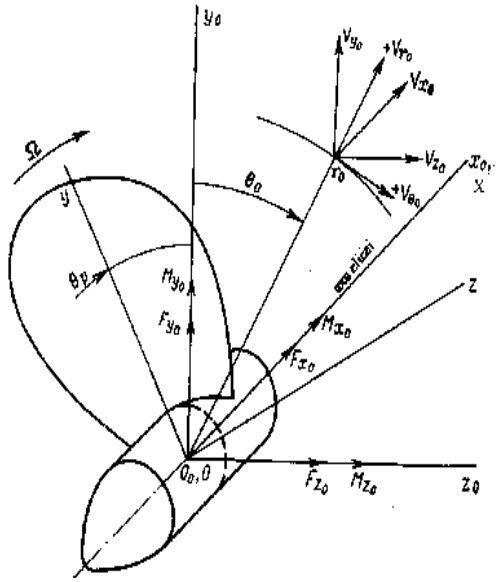

Fig. 1 Cartesian and Cylindrical Coordinate Systems of pump rotor

A local Cartesian coordinate system (fig.2) is used to represent the cylindrical blade section geometry (Φ is the pitch angle).

Two non-dimensional function are used to describe the geometry of a cylindrical blade section:

camber function $F_c = \eta_c / f_M$

thickness function $F_T = \eta_t / e$ where $e = \max \eta_t$ (ξ) and $f_M = \max \eta_c$ (ξ)

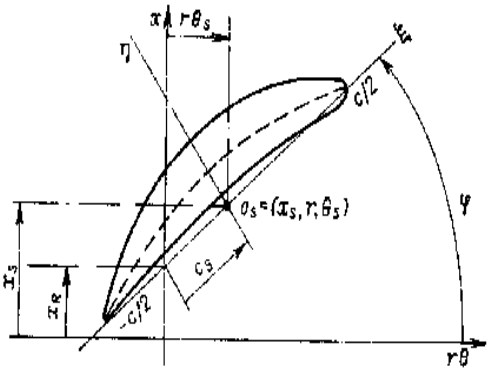

Fig.2 Local Cartesian Coordinate System for a Cylindrical Blade Section [1]

Knowing eight main geometrical parameters which define completely the propeller blade geometry:

- Radial distribution of pitch P(r)
- Radial distribution of chord length c (r)
- Radial distribution of maximum chamber fm (r)
- Type of chamber distribution F_c (ξ, r)
- Radial distribution of maximum thickness e (r)
- Type of thickness distribution F_T (ξ,r)
- Radial distribution of skew C_S (r)
- Radial distribution of rake x_R (r)

the equations of the blade surface in cylindrical coordinates are:

-for the upper side:

$$\bar{x}^{+} = \bar{x}_R + (\bar{c}_s + \bar{c}\cdot\xi\%)\sin\varphi + (\bar{f}_M \cdot F_C + \bar{e}\cdot F_T)\cos\varphi$$

$$\theta^{+} = \frac{1}{r}[(\bar{c}_s + \bar{c}\cdot\xi\%)\cos\varphi - (\bar{f}_M \cdot F_C + \bar{e}\cdot F_T)\sin\varphi \qquad (1)$$

-for the lower side:

$$\bar{x}^{-} = \bar{x}_R + (\bar{c}_s + \bar{c}\cdot\xi\%)\sin\varphi + (\bar{f}_M \cdot F_C - \bar{e}\cdot F_T)\cos\varphi$$

$$\theta^{-} = \frac{1}{r}[(\bar{c}_s + \bar{c}\cdot\xi\%)\cos\varphi - (\bar{f}_M \cdot F_C - \bar{e}\cdot F_T)\sin\varphi \qquad (2)$$

The relationships between the cylindrical and Cartesian coordinates are:

$$\begin{aligned} x &= x \\ y &= r\cos\theta \\ z &= r\sin\theta \end{aligned} \qquad (3)$$

The most usual type of section for marine propeller is NACA 66 a = 0,8. In next table the

non-dimensional distributions of thickness and cambers is given.

Table 1 The non-dimensional distributions of cambers and thickness for NACA 66 a = 0,8

ξ%	$\frac{(1-\xi)}{2}$%	F_C (ξ%)	F_T (ξ%)
1(LE)	0	0	0
0.995	0.0025	0.0235	0.0445
0.99	0.005	0.0423	0.0665
0.985	0.0075	0.0595	0.0812
0.975	0.0125	0.0907	0.1044
0.95	0.025	0.1586	0.1466
0.9	0.05	0.2712	0.2066
0.85	0.075	0.3657	0.2525
0.8	0.1	0.4482	0.2907
0.7	0.15	0.5869	0.3521
0.6	0.2	0.6993	0.4000
0.5	0.25	0.7905	0.4363
0.4	0.3	0.8635	0.4637
0.3	0.35	0.9202	0.4832
0.2	0.4	0.9615	0.4952
0.1	0.45	0.9881	0.5000
0	0.5	1	0.4962
-0.1	0.55	0.9971	0.4846
-0.2	0.6	0.9786	0.4653
-0.3	0.65	0.9434	0.4383
-0.4	0.7	0.8892	0.4035
-0.5	0.75	0.8121	0.3612
-0.6	0.8	0.7027	0.3110
-0.7	0.85	0.5425	0.2532
-0.8	0.9	0.3586	0.1877
-0.9	0.95	0.1713	0.1143
-00.95	0.975	0.0823	0.0748
-1(TE)	1	0	0.0333

3. RESULTS

A computer program has been created to describe the rotor geometry for arbitrary shape of the blade.

Knowing the eight main geometrical parameters, which define completely the rotor blade geometry, the coordinate of any points of the blade can be computed.

The coordinates of cylindrical sections in rotor blade are given in Cartesian and Cylindrical coordinates. The Cartesian Coordinates form a file which can be imported by GAMBIT, a processor for geometry modeling and mesh generations, to create a mesh needed in hydrodynamics analysis of rotor with CFD.

Rotor blade modeling with GAMBIT has four stages:

-Importing the coordinates vertex data file
-Creating the edges which represent the cylindrical blade sections (fig.3)
-Creating the blade surfaces (fig.4)
-Creating the blade volume (fig.5)
-Creating the rotor volume (fig.6)

The illustrations plotted outputs from the program are given in fig. 3-6 for a high skew rotor, and in fig.7-8 for a rotor with a symmetrical blade distribution.

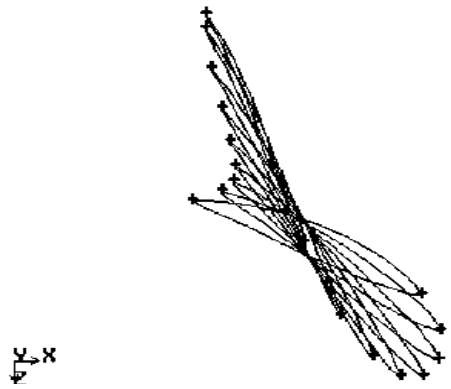

Fig. 3. Views of blade sections

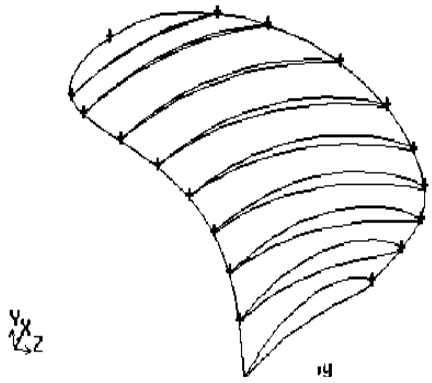

Fig. 4. Blade surfaces (upper side and lower side)

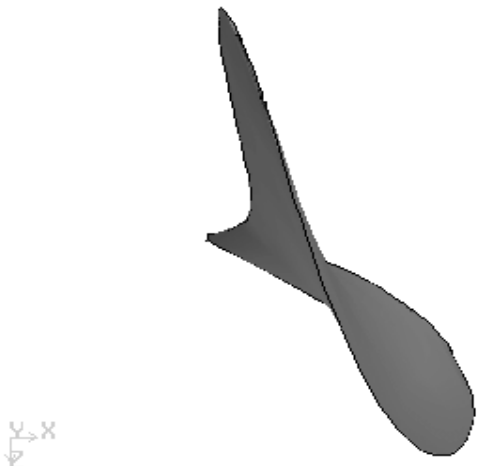

Fig. 5. Rotor blade (volume)

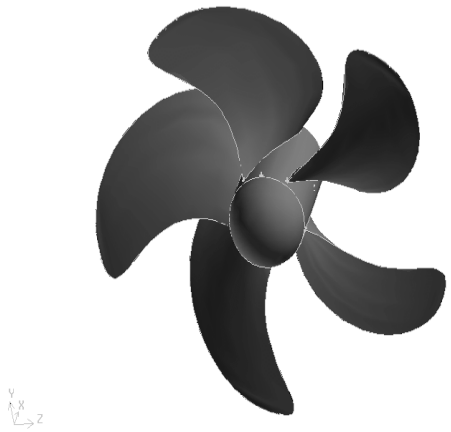

Fig. 6. High skew rotor

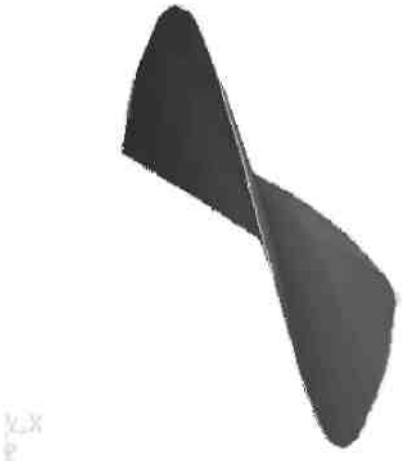

Fig. 7. Rotor blade (symmetrical blade distribution)

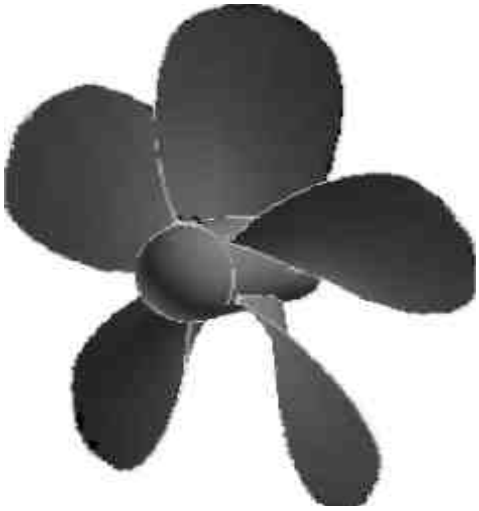

Fig.8. Rotor with symmetrical blade distribution

4. CONCLUSION

Knowing the geometrical parameters of rotor blade is important for numerical calculations, drawings and manufacturing work.

The complex rotor geometry can be given in thousand of offset points and the results obtained are applicable in numerical methods and are functionally convenient for CAD/CAM systems.

The program created is able to construct the rotor surfaces which are used for mesh generations needed in hydrodynamic rotor analysis with CFD methods.

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An Algorithm for Sensor Data Fusion for Unmanned Mini Aerial Vehicles

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***Abstract**: This paper presents a sensor fusion algorithm for estimating the flight parameters of an Unmanned Mini Air Vehicle is presented. The sensor fusion algorithm is illustrated through simulation using a nonlinear six-degree-of-freedom model of the aircraft and simple sensor models.*

Keywords: mini-UAV, sensor fusion, GPS errors, INS errors

1. INTRODUCTION

Sensor fusion is a method for conveniently integrating data provided by various sensors, in order to obtain the best estimate for a dynamic system's states. Sensor fusion algorithms are particularly useful in low-cost UAV applications, where acceptable performance and reliability is desired, given a limited set of inexpensive sensors. The sensor fusion system can provide: filtered high-rate navigation and control data for increased performance, estimation of the flight parameters which are not measured directly (i.e. attitude angles, angle-of-attack, sideslip), detection of significant changes in aircraft dynamics (i.e. icing, airframe damage), and the ability to replace failed sensor outputs with estimates (graceful degradation).

The aim of this research work is to study the applicability of various sensor fusion algorithms for different airplane configurations. The performance of the sensor fusion algorithms will be tested in simulation using models of the aircrafts and sensors.

2. MODELS

For simulation purposes, a nonlinear 6-degree of freedom model was developed, for use in the Matlab/Simulink environment – Fig.1. The model includes Simulink blocks for the equations of motion, aerodynamics, propulsion, inertia, standard atmosphere, background wind, turbulence, and a WGS-84 Earth model [1]. The aerodynamics is based on look-up tables of wind tunnel test results. The aerodynamic coefficients of the models were obtained from the Slope Soaring Simulator [1]. The Slope Soaring Simulator is an open-source flight

The propulsion model is based on propeller wind tunnel tests and engine experimental data.

The simulator model takes the following inputs:

- Actuators: control surfaces - flap, elevator, aileron, rudder deflections, as well as throttle setting;
- Atmospheric conditions: background wind vector, turbulence intensity, sea-level pressure and temperature.

The model outputs the following parameters:

- Aircraft states: body-axes velocities, angular rates, attitude angles, position and engine speed;
- Aircraft sensors: position and groundspeed, accelerations, angular rates, and air data (static pressure, dynamic pressure and outside air temperature);

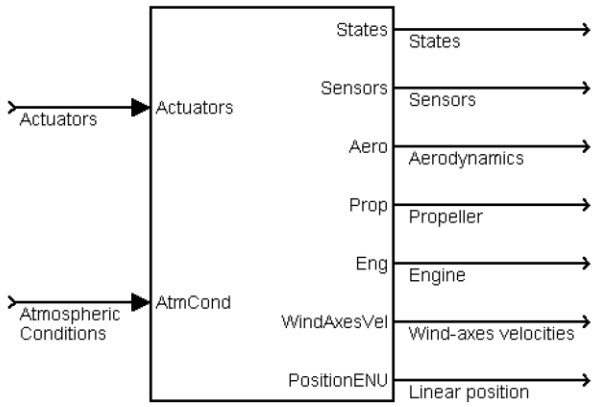

Figure 1: The Simulink Model

- Aerodynamic coefficients;
- Propeller coefficients;
- Engine parameters;
- Wind-axes velocity components: airspeed, sideslip angle and angle-of-attack;
- Linear position - East, North, Up components, relative to the starting point.

The basic sensor set which will be used includes a low cost GPS receiver providing position and groundspeed information at a rate of 1 Hz, 3 accelerometers and 3 rate gyros providing a complete 6-degree of freedom inertial solution, and an air data system which outputs static and dynamic pressure as well as the outside-air temperature.

Simple dynamic models for the sensors were created for simulation purposes. The sensor models were implemented as Simulink blocks and have the following features: white noise, offset drift, scale factor variation, and saturation limits.

The simulation set-up is shown in Fig. 2. The aircraft model can be controlled by fixed actuator commands, manual control using a joystick, or automatic control from an autopilot block. The ideal sensor signals that the aircraft model outputs are corrupted by the sensor model blocks, and then fed to the sensor fusion block, which estimates the aircraft states. The estimated states are then plotted against the actual aircraft states returned by the simulator. This simple comparative plot has the advantage that not only can we see the magnitude of the estimation error relative to the magnitude of the signal, but we can correlate the variation in estimation performance with various aircraft maneuvers during the flight.

Using this simulation set-up we will analyze the performance of each of the sensor fusion algorithm which is presented next.

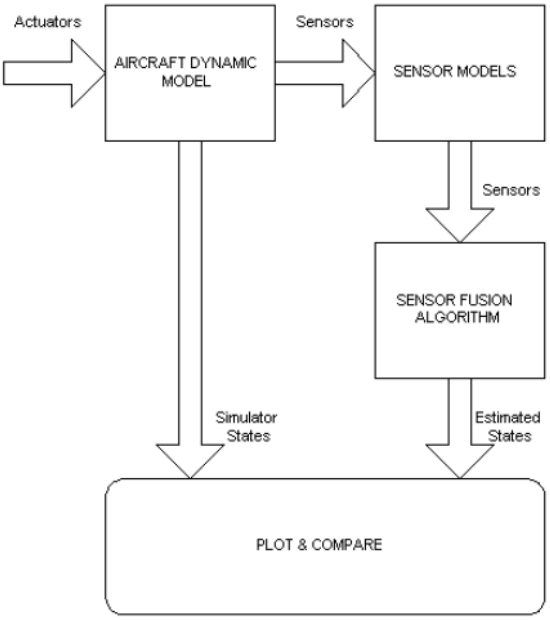

Figure 2: The simulation set-up

3. Considerations about the GPS / INS integration

The INS algorithm integrates the accelerations and angular rates provided by an Inertial Measurement Unit (IMU) to compute the position, velocity, and attitude (PVA) of the vehicle. The algorithm takes into account the Earth rotation rate and geodic shape, and it also includes a gravity model.

An INS algorithm by itself is seldom useful since the inertial sensor biases and the fixed-step integration errors will cause the PVA solution to diverge quickly. The navigation system must account for these error sources to be able to correct the PVA estimate.

A low-cost GPS (Global Positioning System) receiver can output the aircraft position and groundspeed. The measurement will be corrupted by time-correlated noise and provided at a low rate, typically 1 Hz - not fast enough for some flight control applications. Also, the GPS signal is susceptible to

jamming. However, the position and velocity measurements do not drift over long periods of time.

A low-cost IMU (Inertial Measurement Unit) can output the aircraft accelerations and angular rate which can be integrated by an INS to obtain the aircraft position, velocity, and attitude. The IMU measurements are corrupted by noise, scale factor and bias variations with temperature (nonlinear, difficult to characterize). By integrating the IMU measurements with the INS algorithm, the errors will accumulate, leading to significant drift in the position and velocity outputs. One advantage of the IMU is that it can be sampled at high-rates, therefore it is capable to capture the fast dynamics of the aircraft. But the main advantages over GPS is that the INS is autonomous (does not rely on any external aids), it is immune to jamming and inherently stealthy (does not emit nor receives any detectable radiation).

The disadvantages include the following:

1. Mean-squared navigation errors increase with time.
2. Cost, including:
   a) Acquisition cost, which can be an order of magnitude (or more) higher than GPS receivers.
   b) Operations cost, including the crew actions and time required for initializing position and attitude. Time required for initializing INS attitude by gyrocompass alignment is measured in minutes. Time-to-first-fix for GPS receivers is measured in seconds
   c) Maintenance cost.
3. Power requirements, which have been shrinking along with size and weight but are still higher than those GPS receivers.
4. Heat dissipation, which is proportional to and shrinking with power requirements [2].

The advantages and disadvantages of the GPS and INS sensor systems makes them complementary, and the best estimates of the aircraft position, velocity and attitude can be obtained by combining both GPS and INS measurements using the GPS/INS integration method presented below.

4. THE SIMULATION SETUP AND RESULTS

To setup the simulation we had to implement two models:

1. The GPS model
2. The IMU model

The data obtained is processed by a navigation filter.

The outputs of the GPS model are the position and the velocity. The IMU model defines the biases and the noise for the accelerometers and gyros.

The estimated parameters of the UAV are computed by the navigation filter, using the outputs of the GPS and IMU model. Also, the GPS and IMU outputs are ploted to compare the simulated results with the one obtained from the navigation filter.

The model takes as input commands the airspeed command which was setup to the constant value of 26m/s and the bank angle command which is set to the value of 0^0. The wind velocity is set to zero for all the three axes, but it can be modified. The simulation time is set to 50 seconds. The results are presented in the Figure 3.

The blue line represents the simulated value for the groundspeed on x-axis, and the red line is the one obtained from the navigation filter.

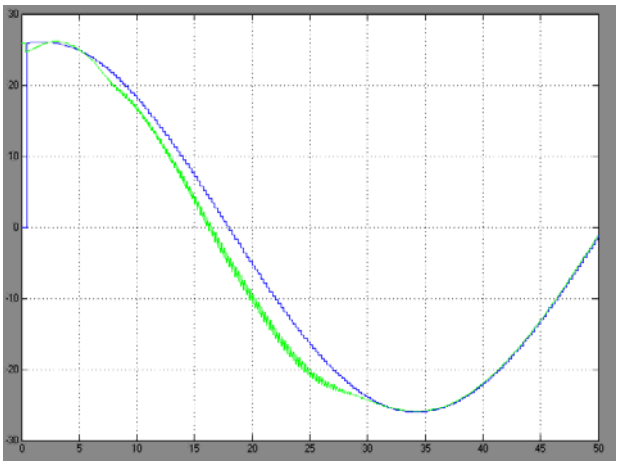

Figure 3: Simulation results for 0^0 bank angle

Similar results are obtained for the y-axis and z-axis. A second simulation was made, in

which the command for the bank angle is set to 15^0. The results are shown in Figure 4.

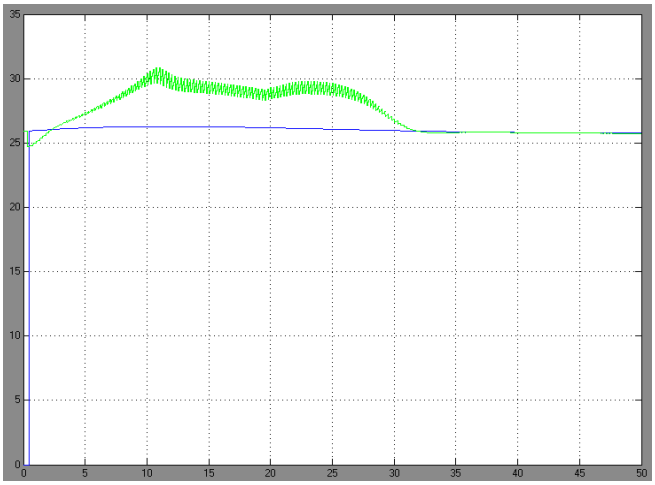

Figure 4: Simulation results for 15^0 bank angle

5. CONCLUSIONS

From Fig. 3 we can see that for a time period of about 30 seconds the speed estimated by the navigation filter is greater with about 4m/s than the speed computed by the GPS model. After this period the filter stabilize itself to a value near to 26m/s. Figure 4 shows that the results obtained with the navigation filter are following closely enough the simulated results. The navigation filter has a satisfactory behavior, but future work must be done for optimizing it.

Acknowledgments

I would like to acknowledge mister engineer Marius NICULESCU from Unmanned Dynamics for his priceless support which was decisive in conceiving this paper.

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COMPUTERIZED SIMULATION OF THE CARBURIZING PROCESS FOR THE HOLLOW ROLLERS OF LARGE BEARINGS

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Abstract: *This paper gives an overview to the problem of reduction of inertial mass in large bearings using hollow rollers and study the resistant of rollers to all stresses and deformations due to heat treatment. The software is developed to predict heat treat distortion and is completed with simulation and optimization process of carburizing in controlled atmosphere Experimental measurement of temperatures and distortions during heat treatment, was made as part of this study and confirm theoretical results to validate and improve the software predictions. Mathematical model is based on mass transfer law and Fick law and the algorithm was implemented in Visual C++. The objective for this work was to develop a strategy for the process control and optimization of carburization.*

Key words: *hollow roller, carburizing, finite element, simulation*

1. INTRODUCTION

Reduction of inertial mass of the large bearings, used in wind power industry lead to important economy of material and energy income, utilization of hollow roller becoming a necessary element in increased request of the market constituting an useful step to define new technologies and high quality products . Also, bring a serious contribution in energy sustentation at constant level, in various conditions of primary source.

The objective of the paper is to show some of the results of investigation into hollow roller heat treatment as a solution for weight reduction in large bearings construction. The use of hallow rollers has mainly been to achieve high speed, accuracy and low maintenance, also is unconventional and new.

Practicability of hollow rollers in large bearings construction, was examined for 2 material types aiming deep carburization effect. The used materials was allied steels : 15NiCr13 and 20NiCrMo7.

The chemical analysis made before the heat treatment for 20NiCrMo7 dignified the following values: 0,17%C, 0.64%Mn, 0,26%Si, 0,012%S, 2,03%Ni, 0,38%Cr, 0,13%Mo, 0,07%Cu. For 15NiCr13, the chemical composition values are: 0,16%C, 0,45% Mn 0,40%Si, 0,03%S, 3,18%Ni, 0,72%Cr.

The casting simulation softwares currently are limited in capabilities to predict distortions and stresses resulting from heat treatment. The model of this simulation, optimize the thermochemical treatment carburization in two steps, in controlled atmosphere with different carbon potentials

2. OPTIMIZATION OF CARBURIZING PROCESS

The carburizing processes optimization for bearings components is an interesting theoretical and practical field-mass transfer process of carbon diffusion in steels.

Initial modeling of carburizing process was based on Harris equations[1]. The result is indicated in Figure 1.

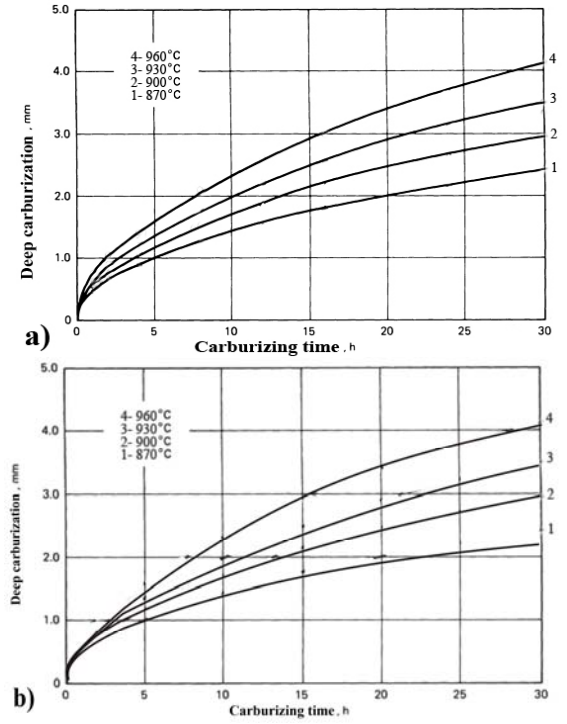

Fig.1 Deep of carburization in mm based on time and temperature for a) 20NiCrMo7 and b) 15NiCr13

On was applied a complex relational model where the percentage of carbon obtained in carburized layer of steel shall be set using finite element method starting with field-mass transfer law [2] for convex surfaces(1,2) and the diffusion equation the second Fick's law [3] at limit conditions (3).

$$\frac{\delta C}{\delta t} = \frac{\delta}{\delta x}\left(D_C \frac{\delta C}{\delta x}\right) - \frac{D_C}{r-x}\frac{\delta C}{\delta x} \quad (1)$$

$$D_C = -\frac{1}{\left(-\frac{1}{x^2} + \frac{1}{x\,(r-x)}\right) t} \quad (2)$$

where D_C is diffusion coefficient of carbon, r is hollow roller radius and x is deep of measurement to surface carburized.

$$\beta(C_p - C_s) = -D_C \frac{\delta C}{\delta x} \quad (3)$$

where β represent mass transfer coefficient, C_P is carbon potential, C_S is the carbon concentration on surface of roller and C is the carbon concentration on x [mm] from surface.

The algorithm has been used to highlight the gaseous atmosphere carbon potential influence on carburizing time and carbon profile of the case depth. Higher carbon potentials closed to the saturation limit corresponding to the carburizing temperature are used to accelerate the carburizing process.

Restrictions consist in carbides formation and residual austenite. These drawbacks can be avoided by low carbon potential closed to the eutectoid content.

The entry data are: chemical composition of steel, carbon potential, mass transfer coefficient of steel, the roller radius, time of maintaining in controlled atmosphere and the temperature of this space. For optimal results, is imposed to obtain an controlled percent of carbon to a certain depth, making allowances for rectification processes so that the hollow rollers must be resistant to the load stresses end to the heat treatment.

The percentage target of carbon is 0,3% to a 2,8mm depth. The diffusion coefficient D_C is calculated with Tibbetts relation[4]:

$$D_{C(\gamma-Fe)} = 0{,}78\exp\left[-\frac{18900}{T} + \left(\frac{4300}{T} - 2{,}63\right)C^{1.5}\right] \quad (4)$$

where C is the percent of carbon and T is the absolute temperature.

The analysis model is presented in Figure 2.

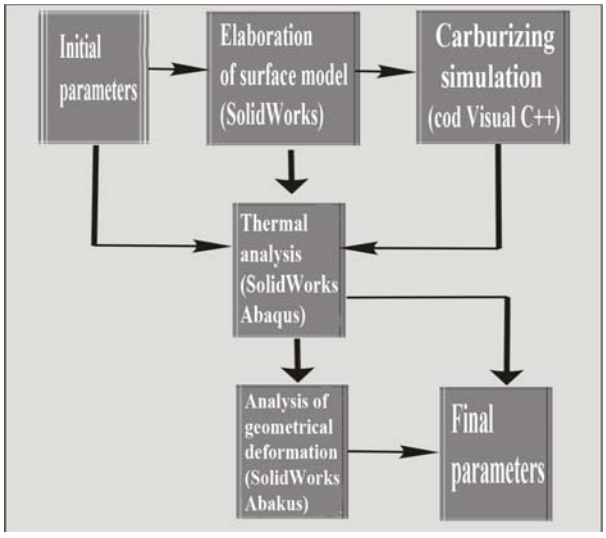

Fig.2 Mathematical model of geometrical and thermal analysis for hollow rollers

The carburization process is made in two stages, the first with a high carbon potential for acceleration of the reactions, the second having the carbon potential at a level close of the concentration to eutectoid (0,7-0,8%). Have in view two aims: the carbon concentration and the depth of the carburization. For the construction of the theoretical model it were selected: temperature T= 950^0 C, time t_I=35h and t_{II}=10h, the coefficient transferring of mass $\beta_I=2,5x10^{-5}$ respectively $\beta_{II}=3x10^{-5}$, [5].

In obtained diagram, the calculation of curve II is performed to use as initial parameters the values resulted in calculation of the curve I.

Considering the carbon potential in the second stage equivalent with the percentage of the carbon at surface of the roller and the penetration of the carbon making on the depth about 6 mm, the software establishes improved values of the curve II as well as the time of preserving in the two stages (Figure 3 and 4).

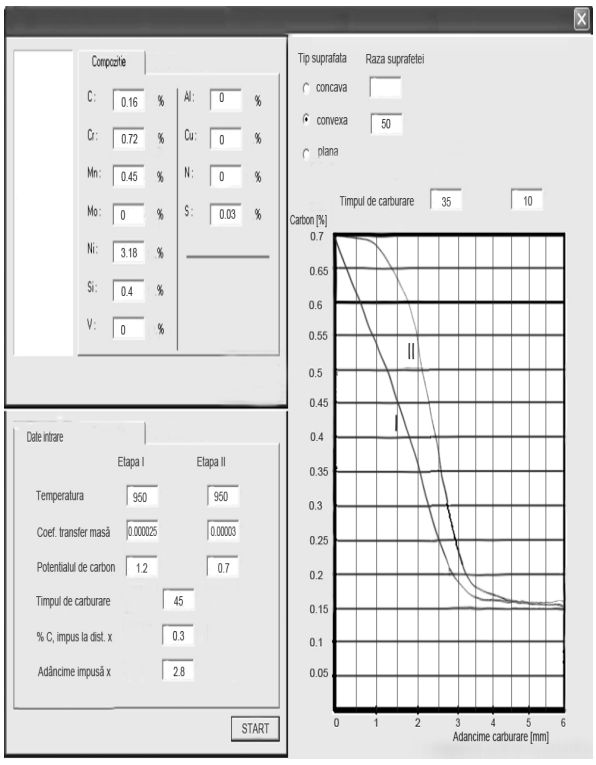

Fig.3. Carburizing optimization for 15NiCr13

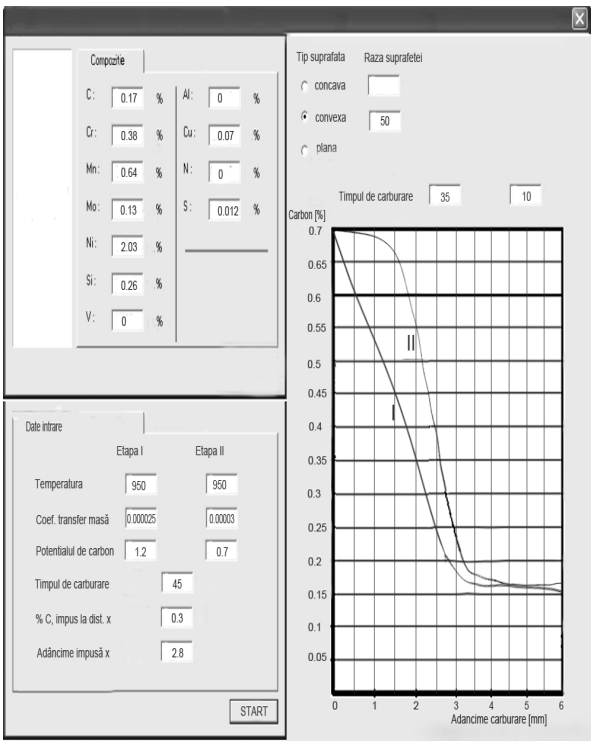

Fig.4. Carburizing optimization for 20NiCrMo7

Few simulations have to be run in order to establish the optimum parameters for a proper carbon profile. In order to obtain an S type carbon profile the desired C profile has to be define. If during the diffusion time the carbon content decreases, the computer orders the carbon potential increasing up to the carburizing carbon potential value in order to recover the carbon content. Once this condition is attained the carbon potential is decreased again to the diffusion level value and maintained till the prescribed case depth is reached, [6]. In Figures 5 and 6 is compared the theoretical and experimental results.

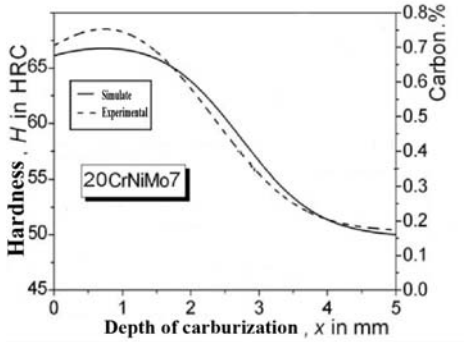

Fig.5. The experimental and theoretical results for 20CrNiMo7

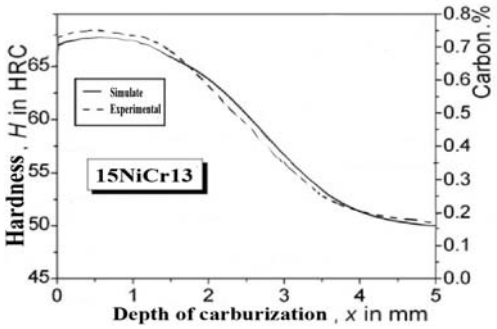

Fig.6. The experimental and theoretical results for 15NiCr13

The both figures summarized the results obtained by means of the reported theoretical-numerical method and experimental method.

3. CONCLUSIONS

The numerical modeling FEM (finite element method) directs to the possibility of simulation and anticipation of the results regarding the heating and diffusion processes and of the transformation in solid state in time of carburization, making easy the achievement of the date banks, looking at the correlation stresses-distortions, the influence of parameters material and of process to the quality of using and finally the designing processes of thermochemical treatment depending specifications of the components.
A simplified model developed to simulate heat treatment of metals was presented.

The approximation used to model the thermomechanical variables was found to be useful in this case.

This type of parametrization permits to make an initial analysis with a minimal amount of data which may predict the behaviour of different steels in time of carburization.

The ability to accurately calculate temperatures, stresses and metallurgical transformations in a single calculation or in a sequence of calculations is the key *to* prediction of distortion, residual stress and phase distribution in quench hardened elements. Successful predictions in turn rely on the adequacy of the input data to the calculation procedure. This data include mechanical and thermal properties of the alloy phases over the range of temperature and strain rates experienced during the heat treat process, the mathematical description of the transformation kinetics, and the accuracy of the heat transfer boundary conditions.

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AN OVERVIEW OF MOTION EQUATIONS OF THE MAIN LANDING GEAR

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***Abstract**: In this paper an approach for modeling landing gear systems is presented. Specifically, a nonlinear model of an main landing gear is developed. This model includes nonlinear effects such as a polytropic gas law, velocity squared damping, a geometry governed model for the discharge coefficients, stick-slip friction effects and a nonlinear tire spring and damping model. An initial model was developed that only included the air-spring above the fluid, fluid dynamics through a fixed orifice, and a linear tire spring term.*

***Key words**: main landing gear, hydraulic spring, shock damper, linear model of equations*

1. INITIAL LANDING GEAR INVESTIGATION

This chapter is intended to familiarize the reader with landing gear terminology and to demonstrate a mathematical development of the equations of motion for a telescoping landing gear. Figure 2-1 is intended to acquaint the reader with basic landing gear components. It shows the simplified components of a telescoping, main landing gear (as opposed to a nose gear).

Point 1 on the figure is a rigid body representation of the aircraft fuselage. Point 2 is a chamber containing compressed nitrogen which serves as a spring that carries the weight of the plane in ground operations. Point 3 refers to the main, upper cylinder which houses the compressed gas, hydraulic fluid, and within which the piston slides. Point 5 is the orifice plate. It is essentially a circular plate with a hole in the center through which the hydraulic fluid flows when the strut is stroking. It, along with the metering pin, point 6, controls the damping characteristics of the gear. Point 7 locates one of many rebound or snubber orifices. These holes lead into a small volume on the backside of the piston head (point 8) called the rebound or snubber chamber. The purpose of the snubber is to provide damping when the strut extends. The Point 9 is the piston.

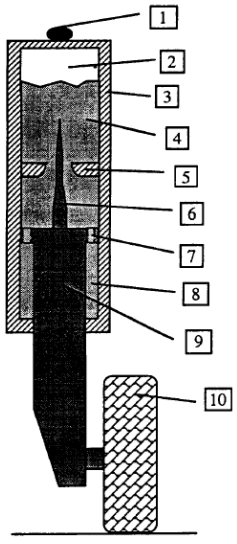


Figure 1. Schematic of typical telescoping main landing gear studied

It houses the metering pin and is also

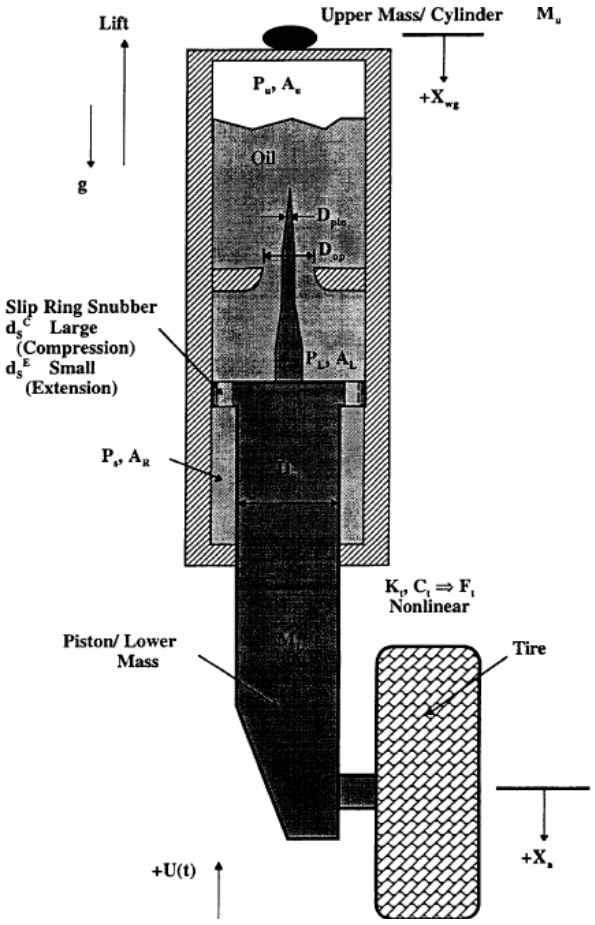
the rigid connection of the wheel axle. Finally, point 10 is the tire. This element of the gear adds both spring and damping characteristics to the overall performance of the gear, and is selected carefully for various applications.

2. NONLINEAR MODEL DEVELOPMENT

This research discusses an independent development of a mathematical model of a main landing gear with all the relevant physical parameters included. The nonlinear equations of motion are developed for a telescoping main gear.

An initial model was developed that only included the air-spring above the fluid, fluid dynamics through a fixed orifice, and a linear tire spring term. This simple model allowed some trend comparison between the results of this model and the early results of the linearized gear. A metering pin was then added to change the main orifice effective diameter as a function of stroke. Another variation was the addition of a snubber, or rebound chamber. This feature provides damping while the gear is extending. The model includes constant seal friction as well as a variable friction that is a function of stroke. In a further effort to be realistic, a nonlinear tire model was added. This tire model has a spring rate that is a function of tire deflection and damping proportional to compression rate. In the equations developed below, the spring and damping coefficient are used as if they were constant. The nonlinear characteristics of each of these terms is included in the equations of motion that are actually integrated.

Figure 2 is a schematic of the gear used in the development of the equations of motion. This schematic is representative of a general telescoping-type main landing gear. It includes the aerodynamic lift on the plane, Lift, the upper mass (of the plane's fuselage) and the mass of the main cylinder lumped together as a rigid mass, M,, and the mass of the piston and the mass of the tire, also lumped together as M_L. The inertial coordinate of the upper mass is X_{wg}. The zero value for X_{wg} is when the gear is fully



extended with the tire just touching the ground. From this same gear configuration, X_a, the coordinate of the lower mass, is taken as zero at the axle of the tire. Therefore, when the gear is in some compressed state, X_a measures the deflection of the tire when the ground input, U(t), is zero.

In the compressed nitrogen chamber (upper cylinder) with cross sectional area of A_u the pressure is P_u. Likewise, in the lower chamber with cross sectional area of A_L, there is a pressure of P_L. In the snubber chamber, with annulus area of A_R, the pressure is defined to be P_s. The orifice plate has a hole of diameter D_{op} through which the metering pin, with variable diameter D_{pin} moves. Fluid reaches the snubber chamber through the orifices d_s^C and d_s^E, where the superscripts represent either the compression mode or extension mode respectively. The diameter of the piston, D_{pi}, is used to calculate A_R. Simply subtract the area of the piston shaft from that of the lower cylinder to get A_R. The tire is also shown in Figure 2 with a distinction of pointing out

that the tire spring and damping coefficients, K_t and C_t are nonlinear and contribute to the calculation of the tire force F_t. Figure 3 shows the forces acting on the upper mass. Balancing the forces on the upper mass gives the following equation:

$$M_U \ddot{X}_{wg} = M_U g - L - P_U A_U - P_L(A_L - A_o) + P_S A_R \pm f \quad (01)$$

Fig.2 Schematic of telescopinc landing gear

The term on the left hand side of Eq. (01) is the inertial motion term, g is the gravitational acceleration, f is the friction present in the gear, and all other terms are as described previously. This equation assumes that the fluid pressure in the upper cylinder is identical to the pneumatic pressure. In this

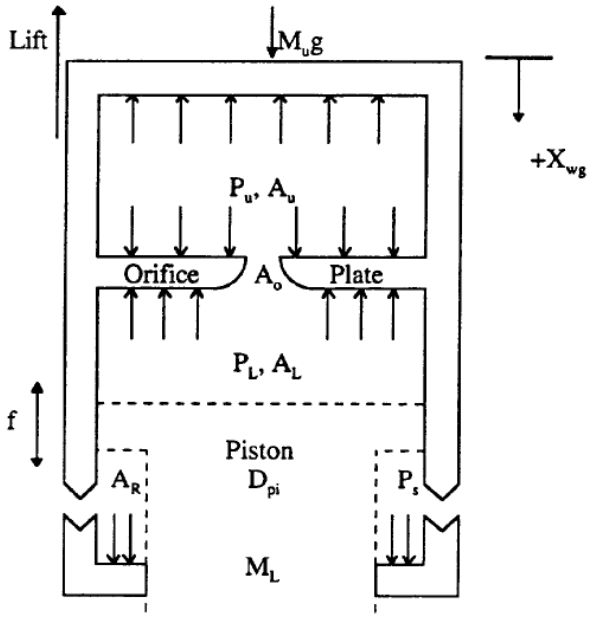


Fig.3 Schematic of upper mass and main cylinder

area, reflects the fact that the metering pin is included, i.e. it is a variable cross-sectional area depending on stroke.

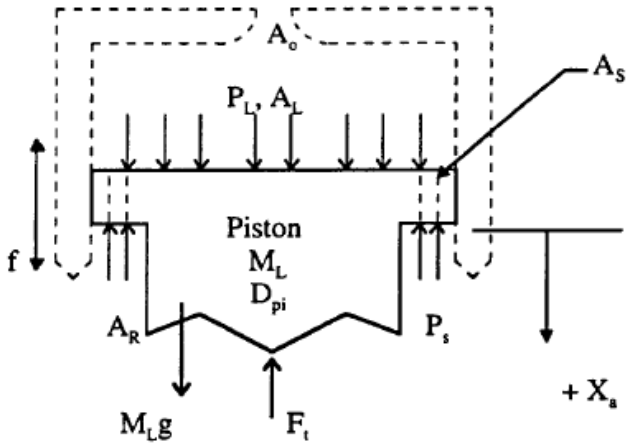


Fig.4 Schematic of lower mass

Figure 4 shows the forces acting on the piston. Summing the forces on the lower mass (piston) the force balance equation is:

$$M_L \ddot{X}_a = M_L g + P_L(A_L - A_S) - P_S(A_R - A_S) - F_t \pm f \quad (02)$$

where the left hand side of Eq. (02) is the inertial motion of the lower mass and A_s is the area of the snubber orifice. F_t is the force that is transmitted through the tire from the ground and has the form:

$$F_t = K_t(X_a + U) + C_t(\dot{X}_U + \dot{U}) \quad (03)$$

where the tire force is a function of a nonlinear tire stiffness and a damping force that is composed of a damping coefficient that is proportional to the tire stiffness and the time rate of change of the tire deflection.

3 RELATION OF PRESSURES TO STROKE POSITION AND STROKE RATE

The pressure terms in Eqs. (01) and (02) are as yet unknown and need to be related to the positional variables X_{wg} and X_a or their derivatives. The pressure of the compressed nitrogen in the upper cylinder can be described by the polytropic gas law for a closed system as:

$$P_U = P_{SI}\left(\frac{X_{SI}}{X_{S\max} - X_S}\right)^{\gamma} \quad (04)$$

where X_s is the

stroke *available*, given by:

$$X_S = X_{Wg} - X_a \qquad (05)$$

with X_{SI} as some initial length, P_{SI}, the charge pressure at $X_{S\max}$, and γ, the polytropic gas constant. $X_{S\,max}$ is the maximum value to which the gear can be extended. This form of representation of the pressure change is assumed to happen as a quasi-equilibrium process. The significance of the polytropic gas constant is that it describes the type of process that occurs. An average value is usually sufficient in application

Equation (04) was defined in such a manner that P_u will become very large when X_s is near $X_{S\,max}$, i.e. the gear is nearly completely collapsed. This is a suitable representation of the process, with only the polytropic gas constant y as an unknown.

The pressures (P_L and P_s) of the fluid in the lower cylinder and in the snubber are related to the flow rates of the fluid into and out of those regions. The volumetric flow rates through the orifice plate hole, Q_c, and the snubber orifices, Q_s, can be determined by combining the continuity equation and Bernoulli's equation for fluids. Flow is always from the higher pressure to the lower pressure. Bernoulli's equation for an incompressible fluid states that along a streamline,

$$\frac{P}{\upsilon} + (\frac{1}{2g})V^2 + Z = const. \qquad (06)$$

where P is the pressure at some point, g is the gravitational acceleration, V is the velocity of the flow, *v* is the specific weight of the fluid which is equal to the fluid density (p) multiplied by the gravitational acceleration (g), and Z is the height difference from some zero reference. This equation assumes that the viscous effects within the fluid are negligible, the flow to be steady and incompressible, and that the equation is applicable along a streamline.Equating Bernoulli's equation (Eq. (06)) at two points in the flow along the same streamline yields:

$$\frac{P_1}{\upsilon} + (\frac{1}{2g})V_1^2 + Z_1 = \frac{P_2}{\upsilon} + (\frac{1}{2g})V_2^2 + Z_2 \qquad (07)$$

In the case of a landing gear, the potential distance between Z_1 and Z_2 can be neglected as the distances involved are very small compared to the other terms. Equation (07) with the continuity equation for incompressible fluids which states $Q = A_1V_1 = A_2V_2$ allows for the solution of this equation in terms of one of the velocities. Assuming that $P_1 > P_2$, i.e. the flow is from P_1 to P_2, then solve for V_1 from the continuity equation as:

$$V_1 = \frac{D_2^2}{D_1^2}V_2 \Rightarrow V_2 = \pm\sqrt{\frac{2(P_1 - P_2)}{\rho(1 - \frac{D_2^4}{D_1^4})}} \qquad (08)$$

When the flow reverses, i.e. $P_1 < P_2$, then the velocity at point 2 is described by the above equation with the pressure terms switched and a negative sign on the square root. The ideal volumetric flowrate (Q_{ideal}) for an incompressible fluid can be expressed as $Q_{ideal} = A*V$. Now he have:

$$Q_{real} = CdQ_{ideal} = AC_dV \qquad (09)$$

Substituting Eq. (08) into Eq. (09) for velocity:

$$Q_{real} = AC_d\sqrt{\frac{2}{\rho(1 - (\frac{D_1}{D_2})^4)}}\sqrt{P_1 - P_2} \rightarrow P_1 \triangleright P_2 \qquad (10)$$

For our landing gear, there are two flows that are of concern, the flow through the orifice plate and the flow into and out of the snubber chamber. Define Qs^C as the flow rate into the snubber chamber in the compression mode, where the snubber orifice area (A_s) becomes A_s^c, which allows larger flow. The flow rate through the snubber orifice during the extension mode is defined as Q_S^E, and the area A_s becomes A_S^E, which only allows small, restricted flow. In both cases, the flow through the main orifice plate is Q_O.

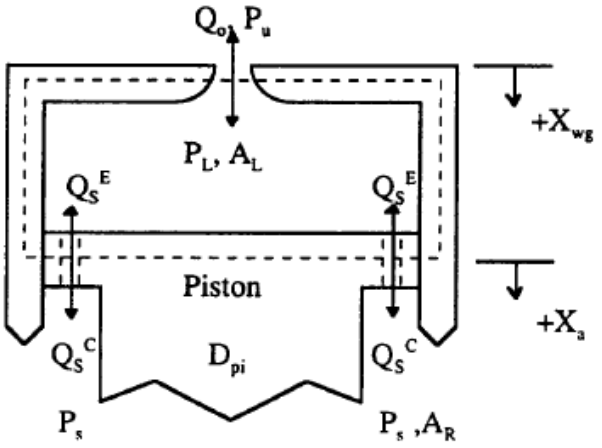


Fig.5 Control volume between piston and orifice plate

Figure 5 shows the direction of fluid flow into and out of a control volume in the lower chamber as a function of stroke mode (extension or compression). In relating the flow rates to the pressures, defining a control volume as shown by the dashed line in Figure 5 is necessary. The stroke rate is defined as

$$\dot{X}_S = \dot{X}_{wg} - \dot{X}_a \qquad (11)$$

where the compression mode is given by $X_S >$ 0.0, and the extension mode by $X_S <$ 0.0. The flow is assumed to be negative leaving the control volume, and is positive entering it. For an incompressible fluid, the volumetric flow rates for compression and extension can be written as:

$$Q_a + Q_S^C + A_L \dot{X}_S = 0.0 \qquad (12)$$

during the compression mode and

$$Q_a + Q_S^E + A_L \dot{X}_S = 0.0 \qquad (13)$$

during the extension mode. Equation (10) defined the general form of the equation for a flow rateand can be written as:

$$Q_o = -A_o C_d \sqrt{\frac{2}{\rho(1-(\frac{d_o}{D_L})^4)}} \sqrt{P_L - P_U} \rightarrow P_L \triangleright P_U \qquad (14)$$

where d_0 is the effective diameter of the main orifice, D_L is the diameter of the lower chamber, and C_d is the discharge coefficient of the main orifice. The flow through the snubber orifices during this mode is described by:

$$Q_S{}^C = -A_S{}^C C_{dS}{}^C \sqrt{\frac{2}{\rho(1-(\frac{d_s{}^C}{D_L})^4)}} \sqrt{P_L - P_S} \rightarrow P_L \triangleright P_S \qquad (15)$$

with d_s^c as the diameter of a snubber orifice, D_L as described above, $C_{dS}{}^C$ is the discharge coefficient of the snubber orifice and A_s^c is the effective area of the snubber orifice. Similarly, for the extension mode , where flow is into the control volume ($P_L < P_U$ and P_S) .

$$Q_o = A_o C_d \sqrt{\frac{2}{\rho(1-(\frac{d_o}{D_L})^4)}} \sqrt{P_U - P_L} \rightarrow P_U \triangleright P_L \qquad (16)$$

where the difference between this equation and Eq. (14) is that the pressure terms have exchanged positions and the whole term is now positive. The flow rate through the snubber orifices during the extension mode is given by

where D_R is the effective diameter of the annulus snubber chamber, d_s^E is the diameter of a

$$Q_S{}^E = A_S{}^C C_{dS}{}^C \sqrt{\frac{2}{\rho(1-(\frac{d_s{}^E}{D_R})^4)}} \sqrt{P_S - P_L} \rightarrow P_S \triangleright P_L \qquad (17)$$

snubber orifice, A_S^E is the effective area of the snubber orifices and $C_{dS}{}^C$ is the discharge coefficient of the snubber orifices in the extension mode. To simplify Eqs. (14), (15), (16), and (17), let the non-pressure terms be redefined as:

$$E_1 = A_O C_d \sqrt{\frac{2}{\rho(1-(\frac{d_o}{D_L})^4)}}, E_3 = E_1$$

$$E_1 = A_O C_d \sqrt{\frac{2}{\rho(1-(\frac{d_o}{D_L})^4)}},$$

$$E_4 = A_S^E C_{dS}{}^E \sqrt{\frac{2}{\rho(1-(\frac{d^E{}_E}{D_R})^4)}},$$ respectively.

Substituting Eqs. (14) and (15) into Eq. (12) and Eqs. (14) and (15) into Eq. (13) using this new notation, rewrite Eqs. (12) and (13) as

$$-A_S{}^C C_{dS}{}^C \sqrt{\frac{2}{\rho(1-(\frac{d_s{}^C}{D_L})^4)}} \sqrt{P_L - P_S} + A_R \dot{X}_S = 0.0$$

$$-E_1\sqrt{P_L - P_U} - E_2\sqrt{P_L - P_S} + A_L \dot{X}_S = 0.0 \text{ for } \dot{X}_S > 0 \quad (12.a)$$

$$E_3\sqrt{P_u - P_L} - E_4\sqrt{P_S - P_L} + A_L \dot{X}_S = 0.0 \text{ for } \dot{X}_S < 0 \quad (13.a)$$

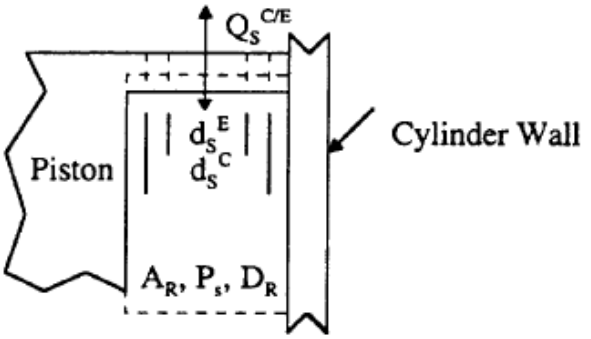


Fig.6 Control volume for the snubber chamber

Additional information about the flow rate-pressure relationship can be gained by studying a control volume in the snubber chamber as shown by the dashed line in Fig.6 . The variables A_R and D_R in Fig.6 are the rebound chamber annulus area and effective diameter respectively. P_s is the pressure in the rebound chamber and d_s^c and d_s^E are the diameters of the snubber orifices in the compression mode and extension mode respectively. In the case of compression, where $X_s > 0.0$ and $P_L > P_s$,

$$Q_S^C + A_R \dot{X}_S = 0.0 \quad (18)$$

Substituting the flow rate Q_S^C of Eq. (15) into Eq. (18) yields:

(19)

From previous notation of E_i this expression becomes: $-E_2\sqrt{P_L - P_S} + A_R \dot{X}_S = 0.0$ (20)

Rearrange Eq. (20) to get an expression for the pressures in terms of the stroke rate as:

$$\sqrt{P_L - P_S} = \frac{A_R}{E_2}\dot{X}_S \quad (21)$$

$$\Rightarrow P_L = P_U + (\frac{A_L - A_R}{E_1})^2 \dot{X}_S^2 \quad (22)$$

where P_u is given in Eq. (04). Square both sides of Eq. (21) and solve for P_s as:

$$P_S = P_L - (\frac{A_R}{E_2})^2 \dot{X}_S^2 \quad (23)$$

Similarly, for the extension case with $X_s < 0.0$:

$$P_L = P_U - (\frac{A_L - A_R}{E_3})^2 \dot{X}_S^2 \quad (24)$$

$$P_S = P_L - (\frac{A_R}{E_4})^2 \dot{X}_S^2 \quad (25)$$

These known pressures [Eqs. (04), (22), (23), (24), (25)] can now be substituted into Eqs. (23) and (24). Algebraic simplification of these equations leads to the compression and extension cases in terms of readily measurable quantities as:

$$M_U \ddot{X}_{wg} = M_U g - L + (A_R - A_L)P_{SI}(\frac{X_{SI}}{X_S})^\gamma + \left\{(\frac{A_L - A_R}{E_3})^2 (A_L - \dot{A}_0) - [(\frac{A_L - A_R}{E_3})^2 - (\frac{A_R}{E_4})^2]A_R\right\}\dot{X}_S^2 - f \quad (01a)$$

$$M_L \ddot{X}_a = M_L g - (A_L - A_R)P_{SI}(\frac{X_{SI}}{X_S})^\gamma + \left\{[(\frac{A_L - A_R}{E_3})^2 - (\frac{A_R}{E_4})^2](A_R - A_S^E) - (\frac{A_L - A_R}{E_3})^2 (A_L - A_S^E)\right\} \cdot \dot{X}_S^2 - F_t + f \quad (02a)$$

$$M_U \ddot{X}_{wg} = M_U g - L + (A_R - A_L)P_{SI}(\frac{X_{SI}}{X_S})^\gamma + \left\{[(\frac{A_L - A_R}{E_1})^2 - (\frac{A_R}{E_2})^2]A_R - (\frac{A_L - A_R}{E_1})^2 (A_L - \dot{A}_0)\right\}\dot{X}_S^2 + f \quad (01b)$$

$$M_L \ddot{X}_a = M_L g - (A_L - A_R)P_{SI}(\frac{X_{SI}}{X_S})^\gamma + \left\{[(\frac{A_R}{E_2})^2 - (\frac{A_L - A_R}{E_1})^2](A_R - A_S^C) + (\frac{A_L - A_R}{E_1})^2 (A_L - A_S^C)\right\} \cdot \dot{X}_S^2 - F_t - f \quad (02b)$$

Introduce a new notation using subscripts to simplify the above equations: "1" and "2" will be associated with compression (equation set

(a)), and "3" and "4" with extension (set (b)). With this change, the equations can be written in the form:

$$M_U \ddot{X}_{wg} = M_U g - L + C_{1/3} \dot{X}_S^2 + K_{1/3} X_S^{\gamma} \pm f \quad (01c)$$

$$M_L \ddot{X}_a = M_L g + C_{2/4} \dot{X}_S^2 + K_{2/4} X_S^{\gamma} - F_t \pm f \quad (02c)$$

where the coefficients of the stroke rate squared term are assigned the C_i's, and the coefficients of the stroke position term are the K_i's.

The only unknown term left in these equations is friction. As mentioned previously, friction in this gear comes mainly from two sources, friction due to tightness of the seal and friction due to the offset wheel (moment). The seal friction is assumed to be a maximum value statically and some function of velocity in the dynamic state. The functional relationship between frictional force level and velocity could be determined through testing. The friction due to the offset wheel is the result of the moment produced by the nonaxially loaded piston within the cylinder.

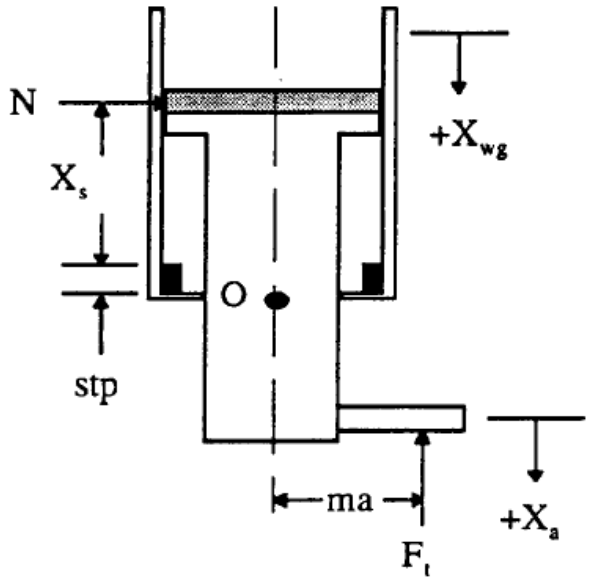


Fig.7 Schematic of gear for friction model development

It can be seen from Fig.7 that the force between the piston head and the cylinder, N, is a result of the tire force, F_t, applied at moment arm, ma, from the centerline of the piston. The frictional force due to the offset wheel (F_{ow} is assumed to be of the form (refer to Fig.7):

$$F_{OW} = \mu N \quad (26)$$

Where N is the normal force of the cylinder wall resisting the side of the piston head, and μ is the coefficient of friction between the two parts. To find the unknown force N, sum the moments about point O to zero to get:

$$\sum M_0 : F_t ma - N(X_S + stp) = 0 \quad (27)$$

Where stp is the minimum distance between the piston head and the lower seal when the gear is fully extended. Rearrange Eq. (27) by isolating N, and then substitute N into Eq. (26) to get an explicit form of F_{ow}:

$$N = \frac{ma * F_t}{X_{wg} - X_a + stp}$$

$$F_t = \mu\left(\frac{ma * F_t}{X_{wg} - X_a + stp}\right)$$

The total friction in the landing gear, f, in equations (01c) and (02c) is now assumed to be:

This paper assumes that a proportionate part of the fuselage (half of the 80% of the total weight that rests upon the main gear) is treated as a lump mass centered at the centerline of the main upper cylinder. Also, this model takes into account only vertical loads on the strut. The tire is modeled as a nonlinear spring and damper. This tire model does not take into account spinning stiffness (because the test tire does not spin) or spin-up drag. The fluid is assumed to be incompressible and all structural members are assumed to be rigid, with each having only a vertical degree of freedom. These assumptions are good only for straight-line taxiing over runway profiles and landing impact (spin-up drag on the tire does not significantly effect the vertical loads on the strut). Any braking or turning maneuvers are not covered in the development. The equations developed here are the basis for a "rollout"

simulation.

4. CONCLUSIONS

In this chapter, the nonlinear equations of motion were developed for a general, telescoping main landing gear.

These equations contain a pneumatic spring that is determined based on the polytropic gas compression law, a hydraulic damping that is proportional to the stroke rate squared, gravitational forces, lift, inputs from a runway, and finally friction, which is composed of both a constant seal friction and a variable bearing friction. These equations explicitly contain the empirical parameters of polytropic gas constant, discharge coefficients for both the main orifice and the snubber orifices, and the friction levels in the gear. These parameters are the only variables that appear in equations (01) and (02) that cannot be directly measured.

Equations (01) and (02) are highly nonlinear and are discontinuous due to the differing values of friction and discharge coefficient as a function of extension and compression. Future work will discuss more about the nature of these equations and present a method of solving these equations for gear displacements and velocities.

LS-DYNA NUMERICAL SIMULATION OF 7.62 MM BULLETS IMPACT WITH A NATO CONTAINER WALL

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Abstract: *This paper describes a numerical simulation of bullets impact of NATO container. Simulation was based on solution of deformable body mechanics equations system with finite element method. Analysis accounted for physical nonlinearities produced by nonlinear behavior of striker and obstacle and for geometric nonlinearity caused by large strains and rotations of elements and presence of contact pairs and material failure. We created a model where the container wall is assimilated to a multilayer panels.*

Key words: *bullet, impact, container, deformation, velocity*

1. INTRODUCTION

In order to determine the capacity of the container wall to resist to the impact with a 7.62 mm caliber projectile an analysis will be performed using the nonlinear numerical analysis program ANSYS LS-DYNA.

A model will be created where the container wall (sandwich panel) is tantamount to a succession of plates.

The impact phenomenon will be analyzed at several impact velocities that match different shooting distances, as shown below:

- V_{ci} =745 [m/s] for distances X_i = 0.0001 m; V_{ci}= 500 m/s for distances X_i = 350 m; V_{ci}= 235 m/s for distances X_i = 1000 m; V_{ci}= 23 m/s for distances X_i = 3000 m.

Figure 1 shows the graphical description of the variation of the impact velocity reported to the shooting distance - X_i .

The 7.62 mm caliber projectile is 39 mm long and has steel core [13].

For the modelling of the projectil plates and for the simulation of impact phenomenon, we propose to achieve the following objectives [1], [2], [6]:

- *determination of the total deformation of the plates;*
- *determination of the values of the total efforts of the plates;*
- *determination of the kinematic parameters of the impact.*

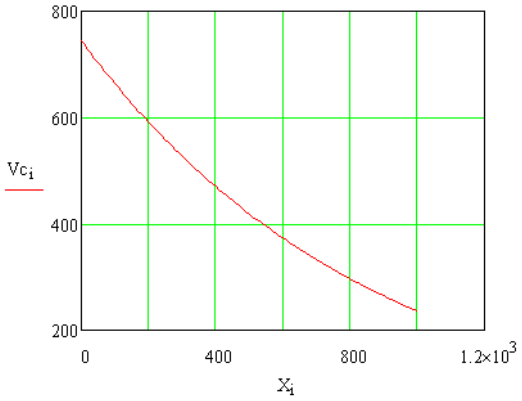


Fig.1 Variation of impact velocity with X_i distance

The model of container's wall has the following composition:

- steel (OL 37), thickness 0.0015 m;
- aluminium, thickness 0.0006 m;
- polyurethane foam, thickness 0048 m;
- aluminium, thickness 0.0006 m.

The dimensions of the plates are 0.05mx0.1m.

The worst case where the plates are overlapped without stiffening was considered.

During the analysis, due to the small mass of the 8g projectile, its gravitational acceleration was neglected. The effect of bullet rotation around its axis has not been considered.

2. NUMERICAL SIMULATION

In order to discretize the projectile and the plates, the SOLID 164 (8 nods hexaeder)- type element was used. This element best meets their behavioral patterns and allows us to rapidly obtain high accuracy results.

The projectile model consists of 1368 elements, the steel-plate model consists of 5000 elements and the aluminium plate model consists of 5000 elements (fig. 2 and fig. 3).

The polyurethane plate model consists of 125.000 elements.

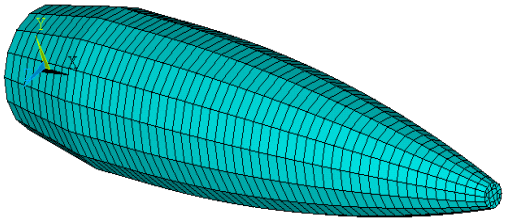
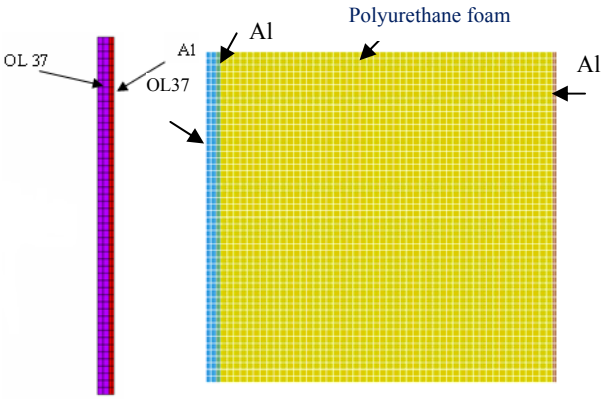


Fig. 2 Finite element model of the 7.62 x 39 mm caliber projectile



a) b)

Fig. 3 Finite element model of the container's wall plates

The material used for the projectile is steel with density ρ=7865 kg/m^3

The material used for bullet and steel and aluminium plates is Plastic Kinematic Model *(*MAT_PLASTIC_KINEMATIC)* [7], [9].

Cowper-Symonds relationship has the following form:

$$\sigma_y = \left[1 + \left(\frac{\dot{\varepsilon}}{C}\right)^{\frac{1}{P}}\right]\left(\sigma_0 + \beta E_p \varepsilon_p^{eff}\right)$$

where: σ_0 is initial strain flow;

$\dot{\varepsilon}$ is strain rate;

C şi P Cowper-Symonds coefficients;

ε_p^{eff} is plastic effective deformation;

E_p is plastic elasticity module.

The model of the material used for foam board is Foam Material Model *(*MAT_LOW _DENSITY_FOAM).*

The properties of the steel bullet material [10], [5], [12] are described in Table 2:

Table 2. The properties of the projectile material

Projectile material	**Material type LS-DYNA**	**Density** [kg/m^3]	**Longitudinal elasticity modulus** [Pa]	**Poisson Coefficient**	**Specific deflection at breakage** [m]	**Flow limit** [Pa]
Steel core	1018 steel	7865	$2 \cdot 10^{11}$	0.27	0.75	$3.1 \cdot 10^8$

The mechanical characteristics of the plates materials are shown in table 3 [3]:

Table 3. Mechanical characteristics of the equivalent plates

Plate type	**Mechanical measures**	**Value**
OL 37	Longitudinal elasticity modulus (Pa)	$210 \cdot 10^9$
	Density (kg/m^3)	7865
	Poisson Coefficient	0.3
	Flow limit (Pa)	$2 \cdot 10^8$
Al	Longitudinal elasticity modulus (Pa)	$7 \cdot 10^{10}$
	Density (kg/m^3)	2700
	Poisson Coefficient	0.34
	Flow limit (Pa)	$1 \cdot 10^8$
Polyurethane foam	Longitudinal elasticity modulus (Pa)	$0.794 \cdot 10^6$
	Density (kg/m^3)	40

From the possibilities offered by the Ls-Dyna we have opted for the

"CONTACT_ERODING_ SURFACE_ TO_SURFACE" contact algorithm [8]:

1. in the area of impact of the bullet with the plates;
2. between the plates.

The following limit condition was applied to the projectile:

- the initial velocity applied to the nodes in order to stimulate the impact velocity with the plate is v_x=745 m/s, v_x=500 m/s, v_x=235 m/s and v_x=23 m/s [4].

The analysis starts from a 0.001 m distance from the steel plate. The period of time for which the impact phenomenon is studied is t = 0.15e-3 s.

The distribution of deformations of the steel plate and aluminium plate at impact velocity (v) of 745 m / s is shown in figure 4.

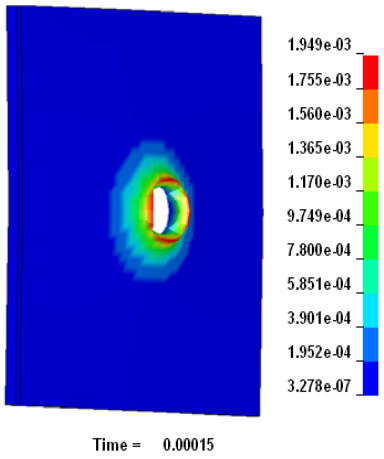


Fig. 4 Deformations field of steel and aluminium plates on the impact direction at impact velocity of 745 m / s

The steel plate and the aluminium plate endure an accentuated deformation, the maximum deformations being about $1.94 \cdot 10^{-3}$ m.

In figure 5 is shown the state of tensions represented through von Mises equivalent stress of the steel and aluminium plates in the impact zone.

The maximum equivalent tensions have the value of 480 MPa, being higher than the breakage tension of the material (σr = 360 ÷ 440 MPa for OL37 and σr = 400 MPa for aluminium).

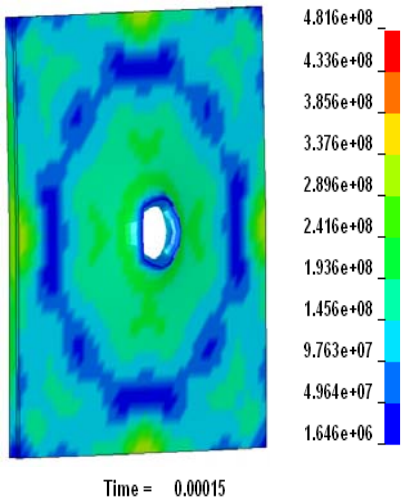


Fig. 5 Von Mises equivalent stress field of the steel and aluminium plates, impact velocity 745 m/s

The variation chart of projectile velocity after the impact is illustrated in figure 6:

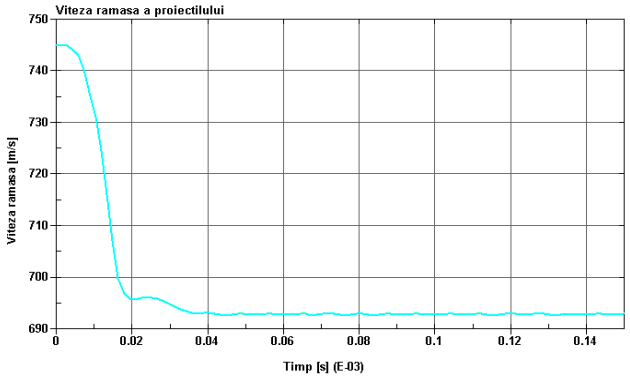


Fig. 6 Variation of the remaining velocity of the projectile after the impact, impact velocity of 745 m/s

Figure 6 shows a value of bullet's velocity after the impact of 695m/s, at an initial impact velocity of 745 m/s.

From the kinetic energy (figure 7, figure 8, figure 9) and internal energy (figure 10) graphs function of time the plastic deformation for materials, geometry and the initial conditions of impact may be established. Figures 7 and 10 represent the variation in time of the kinetic energy for the steel plate and aluminium plate, respectively, at the impact velocity of 745 m / s.

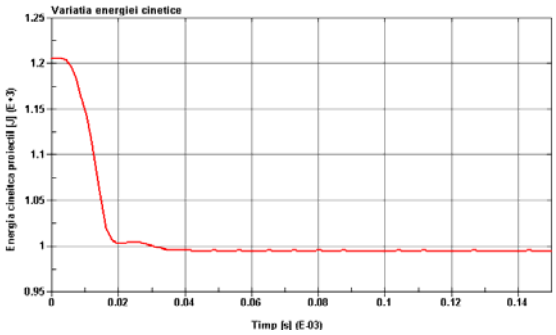


Fig. 7 Variation of projectile kinetic energy, impact velocity of 745 m/s

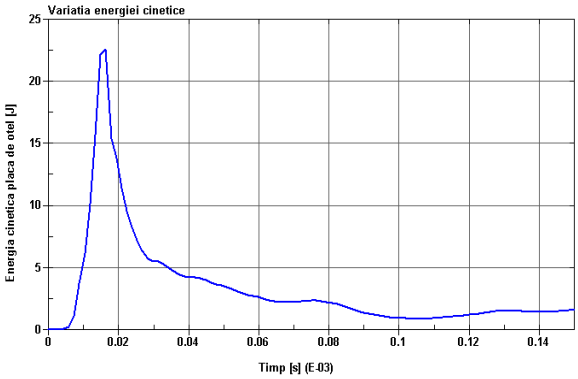


Fig. 8 Variation of steel plate kinetic energy, impact velocity of 745 m/s

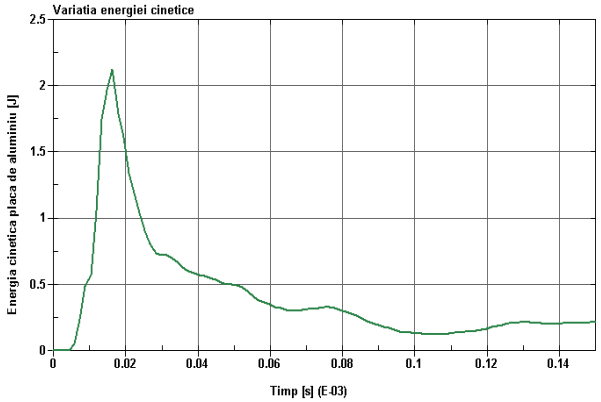


Fig. 9 Variation of aluminium plate kinetic energy, impact velocity of 745 m/s

The steel plate and the aluminium plate endure a significant deformation, the maximum value for the deformations being $1.75 \cdot 10^{-3}$ m.

The maximum equivalent tensions' value is 500 MPa, exceeding the flow tension of plates materials.

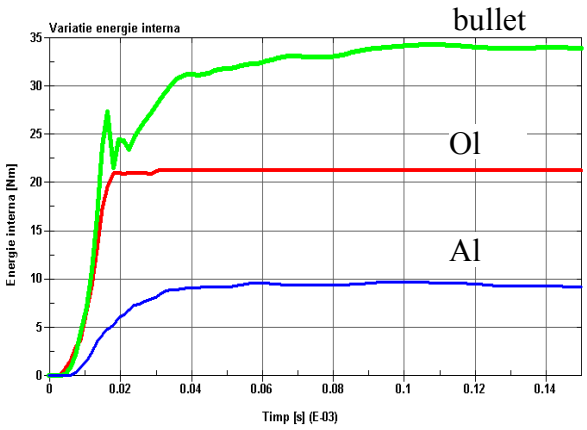


Fig. 10 Variation of internal energy of the projectile, steel plate and aluminium plate, impact velocity of 745 m/s

Figure 11 shows the field of deformations of the plates and projectile on impact direction and Figure 12 the von Mises equivalent stress.

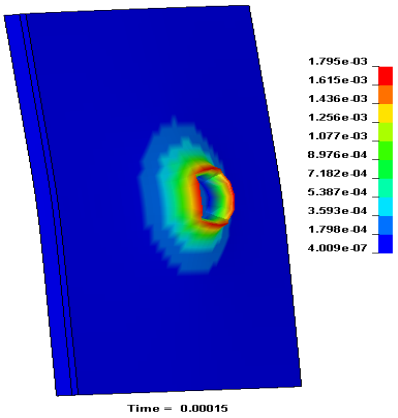


Fig. 11 Deformation field of steel and aluminium plates on impact direction, impact velocity 500 m/s

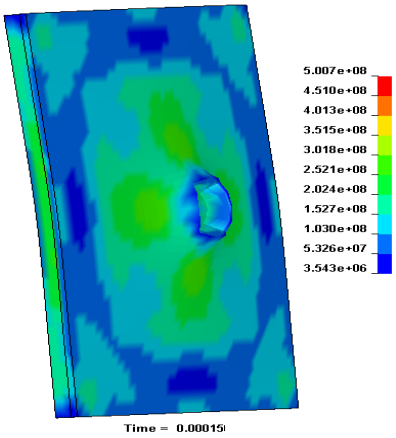


Fig. 12 Von Mises equivalent stress field for the steel and aluminium plates, impact velocity 500 m/s

In figure 13 it can be observed a value of bullet's velocity after the impact of 430 m/s, at an initial impact velocity of 500 m/s.

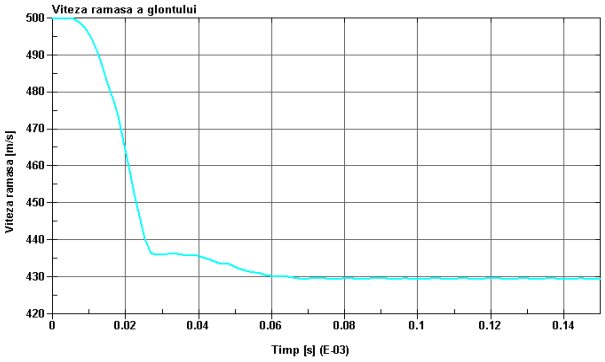


Fig. 13 Variation of remaining speed of the bullet after the impact, impact velocity of 500 m/s

For the impact velocity V_{ci}= 235 m/s se, in Figure 14 is shown the deformations field for the plates and for the projectile on the impact direction and in Figure 15 the von Mises equivalent stress.

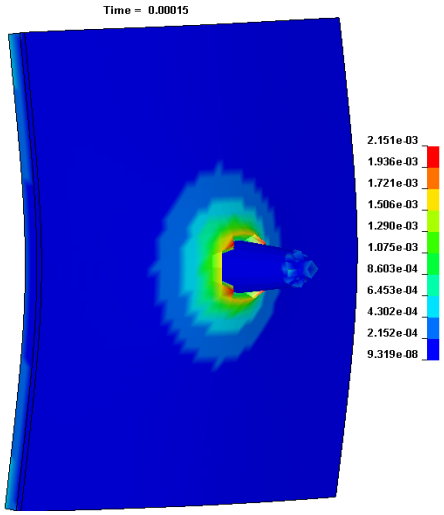


Fig. 14 Deformations field of the steel and aluminium plates on impact direction, impact velocity 235 m/s

The maximum equivalent tensions exceed the flow tension of the plates materials.

For the initial impact velocity of 235 m/s the remaining velocity of the bullet after the impact is 60 m/s (figure 16).

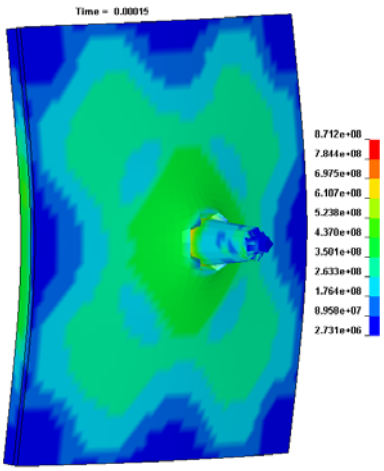


Fig. 15 Von Mises equivalent stress field of the steel and aluminium plates, impact velocity 235 m/s

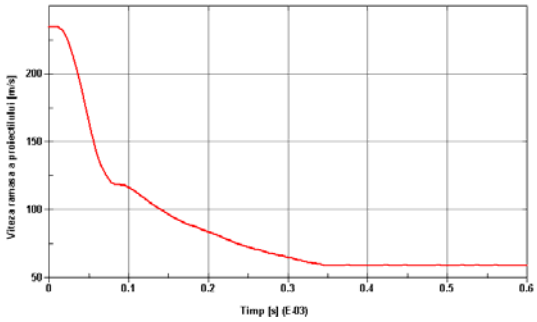


Fig. 16 Variation of remaining speed of the projectile after the impact, impact velocity 235 m/s

For the impact velocity V_{ci}= 23 m/s in Figure 17 is shown the deformations field of the plates and projectile on the impact direction. In Figure 18 is shown the von Mises equivalent stress.

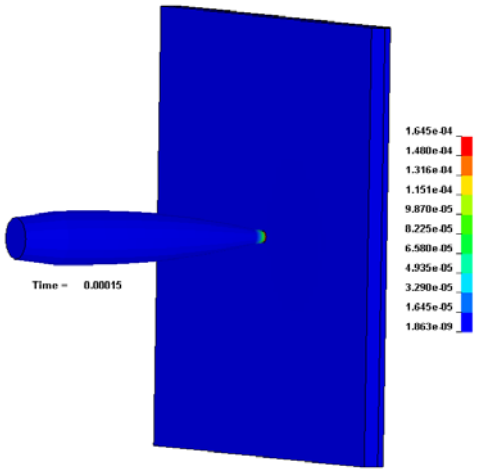


Fig. 17 Deformations field of the steel and aluminium plates on impact direction, impact velocity 23 m/s

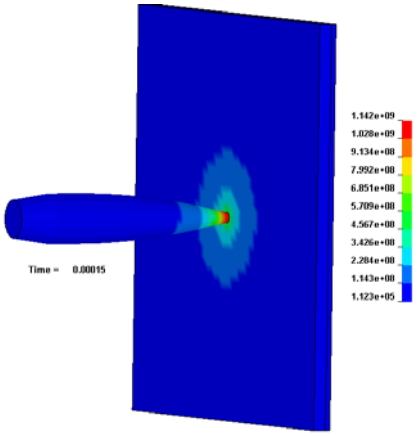


Fig. 18 Von Mises equivalent stress field of the steel and aluminium plates, impact velocity 23 m/s

At a velocity of 23 m/s the 7.62mm caliber projectile does not perforate the plates. The graph of the remaining velocity of the projectile after the impact is shown in figure 19:

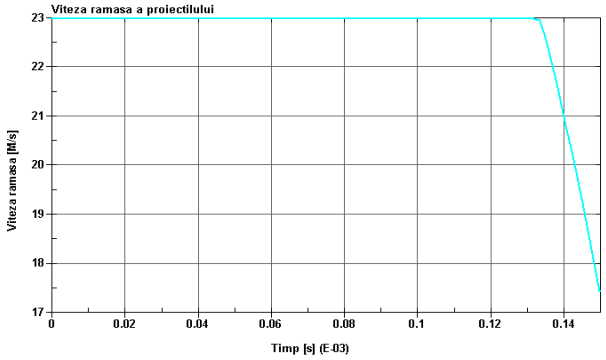


Fig. 19 Variation of remaining velocity of the projectile after the impact, impact velocity 23 m/s

The variation in time of the kinetic energy of the projectile and steel plate for V_{ci} =23 m/s is shown in figure 20 and figure 21.

It is observed that if the thickness of the steel plate is increased at 2 mm, for the impact velocity of 235 m/s the protection against 7.62 mm caliber projectile action is guaranteed.

The deformations field of the plates and projectile on the impact direction is shown in figure 22, and the von Mises equivalent stress is shown in figure 23.

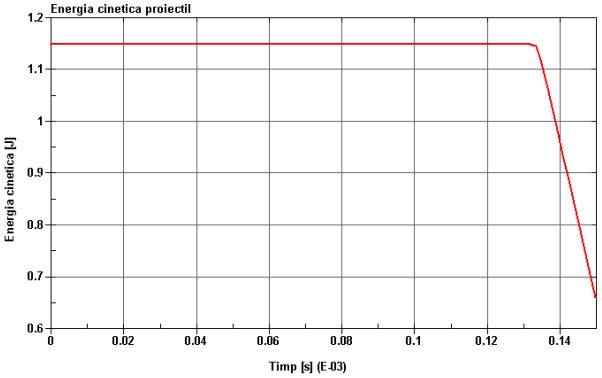


Fig. 20 Variation of the kinetic energy of the projectile, impact velocity 23 m/s

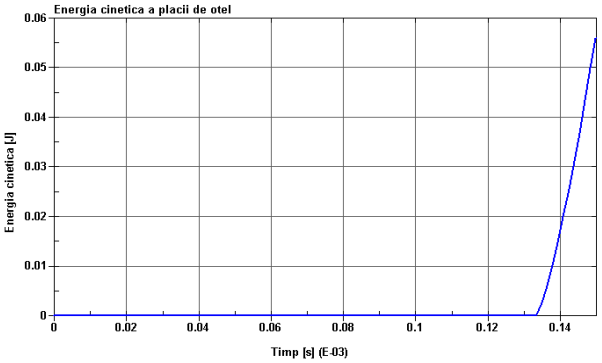


Fig. 21 Variation of the kinetic energy of the steel plate, impact velocity 23 m/s

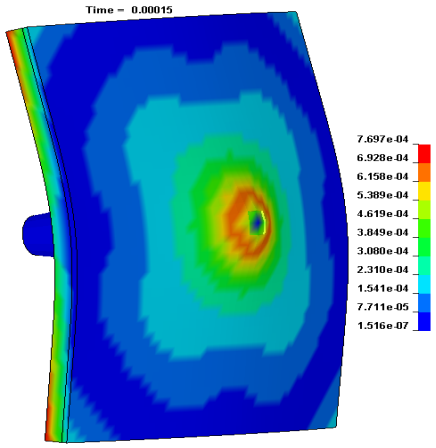


Fig. 22 Deformations field of the aluminium and 2 mm steel plate on the impact direction, impact velocity 235 m/s

Figure 24 shows the graph of the variation of the remaining velocity of the projectile after the impact:

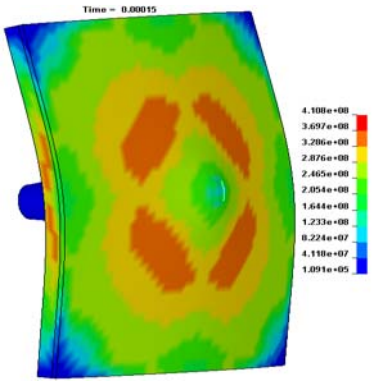


Fig. 23 Von Mises equivalent tensions for aluminium and 2 mm steel plate, impact velocity 235 m/s

The graph of the variation of the remaining velocity of the projectile after the impact is shown in figure 24:

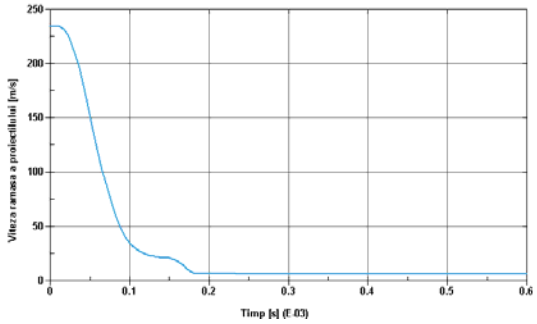


Fig. 24 Variation of the remaining velocity of the projectile after the impact, impact velocity of 235 m/s for a 2 mm steel panel

The distribution of the deformations of the sandwich panel at impact velocity v= 745 m/s is shown in figure 25.

The maximum deformations of the wall plates are of $1.85 \cdot 10^{-3}$ m.

The maximum equivalent tensions value is $5.6.10^{8}$ Pa.

The remaining velocity of the bullet after the impact with the sandwich wall is 692 m/s, at an initial impact velocity of 745 m/s.

In figure 26 is shown the field of von Mises equivalent stress in the impact zone.

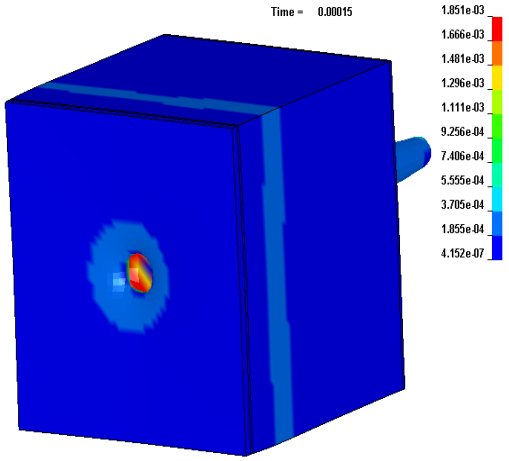


Fig. 25 Filed of von Mises equivalent stress for the sandwich wall plates, impact velocity of 745 m/s

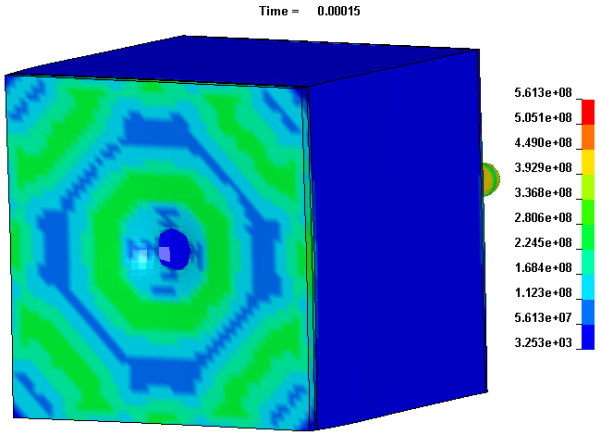


Fig. 26 Filed of von Mises equivalent stress for the sandwich wall plates, impact velocity of 745 m/s

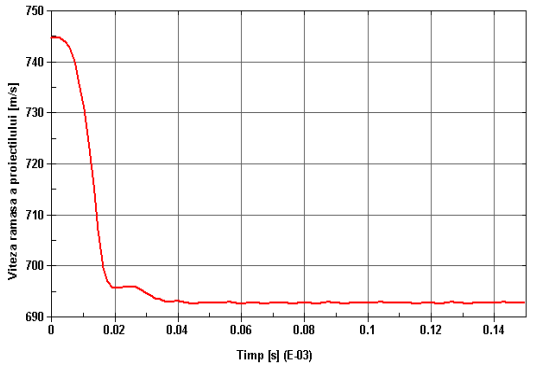


Fig. 27 Variation of the remaining velocity of the projectile after the impact with the sandwich wall, impact velocity 745 m/s

3. CONCLUSIONS

The polyurethane foam from sandwich wall composition provides just phonic and thermal protection.

The present analysis represents a model which can be used for the study of impact phenomenon for shelter walls having various thicknesses and composing materials.

The discretization solution is suitable and allows the extension of the model to plates composed of more layers.

At impact velocity vci= 745 m/s the projectile doesn't deformate due to characteristics of materials of the projectile compared to the impact velocity and with the thickness of the material of the plate. The steel plate along with the aluminium plate endure an accentuated deformation- maximum deformations of 1.94.10-3 m.

The maximum equivalent tensions have a value of 480 MPa, exceeding the flow tension of the materials of the plate.

At the impact velocity of vci= 500 m/s and vci= 235 m/s, the penetration of the target and bullet deformation is occurring. The maximum equivalent tensions exceed the flow tension of the plate's materials.

It is observed that if the thickness of the steel plate is increased to 2 mm, for the impact velocity of 235 m/s the protection against the 7.62 mm caliber projectile action is guaranteed.

At impact velocity of vci= 23 m/s the penetration of the target does not occur.

The developed model can be also applied to other angles and impact velocities.

The shelter's wall guarantees protection to the impact with the projectile only near the point of projectile fall at the end of the trajectory (v_{ci}= 23 m/s). The simulation opens the prospect of further development of impact analysis with various materials and different material thicknesses.

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RISE SAFETY AND SECURITY OF AIR TRANSPORT OF DANGEROUSE GOODS

Eugene BUSA
CFP IFPTR ARAD

1. CURRENT STATUS OF AIR CARGO DANGEROUS

Due to the increased pace of global economic development and technical progress in the last century due to increased trade and hence increased the transport of dangerous goods transport represented niche. International transport of dangerous goods is regulated by international agreements and in many such agreements or conventions or being applied and extended to inland transport of dangerous goods.

To anticipate undesirable events that could occur were developed at the UN level, a series of regulations, technical and legal, which applies to domestic and international traffic in Europe. Regulations refer to the packaging and handling of goods, loading and transport using modern technologies of transport (containerization, palletizing and pachetizare) and compliance with these regulations is possible the safe transport of goods on the transport periculoase.Reglementările dangerous goods for each mode are approved by international organizations and are regularly updated in order to improve safety on dangerous goods. Maastricht Treaty established the European Community's competence to deal with transport safety.

Transport Safety covers a multitude of factors that may directly or indirectly influence of business conditions in this domeniu.Astfel, qualification and professionalism of transport, education of all road traffic, roadworthiness of vehicles, quality infrastructure and facilities are related elements that contribute to conduct transport of dangerous goods in optimal security conditions.

Collection modes and legal tools to organize the safe transport of dangerous goods:
ADR - are prescription-related regulations under the road transport of dangerous goods.
RID - Prescriptions are regulations related to rail transport of dangerous goods regime.
ICAO-TI - Prescriptions are regulations related to air transport of dangerous goods regime.
IMDG - Prescriptions are regulations related to maritime transport of dangerous goods regime.

In the world aviation, September 11, 2001 terrorist attacks had a significant impact on air navigation companies.

Concerning the training of civil aviation administrations and personnel involved in air transport, Romania has approved a project proposed in the National Secretaries meeting in Kiev (November 2005).

Increased terrorist activities resulting in casualties and damage resulted from inherent security measures to increase and showed that these measures are perfect. Aviation security is overseen by the International Civil Aviation Organization to provide international coordination and cooperation with UN agencies such as UNCTC Committee against Terrorism, crime and drugs bureau UNODC, INTERPOL, regional organizations like the OSCE and the G8 initiative group (SAFTA).

The issue of dangerous goods is one of the most pressing contemporary issues of trade, the implications of this broader economic issues affecting both structures, but also public administration, social security etc.. Major issues concerning transport of dangerous goods in air transport that currently exist in Romania are:

-Reduction of highly qualified and specialized personnel in general and in transport, in particular, which led to a

reduction in economic competitiveness of Romania. Technological development and innovations will require a focus on developing technical skills and knowledge in parallel with the economic and general knowledge.

-There is a coherent national program on learning and continuous improvement of staff with responsibility for dangerous goods in air transport. It is necessary for attracting and training staff in transport, since it is a distinct sector, with special characteristics which require specific knowledge, both economic and technical.

2. CHARACTERISTICS OF HAZARDOUS GOODS

Advances in chemistry it is known that many synthetic chemicals are suspected harm the environment and human health, they can be found in many products that we consume daily are present in our environment.

In order to carry dangerous goods in air transport mode safely raised to know the properties of these substances / dangerous goods periculoase.Prin goods: shall mean those substances that their physicochemical nature can cause damage to persons, business, environment .

Depending on the physicochemical properties and the main danger hazardous substances are divided into nine classes:

Class 1: Explosive substances and objects, firecrackers, CART, ammunition, grenades;

Class 2: Gases, Compressed nitrogen, oxygen, BUTAN;

Class 3: Flammable liquids, diesel, petrol;

Class 4.1: flammable solids, substances autoreactive and solid desensitized explosives, Aluminium powder, naphthalene;

Class 4.2: Substances liable to spontaneous ignition (self-igniting), activated carbon, phosphorus, white or yellow awash;

Class 4.3: Substances which in contact with water emit flammable gases, ALUMINUM FUEL;

Class 5.1: oxidizing substances, nitrate, aluminum chloride BARIUM;

Class 5.2: Organic peroxides, organic peroxide TYPE B, SOLID;

Class 6.1: Toxic substances, arsenic, cyanides barium;

Class 6.2: Infectious substances, wastes NSA HOSPITAL;

Class 7: Radioactive substances, uranium, cesium;

Class 8: Corrosives, hydrochloric acid, sodium hydroxide;

Class 9: Miscellaneous dangerous substances and articles WHITE-asbestos, asbestos

Currently we have around 2,800 transport hazardous substances and labeled as corresponding to one of the 9 hazard classes above.

A classification of dangerous substances based on their intrinsic properties, depending on the degree of danger covered by current legislation is as follows:

a) explosive substances and preparations: substances and preparations: solid, liquid, paste or gel, which may react exothermically without atmospheric oxygen immediately producing emissions, and which, under specified test, detonate, a rapid deflagration or under the effect of heating explode when partially confined;

b) oxidising substances and preparations: substances and preparations which in contact with other substances, particularly flammable, has a strong exothermic reaction;

c) extremely flammable substances and preparations: liquid substances and chemical preparations with a very low flash point and a low boiling point and gaseous substances and preparations which are flammable in contact with air at ambient temperature and pressure;

d) flammable substances and preparations - liquid substances and preparations with a low flash point;

e) toxic substances and preparations - substances and preparations through inhalation, ingestion or skin penetration in small quantities can cause death or acute or chronic health conditions;

f) substances and preparations harmful - substances and preparations through

inhalation, ingestion or skin penetration can cause death or acute or chronic health conditions;

g) corrosive substances and preparations - substances and preparations which in contact with living tissues exercises destroy them;

h) substances and preparations for the environment - substances and preparations placed in the environment, would present or present an immediate or delayed for one or more components of the environment.

3. MODE OF TRANSPORT OF DANGEROUS GOODS

Transport is the national economic branch that includes all means of land transport, subterestru, water and airspace to ensure the movement of people, goods and transport system is subject bunurilor.Performance able determining the characteristics of the infrastructure (buildings and networks).

Network properties (connection, connectivity, homogeneity, isotropy, node) confer specific traits of territorial (autonomy, permanence, consistency, organization).

Therefore, planning and transport are considered in conjunction. Multicriteria substantiation, technical, financial and economic development decisions of the transport system in conjunction with the foreseeable development of socio-economic environment is proposed to be achieved in an integrated manner.

In the postwar passenger and freight air traffic worldwide has grown rapidly. The plane has long ceased to have a means of luxury transportation and prohibition, is increasingly preferred for rapid transport and efficient organization and conduct of traffic for increased comfort and safety of flights. An increasing use of aircraft known and transport of dangerous goods transport indicators-thousand tonnes worldwide doubling every 8-10 years.

Plane can provide rhythmic supply of other transport inaccessible locations, uttilizarea of cheap and lightweight packaging, eliminating storage costs of goods before and after transport, transshipments to avoid excessive damage leading to dangerous goods.

The main features of air transport are:
¬ speed (distance is completed in record time on direct routes, uninfluenced by geography)
¬ convertibility, they offer the opportunity for the adoption of operational aircraft to various categories of transport (freight, passenger, mail, mixed ...)
¬ opportunity, that transport the appropriate place and time in various parts of the world
¬ effectiveness of flights that can be achieved under regular and constant frequency
¬ availability at reasonable prices that transport cargo and passengers
¬ dangerous goods transport safety.

Air transport: an advantage over rail and car, they do not require fitting by means of communication, requiring portuală.

Transportul area rail can move with speed to shipping and with a speed lower than air. Is used to transport large amounts of substances with low degree of risk.

Mode of transport of dangerous goods must be chosen according to the risk it involves transportation. The main objective of risk assessment of the goods / hazardous substances is to provide a reliable database to decide safeguards / security measures (risk management) based on specific uses.

The risk assessment provides an estimate of the situation that if a substance used as specified by a scenario of exposure could cause adverse effects. It includes a description of the nature and effects a calculation of the probability that they happen, and an assessment on the extension or magnitude.

Any assessment of risk goods / hazardous substances has two distinct components:

a) evaluare intrinsic property known hazards assessment.

b) estimare exposure depending on usage.

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Restrictions on transportation methods are:
a) the prescription of routes followed by aircraft carrying certain dangerous goods to avoid commercial areas, residential or environmentally sensitive areas, industrial areas where the hazardous installations or

routes which are major natural hazards; b) within each class of dangerous goods are substances that can not be accepted for carriage because of the danger presented too large to transport.

4.CONCLUSION

Participants in the transport of dangerous goods must be trained to meet the requirements of their activities and the responsibility imposed in the exercise of their activities. In those circumstances will possess expert knowledge on the characteristics of hazardous substances and objects that can be transported, their hazards, emergency equipment required, and recommendations on how to proceed and to act when losses occur (fumes, leaks) or events (fire, explosion, contamination) that endanger human life or health, jeopardize the integrity of material assets (buildings, structures, facilities), or affect environmental quality.

Each airport in Romania would be to have one or more safety advisers because the airport is fueling aircraft fuel (kerosene), and each airport should be as security plans regarding safety, air transport (cargo or passenger) is more often the target of terrorist attacks.

Mode of transport of dangerous goods should be chosen taking into account:
⎫ aggressiveness of dangerous goods to be transported and inspection procedures for equipment used in the transportation, loading or unloading hazardous
⎫ Check that personnel involved in transport, loading or unloading of dangerous goods have detailed procedures and work instructions and measures to raise the risk inherent in the transportation, loading or unloading dangerous.

Development, modernization and efficient transport of dangerous goods is made possible by:
⎫ expanding and harmonizing the legislation of dangerous goods in EU countries,
⎫ safety and improve security on the transport of dangerous goods
⎫ raising staff training that is involved in transport and handling of dangerous goods.
⎫ achieve a coherent national program on learning and continuous improvement of personnel responsible for air transport of dangerous goods.

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WOOD WASTE BIOMASS GASIFICATION POWER SAVING AND RATIONAL USE OF ENERGY

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Abstract: *Biomass is potentially a major renewable energy source because it can be considered as a relatively clean fuel as it decreases net CO_2 emission, it has low sulphur and nitrogen content and particulate emission are lower than fossil fuels. In this paper we present the possible energetic use of solid biomass. We will obtain two certain advantages: the decrease of energetic costs for the production and the decrease of the environmental impact proper to those processes. Gasification of biomass is a thermal – chemical process which converts solid biomass of combustible gases, called gasogen, and the ash is separated and eliminated from the energetic cycle.*

Key words*: wood biomass, clean fuel, fossil fuel, biomass sources, gasogen.*

1. INTRODUCTION

A far-reaching definition of the biomass is according to "biodegradable fraction of the products, loss and waste from agriculture (including animal and vegetal substances), sylvan field and related industries, as well as biodegradable fraction from garbage waste and industrial waste"[1, 6, 7]state of the domestic and wild plants is biomass.

One important aspect of the biomass is cumulating solar energy witch can be converted later in electricity, fuel or heat. The necessity of a durable energetic development and efficient environmental protection led in the last few years to high preoccupations regarding the renewable energy sources promotion and industrial support technology (Table 1).

The entire material (tissue) in raw or processed state of the domestic and wild plants is biomass. One important aspect of the biomass is cumulating solar energy witch can be converted later in electricity, fuel or heat. The necessity of a durable energetic development and efficient environmental protection led in the last few years to high preoccupations regarding the renewable energy sources promotion and industrial support technology.

Table 1 Potential of the renewable energy resource

No	Source	Potential	Applications
1	Solar energy *Thermal *Photovoltaic	High Medium	Termal energy Electrical energy
2	Wind power	High	Electrical energy
3	Water power Geotermal energy	Medium Medium	Electrical energy Termal energy
4	Biomass	High	Termal energy

The major factor in electric energy production from renewable sources is Biomass, and the most used form is wood [2].

It is estimated till 2010 the percentage of renewable energy sources in balance with primary source to be minimum 12 % towards 8% that is now and electric energy percentage made from renewable source to raise form 14,3 % to minimum 23,5 %.

Farming provides a bigger quantity of biomass versus biomass extracted from sylvan field [4]. Processes like: cogeneration,

gasification and fermentation can go into energy transformation for our benefit.

The wood's chemistry has a very low variation from species to species (Fig. 1).

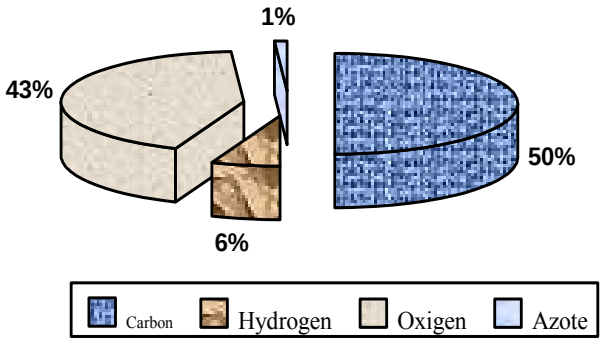

Fig. 1 Average composition of the wood burning mass

There is a high potential of biomass that can be also increased by a good management of the present resources [5, 6, 7] and trough a step by step grown of the crop productivity (Table 2).

Table 2 Crop productivity

No	Dry mat. (t/ha)	Crop	Oil equiv. prod (l/ha)
1	30	Sorghum, Reed, Sweet Sorghum	12.000
2	20	Peace, Cereal crops, Willow,	8.000
3	10	Rape	4.000

2. FACILITY INTRODUCTION

The Gascoigne Heating Facility is distinguished by the using the Descendent Gasification System technology of the wood biomass, filtering and cooling the obtained gas and in the last phase burning of the gas trough a nozzle making a Direct Heating System for Greenhouses.

The Facility (Fig. 2) includes: one gasified, gas filter, gasogen deriver, blower, burning nozzle, frame, and flexible tube.

To be able to obtain the Gascoigne trough gasification by a thermo chemical process of wood biomass then driving the gas, filtering, cooling and finally burning the facility must have a very good sealed tube structure.

The process is similar as the burning conversion, but here is less oxygen like in the conventional burning process.

It's called Equivalent Ratio the ratio between the oxygen quantity that enters in reaction and the necessary oxygen quantity for a complete burn; then it is possible to determine the gas composition.

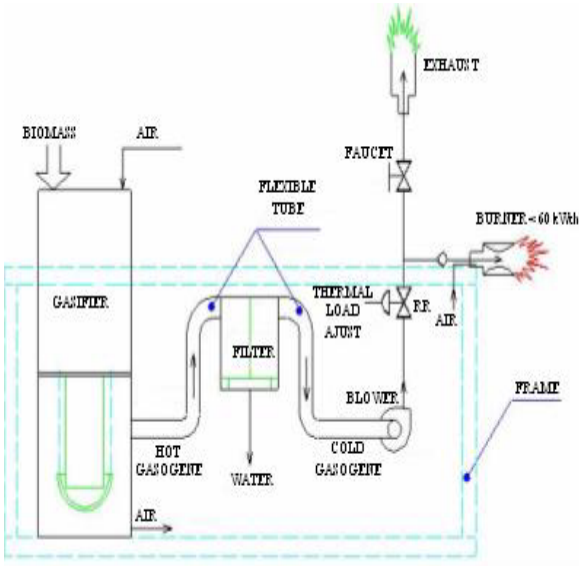

Fig. 2 Facility indication

Gasification is taking place at a ratio from 0.2-0.4, because here is the maximum energy transfer from biomass to the gas.

Table 3 presents chemical composition and inferior calorific powers of the gas according with the wood mass.

Table 3 Chemical composition and inferior calorific powers of the biomass

Wood Biomass	Dry Oke	Dry Beech	Dry Fir	Wood Coal	Coal
CO	18,3	18,3	18,3	18,3	18,3
H_2	16,9	16,9	16,9	16,9	16,9
CH_4	2,8	2,8	2,8	2,8	2,8
C_nH_{2n}	0,5	0,5	0,5	0,5	0,5
CO_2	16,0	16,0	16,0	16,0	16,0
N_2	-	49,3	49,3	49,3	49,3
Infer. Calorif. Power kcal/m^3	1295	1295	1295	1295	1295

The gas obtained from wood biomass by thermo chemical process [3] conversion trough oxidation at a high temperature of the matter is called gasogen "middle quality gas".

It contains CO, CO_2, H_2, CH small quantities of hydrocarbons, water, azoth little particles of charred coal, asphalt oil and oil.

Starting for the first time the Gasogen Heating Facility, the grassfire grate and a half of the fire tube is filling up with good quality charred coal. In fig 3, is presented overview of heating gas-producing facility, and in fig. 4 front view of the heating plant.

Fig. 3 Overview of heating gas-producing facility

The faucet towards the gas burner is closed and the other 2 (faucet and thermal load adjustment) are opened, till the wood is transformed into charred coal the facility is working as a normal thermal plant.

Fig. 4 Front view of facility

When the gas leaves the gasifire unit all the existent oxygen is chemically modified and is retrieved in CO and H_2O.

Biomass material used for testing is shown in fig. 5, this is rubbish timber.

Fig. 5 Biomass material used for tests

To assess functional characteristics of the installation of special equipment were used in fig 6, end table 4.

Fig. 6 Measuring equipment

3. SPECIFICATIONS

Measurements of the equipment shown in fig. 6 allowed obtaining the following specific:

- Reated Power 60 kW
- Gasogen Calorific Power 5 MJ / m N

- Biomass specific consumption 0.35 kg / kW
- Biomass flow 21 kg/h
- Gas flow 48 m /h
- Tank 0,05 m
- Gazogen Filter Tank 0,05 m
- Fire Tube diameter Ø = 175 mm
- Length of the Fire Tube L = 359 mm

Table 4 Control and measuring equipment

No	Name of instrument or apparatus	Measurement range	Observation
1	Electronic Gas gauge differential measurement TESTO 506	0 ÷ 1 mbar 1 ÷ 10 mbar 10 ÷ 200 mbar	± 0,03 mbar ± 1,5 % ± 1 %
2	Digital Dust Analyzer MICRO DUST PRO	0,001÷2.500 mg/m^3	± 0,1 %
3	Digital aeir speed, temperatures and air flow measurement TESTOTERM 4000	0,4 ÷ 40 m/s - 120 ÷+1.300 ^{0}C 10÷500.000 m^3/h	
4	Digital Laser Thermometer UNITEST	- 50 ^{0}C ÷ 0 ^{0}C 0 ^{0}C ÷ +200 ^{0}C +200^{0}C÷+1.333 ^{0}C	± 2 % ± 1,5 % ± 1 %
5	Gas Analyzer, Tempest 50	O_2/CO/NO Calc.CO_2, CO/CO_2	

4. CONCLUSION

It is clearly that in the nearby future more and more legislative and organizatorial measures will be imposed to reduce pollution, greenhouse effect emissions, reduction of the oil import that will rise eventually and leading to its worn; solution is biomass resources to produce biofuels solid (wood, igniters and shiver), liquid (ethanol, biodiesel and pure vegetable oil) and gas (biogas).

It's a necessity to re run the complex research for Sweet Sorghum, Rape and other energetic plants aquatic, which grows quickly.

We can become big exporters – consumers of bioethanol, biodiesel and pure vegetable oil, implementing the pyrolysis and gasification technology for our biomass potential [6, 7].

Appling efficient technology with low energy consumption, assuring a durable functionality of the industrial facilities will led to a cost reduction and economical competitiveness of the Romanian biofuels on the European Market.

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COMPARATIVE STUDY REGARDING THE BEHAVIOUR OF DIFFERENT BIOMASS RESIDUES DURING ANAEROBIC FERMENTATION IN A BIOGAS PILOT PLANT

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Abstract: *The use of renewable resources has evolved considerably in the last period of time, mainly because of the fact that those resources are inexhaustible and they can be found at lower prices on the market than the fossil fuels. From this category of resources, the biomass is one of the most important sources of energy, being the first renewable resource that has been used to produce heat on the stair of human evolution.*
The main purpose of this study is to present some of the types of biomass used in our days, and also to present some experimental aspects of their behaviour during the process of anaerobic fermentation inside a pilot plant used for transforming the biomass found in both wood and agricultural residues in biogas. This model of installation is present at the Politehnica University of Timisoara, Mechanical Engineering Faculty.

Key words: *biomass residues, main parameters, anaerobic fermentation.*

1. INTRODUCTION

The use of biomass has for millennia helped human society to fulfil many of its fundamental energy needs, such as for the production of goods, cooking, domestic heating and the transport of people and goods [1].

The global energy demand is growing rapidly, and about 88% of this demand is met at present time by fossil fuels. Scenarios have shown that the energy demand will increase during this century by a factor of two or three (IEA 2006). At the same time, concentrations of greenhouse gases (GHGs) in the atmosphere are rising rapidly, with fossil fuel-derived CO_2 emissions being the most important contributor. In order to minimize related global warming and climate change impacts, GHG emissions must be reduced to less than half of global emission levels of 1990 (IPCC 2000). Another important global challenge is the security of energy supply, because most of the known conventional oil and gas reserves are concentrated in politically unstable regions. In this context, biogas from wastes, residues, and energy crops will play a vital role in future [2].

Biogas can be produced from nearly all kind of biological feedstock types, within these from the primary agricultural sectors and from various organic waste streams from the overall society [3].

Biogas is produced in different environments, e.g., in landfills, sewage sludge and biowaste digesters during anaerobic degradation of organic material. Methane, which is the main component of biogas, is a valuable renewable energy source, but also a harmful greenhouse gas if emitted into the atmosphere. Methane, upgraded from biogas, can be used for heat and electricity production or as biofuel for vehicles to reduce environmental emissions and the use of fossil fuels [4].

Related to obtaining biogas from waste biomass in Figure 1 is presented the biogas production in Europe, observing that most developed countries in this regard are France,

Germany, Italy, Britain and Spain, while Denmark and Sweden do not put as much emphasis on the use of biogas, in these countries using other types of renewable energy (wind, solar).

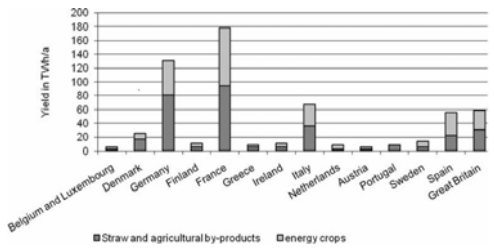

Fig. 1 Biogas production across European countries [5]

In Romania there are not in use today any biogas plants for vegetable waste (cellulose) in the absence of technology, not the raw material that is available in considerable quantities.

2. EXPERIMENTAL PART

At the Multifunctional Laboratory in the Mechanical Engineering Faculty of the Politehnica University of Timisoara, there was realised a pilot installation where was studied the behaviour of different types of biomass residues during the process of anaerobic fermentation.

In this paper there will be presented two types of materials, mainly linden dust and corn cobs waste, with their determined chemical properties and their behaviour, during the influence of the main parameters of the process : temperature and pH. Also there will be presented the pressure difference corelated with the field of temperatures inside each reservoir for each of the two batches.

In Figures 2 and 3 there are presented the materials used for the batches.

Fig. 2 Grains of corn waste [6]

Fig. 3 Linden dust [6]

In Table 1 are presented the chemical characteristics of the two types of biomass residues.

Table 1 Chemical characteristics of the two types of biomass residues [6]

No	Sample	High calorific value [kJ/kg]	Low calorific value [kJ/kg]
1	Grains of corn waste	15933	14488
2	Linden dust	17705	16263

In Figure 4 it will be presented the schematics for the biogas pilot installation.

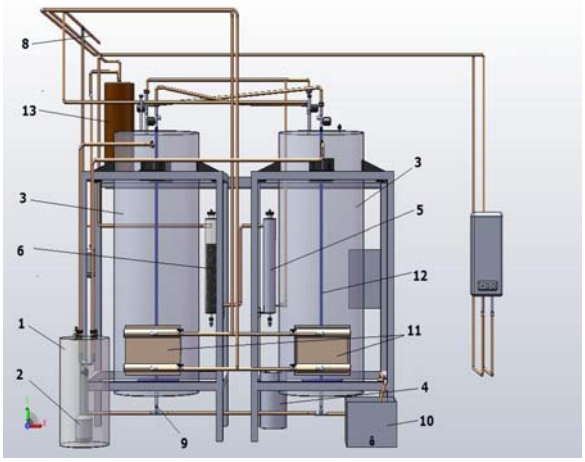

Fig. 4 Schematics for the pilot plant used for obtaining biogas from biomass residues [6]

1 – preparation tank, 2 – pump, 3 – fermentation reactors, 4 – correction agent tank, 5 - filter for retaining the H_2S, 6 - system used for retaining CO_2. 7 - adjacent system for CO_2 desorption and compression, 8 – consumer , 9 - gravimetric system, 10 – system for neutralizing the resulting liquid, 11 – heating system, 12 - bubbling system, 13 - small tank for biogas samples.

From the biomass deposit, the used material is passed through a mill, and then it's sent to the tank where the preparation of the suspension of biomass is made (1). The biomass suspension is transported with the help of the pump (2) and introduced into the fermentation reactors (3). The correction agent tank for the pH assures, through the control

system, the conditions for the process of anaerobic fermentation. The resulted biogas is passed through a filter for retaining the H_2S (5) and after that, through a system used for retaining CO_2 (6), after which takes place the CO_2 desorption and the compression of the CO_2 in the adjacent system (7) and the purified biogas is sent for being used (8). The used material is discharged through the means of a gravimetric system (9), and the solid material is retained for being dried using the natural drying, and after that is sent to a compost deposit for being used as a soil fertilizer. A part of the resulting liquid is neutralized when the case, in the system (10) and sent to the sewerage network, or is transported by the recirculation pump (2) from the suspension preparation tank (1). The fermentation reactors are thermostat heated with the system (11). For the homogenization of the suspension is used a bubbling system (12) made by polypropylene pipes to avoid the possible corrosion. Also, for depositing small quantities of biogas of the purpose of analyzing, the installation is equipped with a small tank (13) positioned at the top of the reservoirs.

In Figures 5 and 6 are presented the variation of the main parameters of influence (temperature and pH for the corn cobs waste batch).

In Figures 7 and 8 are presented the variation of temperature and pH for the linden dust batch.

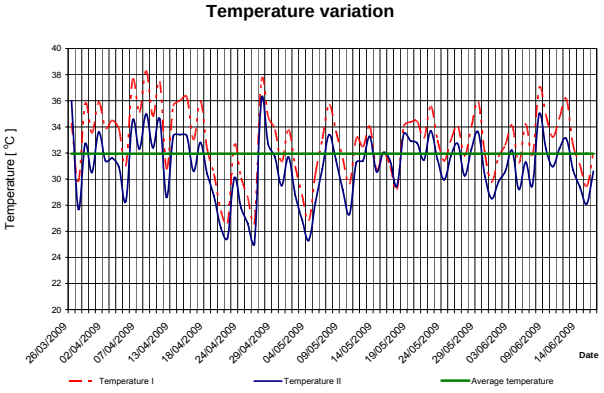

Fig. 5 Temperature variation for corn cobs batch [6]

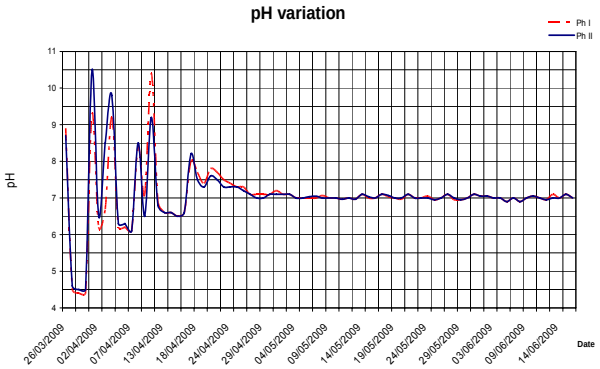

Fig. 6 pH variation for corn cobs batch [6]

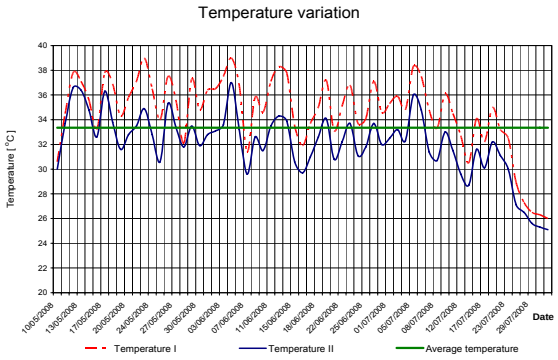

Fig. 7 Temperature variation for linden dust batch [6]

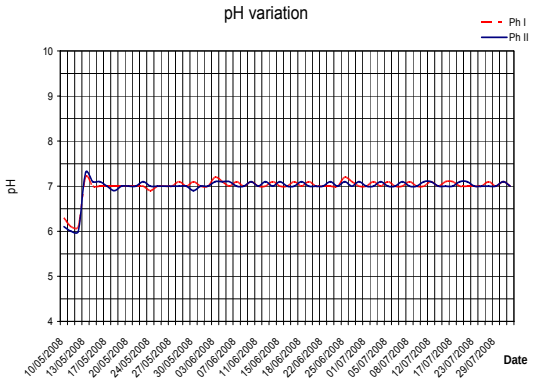

Fig. 8 pH variation for linden dust batch [6]

From Figures 5 and 6 it can be observed a variation in temperature and pH for the first batch. The small difference between the temperatures for the first and second reservoir can be caused by a slightly different behavior of the material for each reservoir, or from a difference in the possibility of equally heating the reservoirs by the heat exchangers.

The pH presents large variations in the acid zone and after the initial period it is stabilized

with the help of dosing pumps. The second batch, presented in Figures 7 and 8 have common points with the first one both from the temperature and pH perspectives. The value of temperature has the about the same behavior like in the first batch and the pH is stabilized around the value 7, a neutral one with little influence on the anaerobic fermentation process.

In Figures 9 and 10 there will are presented the difference in pressure for the batches, this aspect being correlated with biogas production.

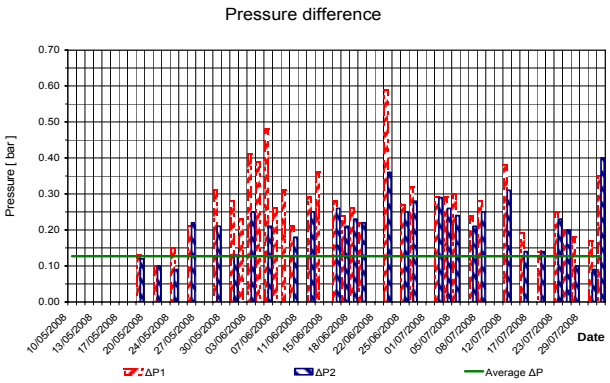

Fig. 9 Pressure difference for linden dust batch [6]

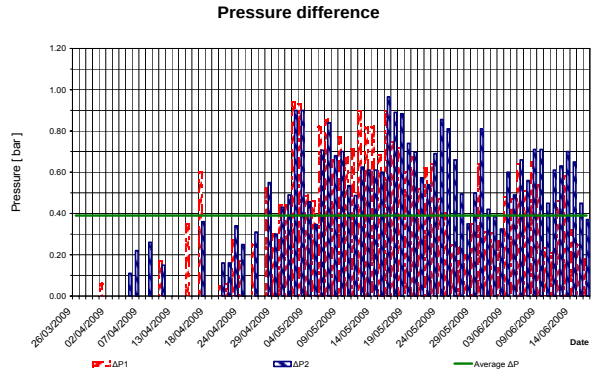

Fig. 10 Pressure difference for corn cobs batch [6]

The pressure difference shows that the corn cobs batch produced a larger quantity than linden dust, making it more suitable for obtaining biogas using the anaerobic fermentation process.

3. CONCLUSIONS

1. Biogas is a type of unconventional energy for the future, one way to produce energy and still tends to assume a growing impact in the present context related to reduce amounts of fossil fuels;

2. Biomass represents an inexhaustible energy resource that can be used partly or wholly for biogas production, both by anaerobic fermentation and other processes (aerobic fermentation, gasification), related technology for anaerobic fermentation process being used in the present;

3. Main parameters of influence on the anaerobic fermentation process are the temperature at which the process is done, the pH of slurry, elementary, the chemical composition of the materials used and the biomass nature;

4. Because of the high content of amide in corn cobs, this batch will be more suited for obtaining biogas than the linden dust batch, which contains lingo-cellulose chains, very difficult to be broken during the anaerobic fermentation process.

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A NEW APPROACH OF PROJECTILE MOTION INSIDE THE BARREL OF ARTILLERY SYSTEMS

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Military Technical Academy

***Abstract**: In this paper it is proposed a mathematical model of a projectile motion under action of powder gases pressure inside of a gun with grooved barrel, using the gas dynamics equations. In order to solve this mathematical model it was used the method of characteristics, elaborating an interior ballistics software which allows us to study the variation of the powder gases pressure and the projectile velocity versus its displacement inside of gun and versus time which represents the content of fundamental problem of interior ballistics. For an existent gun, the theoretical results obtained with the aid of this software and the experimental data are compared.*

***Key words:** gas dynamics equations, characteristic's method, fundamental problem of interior ballistics*

1. INTRODUCTION

In this paper it is proposed a mathematical model of a projectile motion under the action of powder gases pressure inside of a gun with a grooved barrel, using the gas dynamics equations. The mathematical model takes into account the waves system that forms inside the barrel once the projectile starts its displacement.

In the classical interior ballistics one cannot include the waves system which occurs during the ballistic cycle, and the fundamental problem is evaluated as follows:

- the density of gases is assumed to be uniform in the flow field between the breech and the bullet at any particular time during the weapon firing process;
- the space-mean values are assumed for the thermodynamic variables;
- the dynamic effects are included through the inclusion of various correction factors only determined more or less empirically.

Therefore a new approach is needed. The mathematical model proposed involving unsteady, one-dimensional motion of gases permits a study of the fundamental problem of interior ballistics and provides more accurate results than the data obtained by classical methods.

Due to the complexity of projectile motion inside of a grooved barrel, are accepted some assumptions:

a) the powder grains start burning in the same moment;

b) the powder gases are considered not being in motion until the projectile starts moving and the pressure, the same in every point of the domain, reaches p_{const};

c) the powder gases and the unburned grains of propellant form a homogenous mixture;

d) the resistance against projectile's movement is neglected;

e) the barrel's recoil is not taken into consideration;

f) heat loss through transfer through the barrel's walls is neglected.

According to these assumptions, the fundamental problem of interior ballistics becomes a problem of non steady state and one-dimensional motion of varied gases amount. The motion, continuity, and energy equations have the following expressions:

$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + \frac{1}{\rho}\frac{\partial p}{\partial x} = 0; \qquad (1a)$$

$$\frac{\partial \rho}{\partial t} + u\frac{\partial \rho}{\partial x} + \rho\frac{\partial u}{\partial x} = 0; \qquad (1b)$$

$$\frac{\partial\left(pw_1^{\gamma}\right)}{\partial t}+u\frac{\partial\left(pw_1^{\gamma}\right)}{\partial x}=0, \qquad (1c)$$

in which: u – the motion velocity of gases and unburned powder mixture; p – the pressure of the mixture; ρ – the mixture's density; w_1 – the mass volume of mixture.

2. THE MATHEMATICAL MODEL

The system (1) was completed with the equation of gases forming velocity and transformed by the introduction of relative variables, as follows:

$$\bar{a}=\frac{a}{a'_0};\ \bar{x}=\frac{x}{\ell_0};\ \bar{t}=\frac{ta'_0}{\ell_0};\ \bar{u}=\frac{u}{a'_0};$$

$$\bar{p}=\frac{p}{p_{max}};\ \bar{a}'=\frac{a'}{a'_0};\ \bar{\Phi}=\frac{\Phi}{\Phi_0}\ \text{wherein:}$$

$$a=\sqrt{\frac{\gamma p}{\rho^2\left[\frac{1}{\rho}-\frac{1-\psi}{\delta}-\alpha\psi\right]}};$$

$$a'=\sqrt{\gamma p\left(\frac{1}{\rho}-\frac{1-\psi}{\delta}-\alpha\psi\right)}$$

$$\Phi=p\left(\frac{1}{\rho}-\frac{1-\psi}{\delta}-\alpha\psi\right)^{\gamma}.$$

$$\ell_0=\frac{W_0}{s};\ p_{max}=\frac{f\Delta}{1-\alpha\Delta}=\frac{f\rho_0}{1-\alpha\rho_0};$$

$$\Phi_0=f\left(\frac{1}{\rho_0}-\alpha\right)^{\gamma-1};a'_0=(\gamma f)^{\frac{1}{2}}.$$

The system (1) becomes:

$$\frac{\partial\bar{u}}{\partial\bar{t}}+\bar{u}\frac{\partial\bar{u}}{\partial\bar{x}}+\frac{2}{\gamma-1}\bar{a}\frac{\partial\bar{a}'}{\partial\bar{x}}=\frac{\bar{a}\bar{a}'}{\gamma(\gamma-1)}\frac{\partial(\ln\bar{\Phi})}{\partial\bar{x}}; \qquad (2a)$$

$$\frac{2}{\gamma-1}\left(\frac{\partial\bar{a}'}{\partial\bar{t}}+\bar{u}\frac{\partial\bar{a}'}{\partial\bar{x}}\right)+\bar{a}\frac{\partial\bar{a}}{\partial\bar{x}}=$$
$$=\frac{\bar{a}'}{\gamma-1}\left(\frac{\partial(\ln\bar{\Phi})}{\partial\bar{t}}+\bar{u}\frac{\partial(\ln\bar{\Phi})}{\partial\bar{x}}\right)+\Gamma' D\sigma\frac{\bar{p}^2}{\bar{a}'}; \qquad (2b)$$

$$\frac{\partial(\ln\bar{\Phi})}{\partial\bar{t}}+\bar{u}\frac{\partial(\ln\bar{\Phi})}{\partial\bar{x}}=\left[1-(\gamma-1)D\bar{p}\right]\Gamma'\sigma\frac{\bar{p}}{\bar{a}'^2}; \qquad (2c)$$

$$\frac{\partial\psi}{\partial\bar{t}}+\bar{u}\frac{\partial\psi}{\partial\bar{x}}=\Gamma'\sigma\bar{p}, \qquad (2d)$$

in which: $D=\dfrac{\left(\alpha-\frac{1}{\delta}\right)\rho_0}{1-\alpha\rho_0}$; $\Gamma'=\dfrac{\chi}{e_1a'_0}u_1\ell_0p_{max}$

From the continuity equation (2b) using the energy equation (2c), the natural logarithm of the entropy $\ln\bar{\Phi}$ is eliminated, thus obtaining the relation:

$$\frac{2}{\gamma-1}\left(\frac{\partial\bar{a}'}{\partial\bar{t}}+\bar{u}\frac{\partial\bar{a}'}{\partial\bar{x}}\right)+\bar{a}\frac{\partial\bar{u}}{\partial\bar{x}}=\frac{\Gamma'\sigma(\psi)}{\gamma-1}\frac{\bar{p}}{\bar{a}'} \qquad (2b')$$

With equations (2a) and (2b') the following system is obtained, a system with partial derivatives, first order:

$$\begin{cases}\dfrac{\partial\bar{u}}{\partial\bar{t}}+\bar{u}\dfrac{\partial\bar{u}}{\partial\bar{x}}+\dfrac{2}{\gamma-1}\bar{a}\dfrac{\partial\bar{a}'}{\partial\bar{x}}= \\ \qquad=\dfrac{\bar{a}\bar{a}'}{\gamma(\gamma-1)}\dfrac{\partial\left(\ln\bar{\Phi}\right)}{\partial\bar{x}} \\ \dfrac{2}{\gamma-1}\left(\dfrac{\partial\bar{a}'}{\partial\bar{t}}+\bar{u}\dfrac{\partial\bar{a}'}{\partial\bar{x}}\right)+\bar{a}\dfrac{\partial\bar{u}}{\partial\bar{x}}= \\ \qquad=\dfrac{\Gamma'\sigma(\psi)}{\gamma-1}\dfrac{\bar{p}}{\bar{a}'}\end{cases} \qquad (3)$$

3. SOLVING THE MATHEMATICAL MODEL

One can solve the hyperbolic system of differential equation using the characteristics method. That method transforms the equations with partial derivatives into the ordinary differential equations. The characteristic directions are defined as the curves along which the derivatives of the gases properties such as $\frac{\partial\bar{u}}{\partial\bar{t}}$, $\frac{\partial\bar{u}}{\partial\bar{x}}$, $\frac{\partial\bar{a}'}{\partial\bar{t}}$ and $\frac{\partial\bar{a}'}{\partial\bar{x}}$ are discontinuous. The equations for these curves can be determined by considering the system (3) to which two equations have been added.

$$\begin{cases} \dfrac{\partial \bar{u}}{\partial \bar{t}} + \bar{u}\dfrac{\partial \bar{u}}{\partial \bar{x}} + \dfrac{2}{\gamma - 1}\bar{a}\dfrac{\partial \bar{a}'}{\partial \bar{x}} = \\ \qquad = \dfrac{\bar{a}\bar{a}'}{\gamma(\gamma\text{ -}1)}\dfrac{\partial\left(\ln \bar{\Phi}\right)}{\partial \bar{x}} \\ \dfrac{2}{\gamma - 1}\left(\dfrac{\partial \bar{a}'}{\partial \bar{t}} + \bar{u}\dfrac{\partial \bar{a}'}{\partial \bar{x}}\right) + \bar{a}\dfrac{\partial \bar{u}}{\partial \bar{x}} = \\ \qquad = \dfrac{\Gamma'\sigma(\psi)}{\gamma - 1}\dfrac{\bar{p}}{\bar{a}'} \\ \dfrac{\partial \bar{u}}{\partial \bar{t}}d\bar{t} + \dfrac{\partial \bar{u}}{\partial \bar{x}}d\bar{x} = d\bar{u} \\ \dfrac{\partial \bar{a}'}{\partial \bar{t}}d\bar{t} + \dfrac{\partial \bar{a}'}{\partial \bar{x}}d\bar{x} = d\bar{a} \end{cases} \quad (3')$$

Using the Hristianovich method [1, 3] the equations of characteristics of the system (3') are determined.

The equations of characteristics in both plane of independent variables $(\bar{x}, \bar{t})$ and plane of the searched functions $(\bar{u}, \bar{a}')$ are as following:

- for the first family:

- in plane of independent variables:

$$d\bar{x} = (\bar{u} + \bar{a})d\bar{t}; \quad (4a)$$

- in plane of searched functions:

$$\frac{2}{\gamma - 1}d\bar{a}' + d\bar{u} = \\ = \frac{\bar{a}\bar{a}'}{\gamma(\gamma - 1)}\frac{\partial(\ln\bar{\Phi})}{\partial \bar{x}}d\bar{t} + \frac{1}{\gamma - 1}\Gamma'\sigma\frac{\bar{p}}{\bar{a}'}d\bar{t} \quad (4b)$$

- for the second family:

- in plane of independent variables:

$$d\bar{x} = (\bar{u} - \bar{a})d\bar{t}; \quad (5a)$$

- in plane of searched functions:

$$\frac{2}{\gamma - 1}d\bar{a}' - d\bar{u} = \\ -\frac{\bar{a}\bar{a}'}{\gamma(\gamma - 1)}\frac{\partial(\ln\bar{\Phi})}{\partial \bar{x}}d\bar{t} + \frac{1}{\gamma - 1}\Gamma'\sigma\frac{\bar{p}}{\bar{a}'}d\bar{t} \quad (5b)$$

The used initial conditions for the integration of differential equations correspond to the beginning of projectile motion, when:

$$\bar{t} = 0\text{ '}\ \bar{x} \in [0,1];\ \bar{u} = 0;\ \psi = \psi_{ct};$$

$$z = z_{ct} = \frac{\psi_{ct}}{\chi};\ \bar{p} = \bar{p}_{ct} = \frac{\psi_{ct}}{D_1 - D\psi_{ct}}; \quad (6)$$

$$\bar{a}' = \bar{a}'_{ct} = \sqrt{\psi_{ct}};$$

$$\bar{\Phi} = \bar{\Phi}_{ct} = \psi_{ct}\left(D_1 - D\psi_{ct}\right)$$

where $D_1 = \dfrac{1 - \dfrac{\rho_0}{\delta}}{1 - \alpha\rho_0}$.

The limit conditions for the integration of differential equations are followings:

- at the rear part of barrel: $\bar{x} = 0;\ \bar{u} = 0;$

- at the rear part of projectile:

$$\bar{x} = 1 + \bar{\ell} = 1 + \frac{\ell}{\ell_0}; \\ d\bar{u} = \frac{1}{\rho_1}\frac{\omega}{q}\frac{1}{\gamma(1 - \alpha\rho_0)}\bar{p}d\bar{t}. \quad (7)$$

The equations of characteristics and the equation of energy (2c) allow the determination of values $\bar{u}, \bar{a}', \bar{x}, \bar{t}$ and $\bar{\Phi}$ in the intersection points of opposite family of characteristics.

4. RESULTS AND CONCLUSIONS

For the numerical integration of differential equations with the initial and the limit conditions shown above, a computer code is elaborated which allows us to obtain the values in interest of the fundamental problem of interior ballistic, which are the variation of pressure inside the barrel and the velocity of the projectile function of time and of projectile displacement in the barrel of the system.

For an existent gun, the theoretical results obtained with the aid of this program and the experimental data are compared.

For comparison of the results, for the ballistic system chosen the following data are given:

d=0.009; δ=1540.00; D=1.44; D_1=2.44; D_2=2.281; $\psi_{ct} = 0.0317$; $z_{ct} = 0.0289$; $\bar{p}_{ct} = 0.01324$; $\bar{a}_{ct} = 0.3511$; $\bar{a}'_{ct} = 0.1781$; $\bar{\Phi}_{ct} = 0.0378$; $\ell_0 = 0.270$ m.

Thus, the following results are obtained:

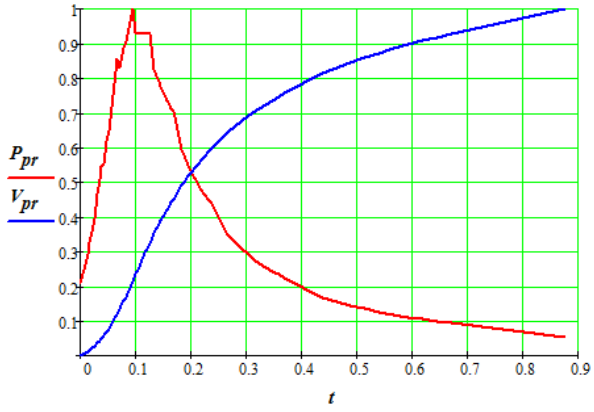

Fig. 1 – Variation of the pressure of the gases and velocity of the projectile versus time

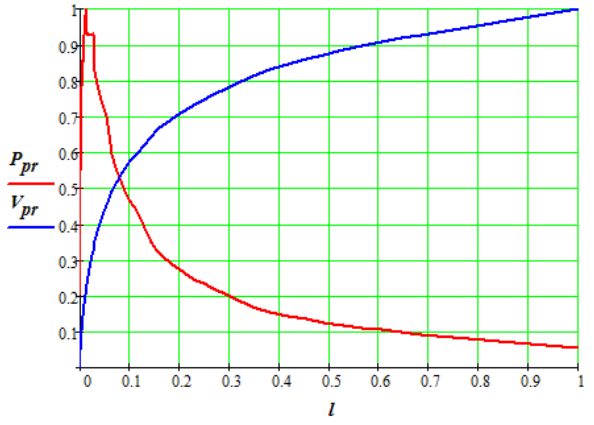

Fig. 2 – Variation of the pressure of the gases and velocity of the projectile versus projectile's displacement in the barrel

The theoretical results, obtained through the conceived computer program, are in a good correspondence with the experimental data, for the ballistic system of choice, as it can be observed in the table below:

Table 1. Comparison between theoretical and experimental results

$V_{0_{th}}$	387 m/s	$p_{max_{th}}$	1930.00bar
$V_{0_{exp}}$	402.3 m/s	$p_{max_{exp}}$	1967.55bar

As it can be observed in the table above the difference between the values of muzzle velocity as resulted from experimental data and from theoretical calculi is 3.95%, which is a normal value considering the hypothesis d) made in the beginning of this paper, that the resistant forces of friction between the projectile and the barrel of the gun are neglected. The difference between the experimental data and the computed value of powder gases pressure is 1.94%, which is a direct result of the assumptions being made.

The same assumption d) gives us the angular points on the graphics of variation of pressure versus time and projectile's displacement in the gun barrel, because of the abrupt jump in the acceleration of the projectile at the beginning of the motion, at t = 0. This discontinuity propagates through the characteristics of the system, giving the angular points on the graphics.

With these results I consider that the mathematical model is validated and, with little improvement, to take into account the values neglected through the initial hypotheses, the computer code generated may be used for studying any other artillery system.

Since the mathematical model confers values of the powder gas density, and implicitly the value of the temperature in the current barrel section at any time, it may be a useful tool in the study of the heat transfer from the hot gases to the barrel material through the boundary layer and other applications within the barrel of guns.

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IDENTIFICATION AND PREDICTIONS IN THE AUTOMOTIVE CLAIMS' AREA

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Abstract: *The paper focuses on the forecasting models into the automotive claims. The economic systems are complex, opened systems involving natural and human factors. In particular, into the automotive claims the complex conjunction between the human behavior, the duty service of cars, the weather conditions, and the like interact with the economical processes. The companies involved into the automotive insurance require an effective way to the optimal prediction of the future behavior of the market. The paper focuses on the implementation of statistics and probability into the analysis of these processes.*

Key words: *automotive claims, dynamic models, and identification.*

1. INTRODUCTION

The complex economical processes are affected by deterministic, stochastic and human factors.

The following features distinguish the economical processes in contrast with other nature sciences, [1]. (a) The stochastic factors and conjecture factors require the use of the statistical methods. (b) The dependencies between factors and responses are developed over long periods of time, in contrast with the technical processes that are faster. Follows that a large amount of observations is needed. (c) Inertia and dead time influence the system's responses. (d) It is not possible to test the response of the economical processes in real-time conditions. (e) The human behavior has significant impact over the response of the given process.

The automotive claims area as part of the economical processes features the following characteristics. (1) The input variables are widely stochastic. (2) The drivers' behavior is of major importance. (3) The dependencies between the countable factors such as the road conditions, the duty service of the vehicles, and the predictable factors such as the weather conditions the date and the hour of the claim are of major importance. (4) The decision factors and the actual insurance law frame determine the response. (5) The market policies and the insurance policies of the economical agents are to be taken consideration.

The mathematical models of the economical processes are complicated. However, both analytical/statistical and euristhycal models are available [2].

The implementation of the model has two main parts: the analysis of the observations and the synthesis of the model.

The analysis of the observations may be performed by means of statistical methods. The stochastic factors may be emphasized through the correlation analysis or the spectral analysis of the observations. The synthesis of the model may be performed either with analytical methods or with euristhycal methods.

The statistical analysis is based on two items: the mean and the variance of the stochastic variables. This approach leads to an analytical representation of the response that finally provides the dynamic models on the

form of difference equations or sets of difference equations.

The euristhycal approach leads to the knowledge-based model i.e. rules- and inferences-based model. These methods, also denominated artificial-intelligence-based methods are used in biology, sociology, robotics, and optimal control systems. [2, 3].

The paper focuses on the analysis of the response of a automotive claims process over a set of observations. More specific the correlation between the amount of claims and the human or the physical factors are investigated. In the paper, the optimal polynomial model of the process is also synthesized. A comparison between observations and the estimate is used to validate the proposed model.

2. THE CORRELATION ANALYSIS OF THE OBSERVATIONS

The correlation between the claims amount and the input factors such as age of the driver, the amount the car years of service have been investigated based on over two months observations. The correlation between the claims amount and the interest factors has been separately analyzed.

The results of the analysis are presented in Figures 1 and 2. Follows that the largest amount of claims is (1) for the male drivers' category - teens under 30's and for the elders over 60's. The maximum amount of claims is referred to the new vehicles, i.e. of 1 to 3 years duty service.

An analysis of the correlation between the number of incidents and the day when it was produced is presented in Figure 3. The results clearly prove that there is a weekly periodicity between the days and the number of incidents. This

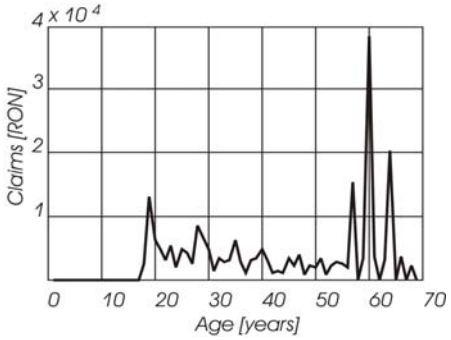

Fig.1. The distribution of the claims with respect to the age of the drivers during the observation period.

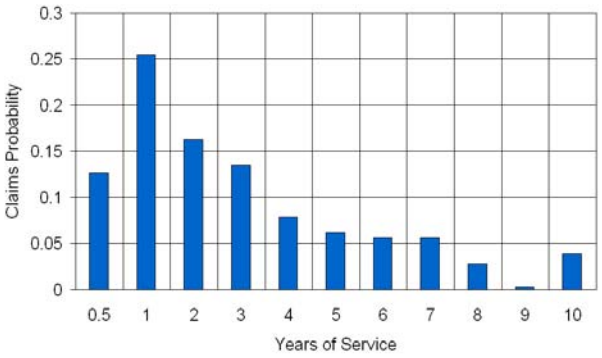

Fig.2. The probability density of the claims with respect to the car duty service.

periodicity is also reflected into the repartition of the claims' amount over the whole month. The claims amount has local maximums at middle of the weeks within the month.

However, there is a peak value at the middle of the month that exceeds the maximum over the other days. This observation proves there is another periodicity of the claims amount over the year.

To emphasize whether or not the input variables are stochastic the auto correlation of factors has to be computed.

In Figure 4 the driver's age entry vs. data is depicted. Figure 5 presents the (auto) correlation between the driver's age entries. As seen from Figures 4 and 5, this entry has a wide stochastic component. The mean value of the driver's age entry is 36.035. However the corrupting noise is zero mean.

In Figures 6 and 7, the claims output and its (auto) correlation are depicted. The claims are largely distributed around the average of 4175.7 RON. The (auto) correlation plot proves that there is a wide stochastic component into the claims data series.

Follows that other possible factors referred as corrupting noise alter the response of the system

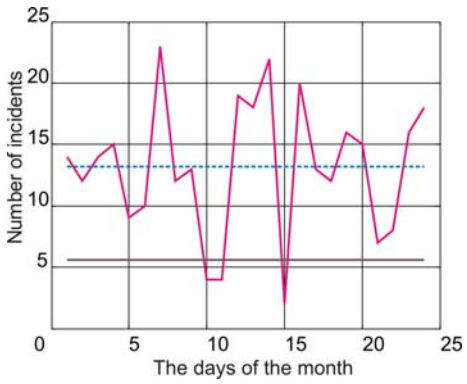

Fig. 3.The distribution of incidents vs the day of the month.

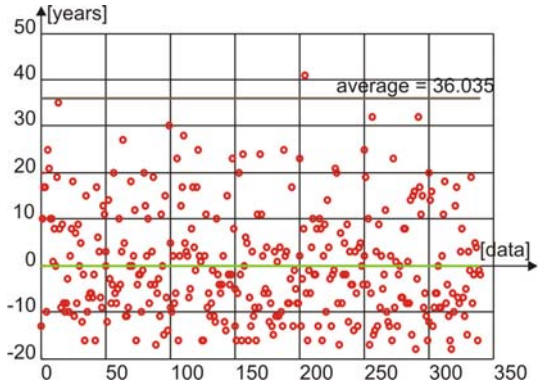

Figure 4 - The driver's age vs. data, (in dots): The mean value of the data sequence and mean of the corrupting noise,

under analysis. The contribution of the driver's age entry may be determinate approximately by means of least-square based methods.

3. THE DETERMINATION OF THE MODEL'S PARAMETERS

The goal in system identification approach is to produce consistent estimates of the response to the given inputs.

The best fitting model must provide not only the minimum errors between the measured data and the estimates but also should be easy to implement. The parametric, polynomial models, such AR, ARMA or NARX provide an appropriate model for the given process.

For the automotive claims process, the authors have investigated an ARMA(4,3,2) model. ARMA models generally provide two models for the system under investigation: a model for the deterministic component of the system and another model for the disturbances.

The general form of the ARMA model,

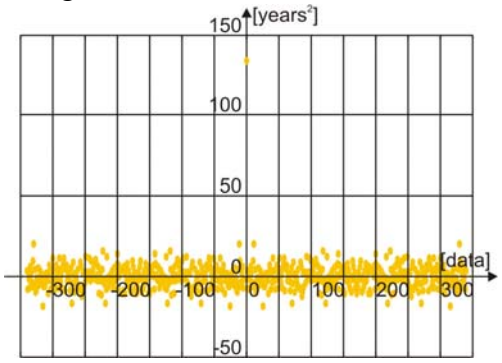

Figure 5 - The (auto) correlation of the driver's age vs. data, (in dots); there is a wide difference between the value in the origin and the other

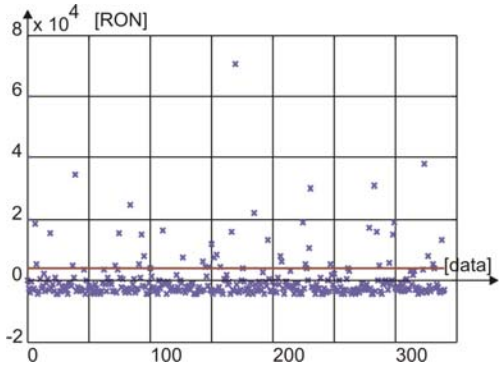

Figure 6 - The magnitude of claims vs. data (with x). The mean value of the data sequence brown and mean of the corrupting noise

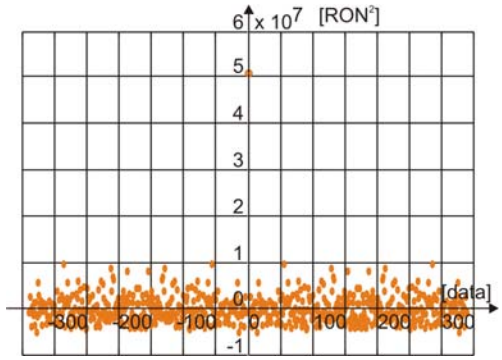

Figure 7 - The (auto) correlation of the claims vs. data, (in dots); there is a wide difference too between the value in the origin and the other values.

[4,5], is given on the parametric form as follows.

$$y(t)=\frac{B\left(q^{-1}\right)}{A\left(q^{-1}\right)}\cdot u(t)+\frac{C\left(q^{-1}\right)}{A\left(q^{-1}\right)}\cdot e(t) \qquad (1)$$

Where: $A\left(q^{-1}\right), B\left(q^{-1}\right), C\left(q^{-1}\right)$ are polynomials whose coefficients are to be determined, $u(t)$ is the sample data of the command to the system, $e(t)$ is the additional noise sample data and $y(t)$ is the response of the system.

The coefficients of the polynomials in notation (1) are computed via an algorithm that generally minimizes a cost function depending on the given procedure. For the particular case of the ARMA models the least-squares-method is used to deduce the estimate for the process.

The parameters of the optimal model are given in Table 1.

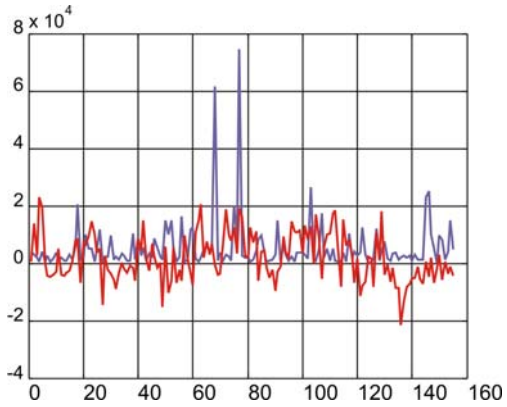

Fig.8. Comparison between the observations and the estimated values of the response.

Table1. The Coefficients of the ARMA model

Coeffi-cients	i	1	2	3
$B(q^{-1})$	b_i	-8.833	10.432	24.692
$C(q^{-1})$	c_i	7452.6	-2109.3	-2839.4
$A(q^{-1})$	a_i	1	-0.28567	-0.37195

The comparison between the observations and the estimated values of the response is presented in Figure 8. The corrupting noise to the output of the model has been a zero mean normal distributed white noise signal.

4. CONCLUSIONS AND FURTHER RESULTS

The analysis emphasized the particular behavior of car drivers with respect to several important factors i.e. the driver age, the duty service of the car. Moreover, the analysis proves that the parametric estimation methods may be successfully used to predictive models for the automotive claims field.

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PNEUMATIC CONVEYING EQUIPMENT AND SYSTEMS

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Abstract: *From pick-up spike to piping to receivers and vacuum pumps, K-Tron Premier offers a wide range of equipment for pneumatic conveying needs, whether for automated refill of feeding systems or as stand alone conveying applications. The following list describes the varied elements available from K-Tron for building a complete conveying system for loss-in-weight feeder refill (pictured in the diagram above). The versatility, flexibility, and performance of Handlair® is unmatched in the grain vac industry. Unlike most grain vacs which are limited to truck loading, a Handlair can fill tall bins, silos, and flat storage; transfer grain over long distances (several hundred feet); and gently handle seed grains - all while using lightweight 4" to 6" piping that makes set-up, operation, and take-down a breeze.*

Keywords: *vacuum, pneumatic, conveying, systems, elements, grain, silos, transfer*.

1. LEAP ENGINEERED PRODUCTS

LEAP is a leading manufacturer of bulk handling component. Leap manufactures a comprehensive line of products for a wide range of bulk handling applications for the industrial and food market. LEAP offers heavy duty and reliable equipments.

Fig.1.1 Conveying Eductors

Fig.1.2 Sanitary Eductors

Fig.1.3 Screw Feeders

Fig.1.4 Big Bag Unloaders

Fig.1.5 Conteiner Loading

Fig.1.6 Pneumatic conveying

Fig.1.7 Control Panel

2. CONVEYING SYSTEMS
2.1.BAUM PNEUMATICS

Fig. 2.1.a Disc Screens

Fig. 2.1.b Diverter Valves

Fig.2.1.c Blowers

Fig. 2.1.d Cyclones

2.2. ELEMENTS OF A VACUUM CONVEYING SYSTEM

From pick-up spike to piping to receivers and vacuum pumps, K-Tron Premier offers a wide range of equipment for pneumatic conveying needs, whether for automated refill of feeding systems or as stand alone conveying applications. The following list describes the varied elements available from K-Tron for building a complete conveying system for loss-in-weight feeder refill (pictured in the diagram above).

2.2.1. Material Pick-up

From simple suction wands for free flowing materials to fully fluidized feed bins (1), silo pick-up pots (2) or bag dump stations (3) with prefeeders for powders, Premier offers a wide variety of equipment

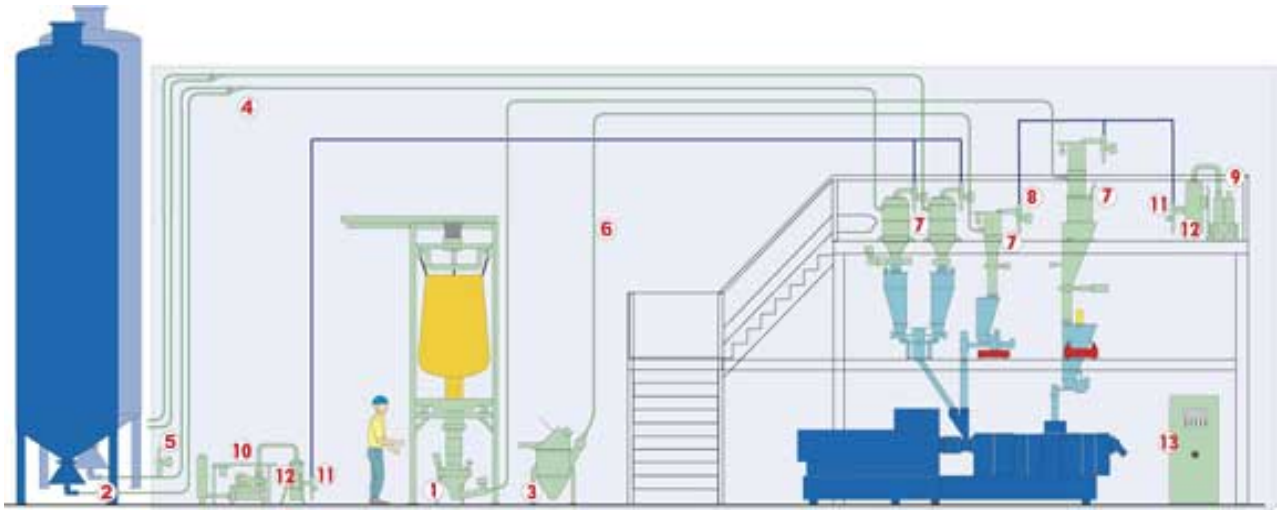

Fig. 2.2.a Operating caracteristic

to ensure reliable material pick-up into the conveying air.

2.2.2. Conveying Line

Connecting one or multiple material pick up stations to a vacuum receiver. To ensure blockage-free conveying, diverter valves (4) and line clearance valves (5) are available in addition to the piping (6).

2.2.3. Vacuum Receivers

Various models of central (7) and self-contained receivers are available to separate the material from the conveying air stream, alternating between suction and discharge modes of operation.

2.2.4. Sequence & Vent Valves

Sequence & vent valves (8) allow the air stream to bypass and vent the vacuum receiver during the discharge cycle.

2.2.5. Pump Packages

Vacuum pump packages include the pump -- regenerative blower (9), sliding vane or rotary lobe blower(10) -- to produce the air stream as well a bypass valve (11) to allow the pump to run while no receiver is conveying and a secondary filter (12) to protect the vacuum pump from entrance of foreign bodies.

2.2.6. Controls

HCU/HSU control and operator interface are available to control a single central or self-contained unit. To control the sequence of a multi-component system PLC controls (13) are available which are programmed to suit the client's process. Siemens, Mitsubishi and Allen Bradley PLC controls are available.

Fig. 2.2.b. Dynamicair systems

2.3. VacBoss PTO

Fig. 2.3 A tractor's friend near a grain pile

2.4. VacBoss Diesel

Fig. 2.4.a. Self-powered super suction

Fig. 2.4. b. Self-powered super suction

2.5 HANDLAIR PNEUMATIC CONVEYORS

Fig.2.5. Handlair pneumatic conveyors.

The versatility, flexibility, and performance of Handlair® is unmatched in the grain vac industry. Unlike most grain vacs which are limited to truck loading, a Handlair can fill tall bins, silos, and flat storage; transfer grain over long distances (several hundred feet); and gently handle seed grains - all while using lightweight 4" to 6" piping that makes set-up, operation, and take-down a breeze.Developed and built for years of service in the heart of USA's corn and soybean country, Handlair continues to set performance standards for grain vacs.

2.6. AUGERVAC PNEUMATIC CONVEYORS

Fig.2.6 . AugerVac™ pneumatic conveyors

Industry's heaviest constructed fan / auger grain vac! Backed by over 50 years of pneumatic manufacturing experience.

MODEL 110

Christianson Systems, the creator of Handlair and VacBoss pneumatic grain conveying systems, is proud to introduce the NEW AugerVac grain conveyor.

Fig.2.7 SuperTower® Fanless™ Ship Unloaders

Dust-free unloading from 200 to 600 metric tons/hour

Fig.2.8 SuperTower® Model 405/22.5 Fanless Shipunloaders

SuperTower® Fanless™ Shipunloaders set new standards of performance, environmental-friendliness, serviceability, and most importantly return on investment!

SuperTower Fanless™ technology provides virtually damage-free grain handling; maintains higher discharging capacities throughout the hold of the vessel; and requires less energy per ton (customers have reported 0.6 kW/MT).

SuperTowers are manufactured in six standard sizes from 200 to 600 MTPH with intake booms of 15 to 30 meters.

Fig. 2.9 SuperTower® Model 505/25 Fanless Shipunloader

Quiet: under 85 dBA @ 3 meters

SuperTowers are available in three structural configurations: mobile gantry for rails, mobile gantry on tires, or fixed pedestal.

Find out why so many companies are choosing SuperTowers as their unloading solution for the 21st century.

Fig.2.10 SuperPortable discharging ship in Brazil

SuperPortable™Fanless™ Shipunloaders achieve tower-like capacities of up to 300 metric tons/hour - the highest conveying rate of any portable ship unloader manufactured today!

Designed as a cross between a conventional portable pneumatic conveyor and a tower-type ship unloader, SuperPortables achieve unprecedented levels of performance while lowering energy consumption.

Fig,.2.11 SuperPortable® Fanless™ Ship Unloaders

Three standard sizes ranging from 200 MTPH to 300 MTPH with diesel or electric power are available.

The powerful vacuum of a SuperPortable is generated by its Fanless™ prime mover. Fanless technology maintains high suction even as the SuperPortable's intake nozzle is lowered deep into the hold of a ship.

An Automatic Self-Cleaning Filter Receiver keeps abrasive dust out of the Fanless prime mover and provides for dust-free operation.

SuperPortables are configured as vacuum-intake/mechanical-discharge systems, just like tower type ship unloaders. This unique design provides the lowest energy consumption and most gentle grain handling possible.

CONCLUSION

The versatility, flexibility, and performance of Handlair® is unmatched in the grain vac industry. Unlike most grain vacs which are limited to truck loading, a Handlair can fill tall bins, silos, and flat storage; transfer grain over long distances (several hundred feet); and gently handle seed grains - all while using lightweight 4" to 6" piping that makes set-up, operation, and take-down a breeze.Developed and built for years of service in the heart of USA's corn and soybean country, Handlair continues to set performance standards for grain vacs.

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Nonlinear lateral/directional motion identification using neural network for IAR 99 aircraft

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The neural networks have the capability to accurately model the behavior of a large class of dynamics systems that are encountered in real world problems. The data are obtained from flight tests and the input-output representations are approximated using the neural network. The evolution of aircraft cannot be modeled by the means of linear system when the amplitudes of commands inputs are very large.

Key Words: neural network, back propagation, dynamic system, nonlinear system

1. INTRODUCTION

The neural networks are extensively used to model the nonlinear systems and have large applicability in different domains. In aviation there are many researches [1,2,3,4,5,6,7,8], for aircraft evolution modeling and the implementation of optimal commands in order to ensure the flying qualities imposed by certification standards.

A great deal of time and effort is spent by aircraft manufacturers in the identification and estimation of the parameters that properly describe the aerodynamics of a particular aircraft. The system identification of the aerodynamic model using neural networks involves the selection of the necessary input and output states to the system, representation of the model, and parameter estimation. The application of neural networks as both a model descriptor and parameter estimation technique also requires a close selection of model inputs, to most efficiently utilize the method.

System identification of the entire dynamic system as opposed to the parameter estimation of the derivatives is useful in various applications:

- It highlights deficiencies in flying handling qualities, and allows rigorous stability analysis and investigation without extensive flight testing.
- The model can be used to estimate flight performance under various configurations admissions.
- For non-adaptive flight controller design, the dynamics have to be 'known'. Thus, the modeling of aircraft dynamics is crucial to the safe and effective flight vehicle performance.
- The dynamics of an aircraft can be scrutinized under unusual flight configurations (for example high angle of attack maneuvers), and the model provides useful data in these flight regions which are hard to predict by conventional techniques.
- The model could be useful in accident investigation, since the dynamics of an aircraft can be determined from black box data, and simulations may uncover the cause of the crash.

The paper objective is to realize application software for modeling the nonlinear lateral/directional modes of IAR 99 aircraft, based of the data obtained from flight tests. Using these results it can be designed and implemented an optimal neural controller to improve the flying qualities and specially the Dutch roll mode. The only mode of IAR 99 aircraft that not to meet the specification

for level I in accordance with [9] is the Dutch roll mode.

2. BASICS OF NEURAL NETWORK PROCESSING

The basic architecture of artificial neural network (ANN) consists of layers of interconnected processing units. These processing units, also known as nodes or processing elements, are the functional counterparts of biological neurons. The numbers of layers and the degree of interconnection between nodes vary among different ANN design. The interconnections between the nodes represent the flow of information.

The problem domain of the ANN is commonly formulated as a multivariate nonlinear optimization problem over a very high dimensional space of possible weight configurations. The range of the various parameters such as weights and thresholds can be bounded between minimum and maximum value so that the size of the search space is finite. The process of finding such optimal parameters is also known as the learning algorithm of the ANN.

The processing unit, also called neuron or node, performs a relatively simple job; it receives inputs from neighbors or external sources and uses them to compute an output signal that is propagated to other units.

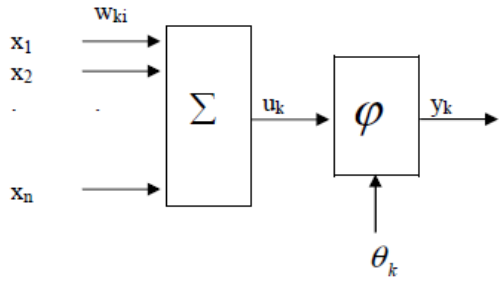

Fig.1 Artificial neuron

$$u_k = \sum_{j=1}^{N} x_j w_{kj}$$

u_k represents neuron net input

To bound the neuron output it is used an activation function

$$y_k = \varphi(u_k - \theta_k) = \varphi(u_k + b_k)$$

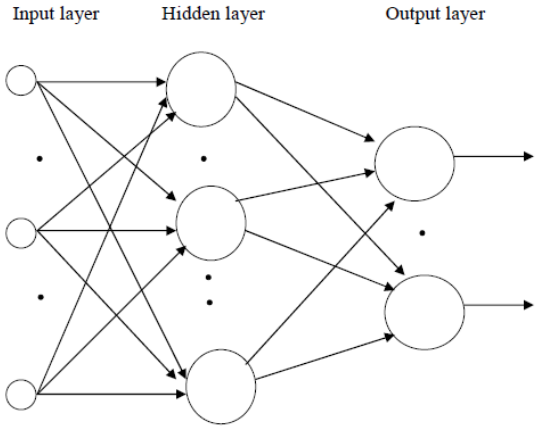

Fig.2 Artificial neural network used

θ_k represents the neuron threshold. In neural network implementation the net input u_k is increased by the term b_k, called bias scale. The value: $v = u_k - \theta_k$ represents activation potential.

A neural network can be considered as a 'black box' which has a number of internal parameters that can adapt in response to the environment. The network has vectors of inputs and outputs, and processing is carried out in the forward propagation direction from the input to output layer. Neural networks are described from a dynamic systems viewpoint in [10]. A general neural network performs a mapping from the input state space to the output state space. The network can be trained using a supervised routine to change the mapping characteristics. In general, we can train the network to perform a particular mapping by applying a candidate input, forward propagating through the network, and finding the network output. This network output is then compared with the target (or desired) output, {T}, and the errors are propagated backwards through the network, with internal corrections occurring in this direction. This is called back propagation, although the principles are characteristic of many supervised learning schemes.

The neural network can then be trained to perform a given functional mapping, even though its internal structure is not well defined. It is therefore a model-free estimator,

since its functional properties do not specifically relate to the exact internal network structure, but to the overall network behavior. This facility is useful in modeling of dynamics, since we don't need to make as many assumptions as to the nature of the dynamics themselves. Certainly, we don't have to assume linearity, since neural network processing is non-linear.

The neural network estimation method is also inherently robust against system noise, including turbulence, as it does not involve the averaging of data sets, but relies on the absolute value of the input state at any discrete point in time. Provided that the correct input state can be accurately measured and modeled, then the process is totally insensitive to system noise.

3. BACK PROPAGATION ALGORITHM

For the output layer, the "*j* "neuron output error, at iteration "*n*" is defined as:

$$e_j(n) = d_j(n) - y_j(d)$$

where d_j represents the desired output and y_j is the output of ANN.

The output layer error is defined as the sum of squared errors of output neurons.

$$\varepsilon(n) = \frac{1}{2}\sum_j e_j^2(n)$$

Using a training set with T training samples, the cost function that must be minimized is:

$$\varepsilon_{av}(n) = \frac{1}{T}\sum_{n=1}^{T}\varepsilon(n)$$

After each training sample the weights are updated as:

$$\Delta w_{ji} = -\eta\frac{\partial\varepsilon(n)}{\partial w_{ji}(n)}$$

where η is the learning rate.

$$\frac{\partial\varepsilon(n)}{\partial w_{ji}(n)} = \frac{\partial\varepsilon(n)}{\partial e_j(n)}\frac{\partial\varepsilon_j(n)}{\partial y_j(n)}\frac{\partial y_j(n)}{\partial \nu_j(n)}\frac{\partial \nu_j(n)}{\partial w_{ji}(n)}$$

$$\varepsilon(n) = \frac{1}{2}\sum_j \varepsilon_j^2(n) \Rightarrow \frac{\partial\varepsilon(n)}{\partial\varepsilon_j(n)} = \varepsilon_j(n)$$

$$\varepsilon_j(n) = d_j(n) - y_j(n) \Rightarrow \frac{\partial\varepsilon_j(n)}{\partial y_j(n)} = -1;$$

$$y_j(n) = \varphi(\nu_j(n)) \Rightarrow \frac{\partial y_j(n)}{\partial \nu_j(n)} = \varphi'(\nu_j(n))$$

$$\nu_j(n) = \sum_j w_{ji}(n)y_i(n) \Rightarrow \frac{\partial \nu_j(n)}{\partial w_{ji}(n)} = y_i(n)$$

The local gradient, for the output layer $\delta_j(n)$ is defined as:

$$\delta_j(n) = \varepsilon_j(n)\varphi'(\nu_j(n)) = -\frac{\partial\varepsilon(n)}{\partial y_j(n)}\frac{\partial y_j(n)}{\partial \nu_j(n)}$$

$$\Delta w_{ji}(n) = \eta\delta_j(n)y_i(n)$$

The local gradient, for the hidden layer $\delta_j(n)$ is defined as:

$$\delta_j(n) = -\frac{\partial\varepsilon(n)}{\partial y_j(n)}\frac{\partial y_j(n)}{\partial \nu_j(n)} =$$

$$-\frac{\partial\varepsilon(n)}{\partial y_j(n)}\varphi'(\nu_j(n))$$

where:

$$\varepsilon(n) = \frac{1}{2}\sum_k \varepsilon^2(n)$$

and k represents the correspondent index of neurons of output layer.

$$\frac{\partial\varepsilon(n)}{\partial y_j(n)} = \sum_k \varepsilon_k(n)\frac{\partial\varepsilon_k(n)}{\partial y_j(n)} =$$

$$\sum_k \varepsilon_k(n)\frac{\partial\varepsilon_k(n)}{\partial \nu_k(n)}\frac{\partial \nu_k(n)}{\partial y_j(n)}$$

$$\varepsilon_k(n) = d_k(n) - y_k(n) = d_k(n) - \varphi(\nu_k(n))$$
$$\Rightarrow \frac{\partial \varepsilon_k(n)}{\partial \nu_k(n)} = -\varphi'(\nu_k(n))$$

`

$$\nu_k(n) = \sum_j w_{kj} y_j(n) \Rightarrow \frac{\partial \nu_k(n)}{\partial y_j(n)} = w_{ki}(n)$$

$$\frac{\partial \varepsilon(n)}{\partial y_j(n)} = -\sum_k \varepsilon_k(n) \cdot \varphi'(\nu_k(n)) w_{kj}(n) = -\sum_k \delta_k(n) w_{kj}(n)$$

The local gradient, for the hidden layer, is computed as:

$$\delta_j(n) = \varphi_j'(\nu_j(n)) \sum_k \delta(n) w_{kj}(n)$$

Weights update:

$$\Delta w_{ji}(n) = \eta \left[\varphi_j'(\nu_j(n)) \sum_k \delta_k(n) w_{kj}(n) \right] y_i(n)$$

4. NEURAL NETWORK IMPLEMENTATION

Consider a class of discrete-time, time-invariant dynamical system, with input-state-output representation:

$$\begin{aligned} x(k+1) &= F[x(k), u(k)] \\ y(k) &= G[x(k), u(k)] \end{aligned} \qquad (01)$$

where $x(k) \in X$, is the state vector of dimension n, $y(k) \in Y$, the output vector of dimension p and $u(k) \in U$ the bounded input of dimension m.

For dynamical system that models the evolution of aircraft the functions F and G are continuous functions. In these conditions the equations (01), can be express as:

$$\begin{aligned} x(k+1) &= Ax(k) + Bu(k) + f(x,u,k) \\ y(k) &= Cx(k) + Du(k) + g(x,u,k) \end{aligned} \qquad (02)$$

where $f(x,u,k)$ and $g(x,u,k)$ are higher order functions [4]. In [1], was shown that if the linear system derived from nonlinear model is controllable and observable. Therefore, the state vector of nonlinear system can be reconstructed from the input and output together with their past values.

$$\begin{aligned} y(k+d) = H[&u(k), u(k-1), \ldots, \\ &u(k-n_1+1), y(k), y(k-1), \ldots, \\ &y(k-n_2+1)] \end{aligned} \qquad (03)$$

where n_1 and n_2 are the order of past inputs and outputs and d is the relative degree of the system.

States of decupled lateral/directional model of fixed wing aircraft, according with equation (02) are:

- sideslip (BETA)
- roll rate (P)
- yaw rate(R)
- roll angle (FI)

The inputs of decupled lateral/directional model of fixed wing aircraft, according with equation (2) are:

- rudder (DDIR)
- aileron (DEL)

Using the representation from equation (03) it has been designed the neural network presented in figure no.3. The neural network has 22 inputs:

- DDIR command + two past values
- DEL command + two past values
- Output BETA by four past values
- Output P by four past values
- Output R by four past values
- Output FI by four past values

The network outputs represents the system states: BETA, P, R and FI.

For the inputs commands with large amplitudes the linear model is inadequate. A linear model implies that $f(x,u,k)$ and $g(x,u,k)$, from equation (02), to be zero. A linear model can be used when the sideslip and roll angle is in domain ± 5 degrees.

The neural network has been implemented in application software developed in Visual Studio 2005 IDE. The network has 22 inputs, 50 hidden neurons and 4 outputs.

The training set is the data obtained during the flight tests. The measured signals are

filtered for noise reduction. The filtering of data that is used for system identification is an operation relatively complex because the filtering process modifies the amplitude and especially the phase of measured signals. This problem has been resolved performing the following operations:

- Extending the time domain signals to the ends by symmetry
- Filtering the extended signal using a digital FIR filter with linear phase
- Filtering, once again, the filtered signal from the end to beginning, to eliminate the phase modification
- Extracting from filtered signal the data segment that correspond with original signal

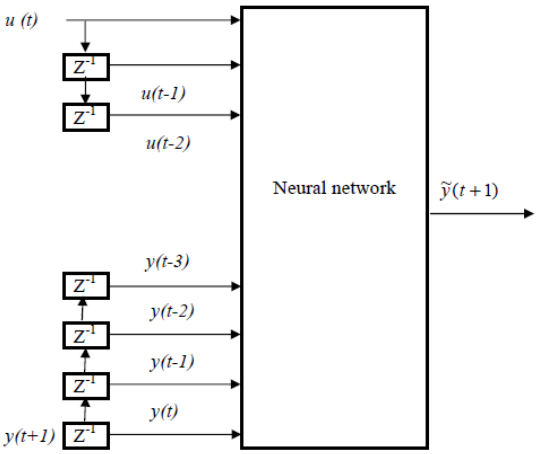

Fig. 3 Neural network configuration

5. RESULTS

Application has been designed in such way that in the training process the user can observe the process convergence. At the end of each training cycle the application displays the neural network mean squared error. The training process is finished when neural network mean squared error is less that imposed error.

Inputs-outputs signals for the training phase are scaled in ± 0.65 domain in order to ensure a small nonlinearity for activation function of hidden layer neurons. The input and output layer neurons have a linear activation function. The best result where obtained for hidden layer with hyperbolic tangent activation function. The result is presented in real data. It was designed a module to scale data for training and rescale, to present the input-output signal in real units.

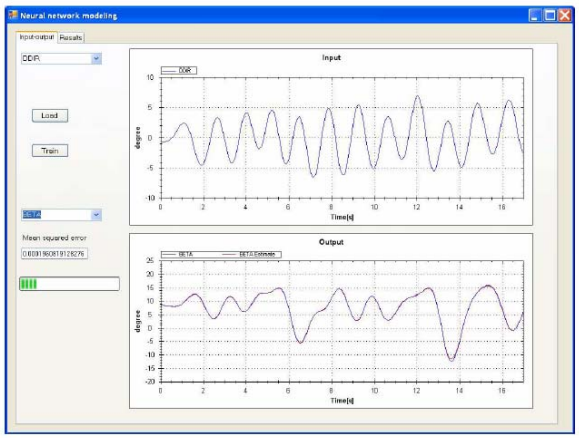

Fig. 4 Main window. The window displays the rudder command, system output sideslip and neural network sideslip output

After training phase the application permits the comparative visualization of real system outputs and the corresponding outputs of neural network. It is also implemented the facility to save the trained network in order to use for future work, for example in the process of designing of an optimal neural controller. The figures presented in this paper show that the neural network identifies with great accuracy the lateral/directional motion of IAR 99 aircraft.

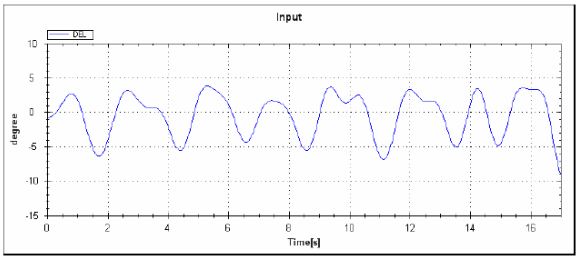

Fig. 5 Aileron command

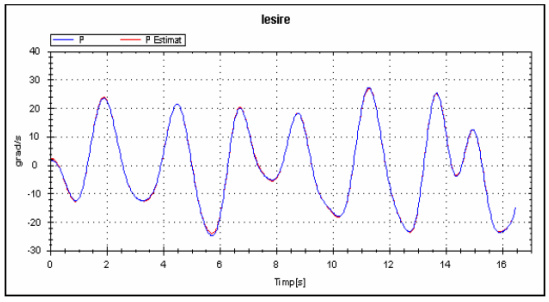

Fig. 6 System output – neural network output for roll rate

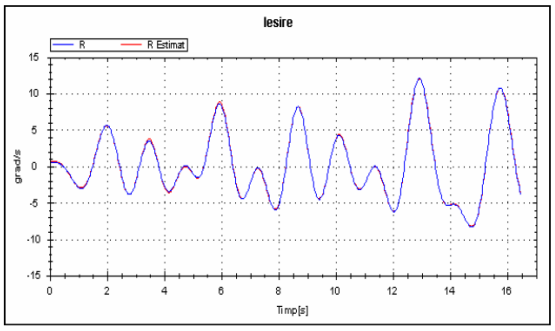

Fig. 7 System output – neural network output for yaw rate

6. CONCLUSIONS

The paper presents an implementation of neural network concepts in order to model the lateral/directional motion of IAR 99 aircraft, when the inputs command is very large and a linear model is inadequate.

The results can be a starting point in upgrading IAR 99 SOIM to improve flight qualities and especially the Dutch roll mode. After imposing requirements for flight qualities, based on results obtained, it can quickly design an optimal controller that meets the requirements.

The software application developed is very flexible and allow neural network, witch was implemented in an advanced programming environment, to be transposed elementary in order to be implemented by a microcontroller.

Another possible application of neural network developed is to investigate the aviation accident because, based on recorded data, the aircraft evolution can be simulated.

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THE SIMULATIONS REGARDING THE AIR FLOW PARAMETERS ON THE OUTER SHELL OF A WARM AIR CURRENT VEHICLE

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Abstract: *This paper presents the variation of static flow pressure on different areas on the outer shell. This analysis is realized for different air flows created by the propeller based system (0.3 – 1 m^3/s) for different flaps positions relative to the vertical position (0º, 30º, 45º, 60º). In the flow direction four areas were chosen to determine static pressure values, thus obtaining the variation of the pressure. The simulations were obtained using FLUENT 6.3 software.*

Keywords*: UAV, dynamic pressure, velocities, Reynolds number, Coandă effect, FLUENT software*

1. INTRODUCTION

The auto-sustainable vehicle is designed for environment surveillance, recording of atmospheric parameters and video surveillance of relatively small areas.

The machine presented in figure 1 has a thrust system based on a propeller driven by an electric motor. The resulting air flow moves along the outer shell in an aerodynamic shape, highlighting the Coandă effect thus obtaining low static pressure values. Using large masses of air due to the dip created on the outer shell as well as the high speed in the flow direction helps obtain the upward force of the machine. It's obvious that the variable parameters can relate to the optimal performance of the vehicle. The UAV is designed as a hybrid system to ensure the sustentation of the thrust and handling using:

I. a propeller driven by an electric motor;

II. the force created by the Coandă effect, on the air flow facing vertically on the curve shaped hull;

III. an upward force can be created using a built-up barrel with helium, a gas with a lower density than the air (ρ_{He}=0,1785 kg/m^3).

From a constructive stand point, the vehicle will be defined using the following main characteristics:

- The main part (1) housing the built-up barrel (3) destined to store the light gas (He), aerodynamically shaped on the top half (5), with the flaps (2) on the bottom half;
- The main part also has the stabilizing elements (4);
- The propeller (6) has an airscrew element (8), and is housed in the outer shell (9);

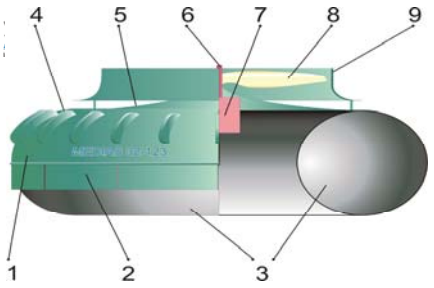


Fig. 1. UAV components:
1 – top half profile; 2 – steering flaps; 3 – built up helium barrel; 4 – anti-rotation fins; 5 – inner outflow cap profile; 6 – prop shaft; 7 – motor without batteries; 8 – prop; 9 – upper prop cylinder [1].

The functioning principle is presented in figure 2. The sustentation force is obtained by

combining two effects:

- The effect of the lift force generated by the axial rotor which is encased (**I**) and the buoyancy effect (**III**) generated by a built-up barrel filled with a light gas (He).
- Through an optimal configuration of the vehicles' hull, as well as through an adequate position of the rotor, and extra effect is obtained, an extra lift due to the air flow on the outer surface of the hull encasing the built-up barrel (Coandă effect) (**II**);

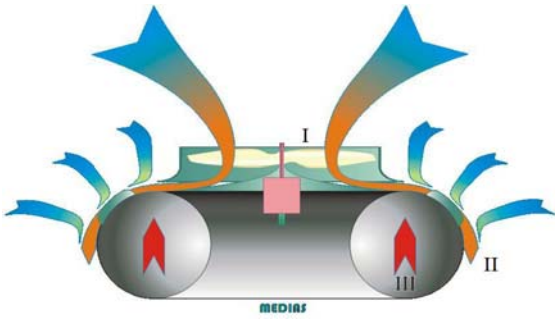


Fig. 2. Section able to see the currents [2, 3]

The change of direction and the horizontal movement is realized using the flaps controlled by the onboard computer [4, 5].
The command and communication devices, the environment surveillance devices as well as the electric motor which drives the axial rotor of the propeller are fueled by the same electric energy source (a lithium polymer battery). The enhancement of the energetic independency of the vehicle can be obtained by integrating solar photovoltaic transducers.

2. THE FLOW AND STATIC PRESSURE ANALYSIS

The flow simulation for the constructive characteristics required for the output slot, for the upper cylinder diameter, for the geometric shape was realized using FLUENT 6.3 software.
Following the static pressure, measured in different points according to figure 3, in the flow direction the variations obtained based on the air flow can be established, observing a reduction of the static pressure with the rise of the flow and the prop speed, respectively, for a certain constructive configuration [6, 7, 8, 9].

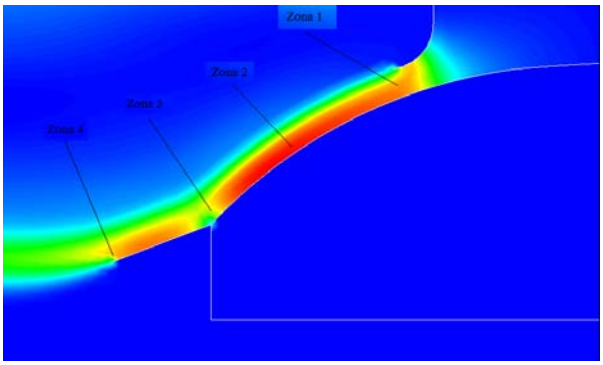


Fig. 3. Points of the static pressure values (the upper cylinder sits on top of the anti-rotation fins)

The static pressure values for different points on the outer shell of the machine, figure 4, in the positions indicated in figure 3 are presented in figure 5 and 6.

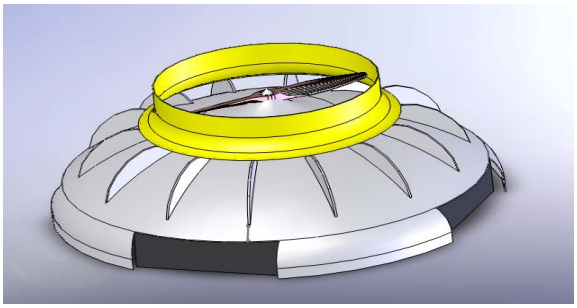
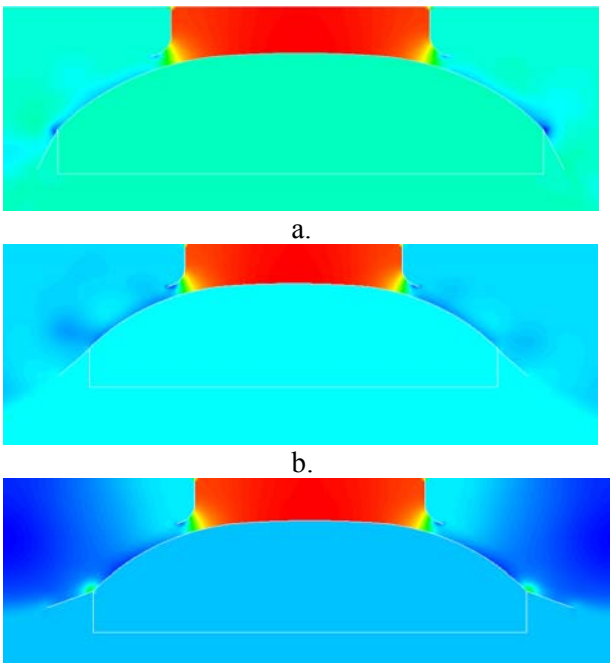


Fig. 4. Machine schematics done in Solid Works

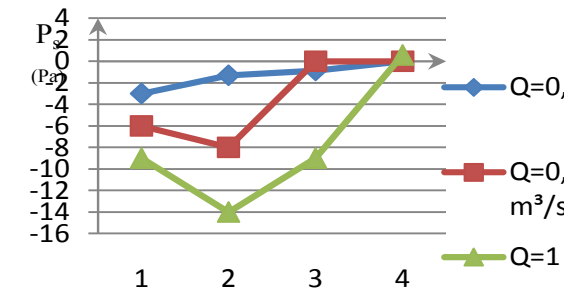


a.

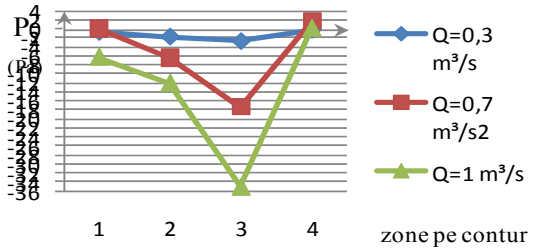
b.

c.

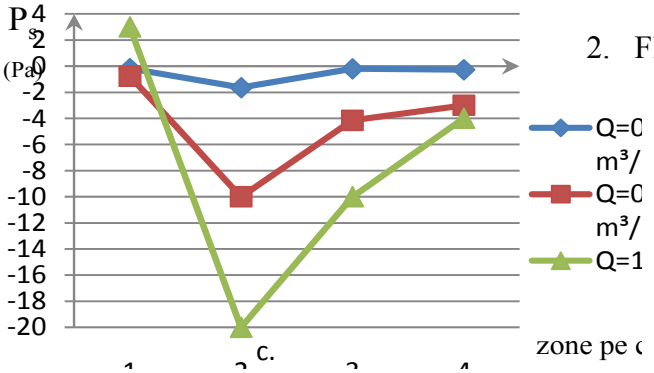
Fig. 5. Static pressure for $Q = 0{,}3$ m^3/s, flaps positioned:
a) at 30^o; b) at 45^o; c) at 60^o



a.



b.



c.

Fig. 6. Static pressure variation, flaps positioned: a) at 30°; b) at 45°; c) at 60°

CONCLUSIONS

A careful analysis of the static pressure variation charts shows that the way the flaps are oriented has an influence on the pressure values, higher values are obtained for high flows and for lower flap angles. The explanation for this fact is that the current deviation by the flap raised over 30° affects the flow, additional turbulences appear, which lead to the rise of the pressure in the concerning area, obvious in figures 5 and 6.

A rise of pressure after zone 2 can also be observed; still remaining in the negative values domain, a critical area in the top part of the flap is present. Higher flow values require lower pressures for the same flap angle.

The constructive geometrical parameters resulted after the design of the machine can be corrected after the experimental trials foreseen for the prototype.

ACKNOWLEDGEMENTS

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THE METHOD OF DESIGNING FLEXIBLE MANUFACTURING SYSTEMS

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Abstract: *In this paper of scientific research, we would like to analyse the structure of flexible manufacturing systems, in order to elaborate mathematical models necessary in the dimensioning and the representation of flexible manufacturing systems, as well as the simulation of these systems functioning. There will be defined and analysed affinity degrees, the consistence and the differentiation of the fabrication task resulted. Then there will be performed the research and the issue of a dynamic model, a graphic analytical one, for dimensioning and representation of flexible manufacturing systems. This paper presents the generalized structure of flexible manufacturing systems for round shafts processing. It is resulting a graphical synthesis and analysis model of flexible manufacturing systems.*

Key words: *flexible manufacturing systems, design, modeling, simulation.*

1. INTRODUCTION

In a world which suffers permanent changes, while the typological diversity of products keeps increasing, apart from requirements and preferences concerning their performances, continuous mutations and changes are imperative in the structure of production systems. Production systems have been lately and they still are submitted to a profound changing process, with ascendant dynamics. The innovation element in the actual conception of production systems evolution is represented by "flexibility". Flexibility represents the most significant answer of producers reported to the tendency of diversification concerning products necessities, which can be perceived in the actual world. Flexibility, representing in the same time characteristics, but also an essential condition of manufacturing, penetrates deeper and deeper in the domain of industrial structures, representing an indispensable condition of evolution, which involves at the highest level automation and computer aid.

An answer to this requirement is flexible fabrication systems (FMS) which are respectively central elements of integrated fabrication systems (CIM). In their evolution, efficient implementing of flexible fabrication systems is noticed, but there are failures too. The latter ones are many times determined by over evaluation of technical solutions, by the impossibility of efficient management of extremely complex systems. Under the conditions of implementing systems with increased flexibility, design additional activities are very important: the analysis of fabrication task, establishing the system structure, as well as the design activity of the organisation and management system.

The conception and the creation of some flexible fabrication systems means to develop knowledge concerning the structure of fabrication systems, as well as concerning reports between functional structure components and the general function of the system.

In this context, in this paper of scientific research, we would like to analyse the

structure of flexible fabrication systems, in order to elaborate mathematical models necessary in the dimensioning and the representation of flexible fabrication systems, as well as the simulation of these systems functioning. By the themes approached, the researchers are compatible with national and international concerns in this domain of flexible fabrication systems research, which is an essential domain, actual and in permanent evolution. Taking into account the actual stage of the research and technical scientific achievements in the domain of flexible systems for processing circular axles, the following conclusions can be stated. Speciality literature offers disparate information concerning the construction and the implementing of flexible fabrication systems, so it is valid for circular axles process, too.

The evolution of fabrication systems has been motivated by two essential factors: productivity growth on the one hand and the growth of products types number which can be realised in the system (system flexibility), on the other hand. When the target is high automation degree in the domain of small and medium series products fabrication, there is necessary a compromise between the two contradictory requirements: high flexibility of equipment and productivity, [1, 3].

A solution for this compromise is offered by the concept of flexible manufacturing system, which benefits from partial flexible automation. The notion of flexible fabrication system is related to the new concept in fabrication, which includes the components integration through the computer and flexible fabrication. As it is stated in speciality literature, flexible fabrication is represented nowadays by an area of dynamic research, which means a lot of research effort as “in the domain of mechanic technologies the future is represented by robotics, flexible automation and on this basis, technology is regarded as a system”.

The concept of flexibility involves the complete study of fabrication systems which can be performed only starting from the features of a complex system, [2, 4].

2. ANALITYCAL MODEL OF FMS

Their level was fixed on grounds of generalized manufacturing task expressed by generalized items (I_k) in manufacturing circular shafts, theoretically grounded and former published [3], needed in designing flexible manufacturing systems (FMS).

As a result of this analysis, conclusions as follows are coming out, regarding time and working station number of flexible manufacturing systems selection as well as machine number of each working station. These conclusions were be used in this paper in view of drawing up the graphic model.

The increase of (m_g) expresses the increase of the different commune elementary geometrical components of all generalized manufacturing task and consequently the increase of affinity degree:

$$AD = m_g(TO_i(I_k)), 1 \le k \le r, 1 \le i \le q \qquad (1)$$

where, TO_i are the technological operations. This expresses reducing of total number of workstation (q_{total} WS) of the flexible manufacturing systems, increase of the processing process in flexible manufacturing system concentration degree, by the group technology. Flexible manufacturing system results as a less flexible structure, objective expected in design by: min q_{total} WS $\{m_i, 1 \le i \le q\}$; n_g - representing the total number of commune and not commune geometrical elements, which defines the generalized item (I_k) and then, the typological nucleus of generalized manufacturing task, it results that difference expresses (n_g-m_g) the not-commune number geometrical elements (completely different, specific) of different items included in manufacturing task, which distinguish them and technologic by different complementary technological operations (TO_c) and additional technological operations (TO_a).

This difference expresses a certain indicator of the processing process division degree in flexible manufacturing system which can’t be made by group technology, but only by different TO_i (TO_c) technologies. Consequently the difference:

$$(CD - AD) = (n_g - m_g)TO_c \quad (2)$$

needs just as much (m_i) of different types.

Either this:

$$q_{different} = (n_g - m_g)TO_i \quad (3)$$

The number (m_i) on which the different TO_i types for some specific item included in generalized manufacturing task are executed.

But,

$$\min \; m_g TO_i \quad (4)$$

expresses on the one hand different (m_g) TO_i, representing commune (m_g) TO_c, consecutively executable by group technology.

Consequently, flexible manufacturing systems should include:

$$q_{commune} = \min \; m_g \; (TO_i) \quad (5)$$

which will execute the commune geometrical elements (m_g) and commune technological operations (TO_i) for all items included in generalized manufacturing task.

From the technological point of view flexible manufacturing system is consisting of:

$$q_{tot} = q_{com} + q_{dif} = \min m_g(TO_i) + (n_g - m_g)(TO_i) \quad (6)$$

On grounds of the manufacturing task synthesis model for the class of circular shafts elaborated in the paper [3] stay structural synthesis matrices of the class features [*SMCL*], general features [*SMG*], family features [*SMF*], variant features [*SMV*] and the item's individual features [SMI_k].

Using the notation M_aT_a (I_k) for the manufacturing task [3] depending on individual items I_k, $1 \le k \le r$ and noting with [SMM_aT_a] – the synthesis matrix of the manufacturing task for circular shafts, the last matrix shall be expressed as:

$$[SMM_aT_a] = [SMCL] \cdot [SMG] \cdot ([SMF] + [SMV] + [SMI_k]) \quad (7)$$

The manufacturing task synthesis matrix (7) on (M_aT_a) is reorganized in the manner to separate the number of commune and different geometrical elements, on grounds of families, variants or individual item group, obtaining the component matrixes within the synthesis matrix (8), were:

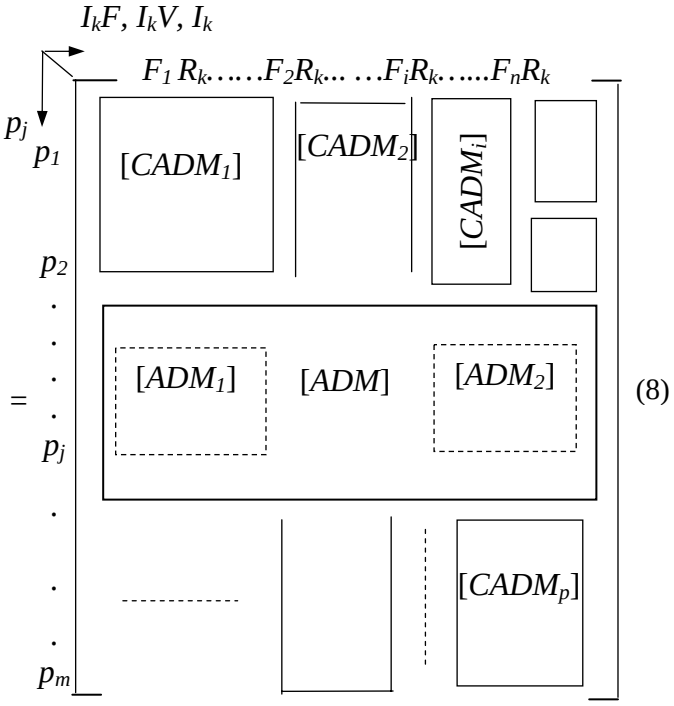
$[SMM_aT_a] = [CDM]$ is the synthesis matrix of the manufacturing task / consistence degree;

[$CADM_i$] is the partial difference matrix $(CD - AD)_i = (n_g - m_g)_i$, p - number of partial matrixes [$CADM_i$], for $j = p$ which appears in complete [*CDM*].

The matrix reorganization $[SMM_aT_a]$ as above is a heuristic engineering question.

For obtaining the graphical model, the comparing model and structure presented , for

$$[CDM] = [SMM_aT_a] =$$



(8)

the six generalized item model types (circular shafts) elaborated within papers [2, 3] having in view that these are on the grounds of shaping and sizing of flexible manufacturing systems for circular shafts processing.

The fundamental element, which has to be the basis of a flexible manufacturing system design, is the current manufacturing task. On the base of the generalized analytical and global synthesis model of the manufacturing task for designing any flexible system for the round shafts processing, generalized item

models, hypothetical and representative items for the family or variant of particular real items have been drawn up. There will be created a data base for the synthesis of the geometric representation from the manufacturing task references, and by the applicative research there will be performed the simulation on the computer for real manufacturing items. The simulating program realized has as objective the application of flexible manufacturing systems for processing round shafts.

If an item family $I_k F_i$ has not p_j parameters, which at least partially should be included in complete affinity degree matrix [*ADM*], this eliminated from manufacturing task ($M_a T_a$). The affinity degree matrix [*ADM*] including all the commune geometrical elements for some item (I_k).

Affinity degrees (*AD*) and (*CD–AD*) differences are influencing composition and structure of flexible manufacturing systems (FMS), their repartition in layout being made by flexible manufacturing systems (FMS) structuring in mixed configuration, sequence (s)-parallel (p)(-sequence), Figure 1.

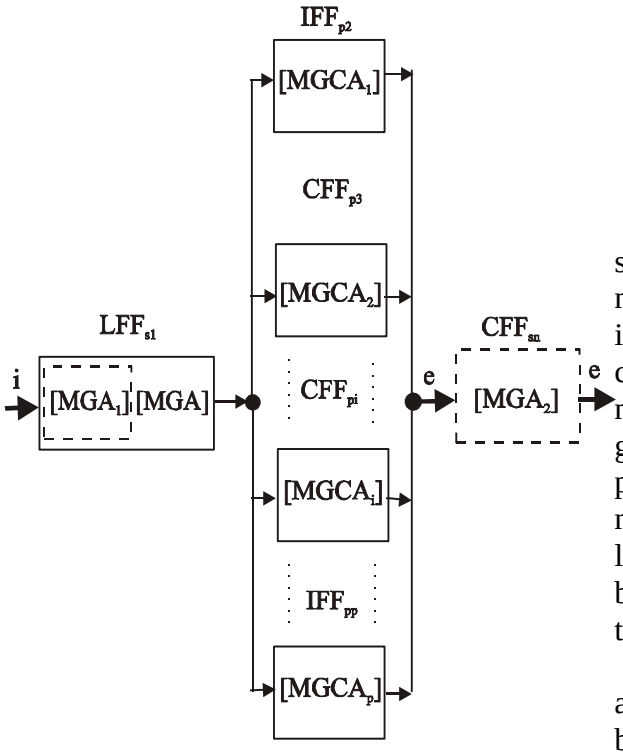


Fig. 1 Composition and structure of flexible manufacturing systems

The structural draft of complex, sequential-parallel flexible manufacturing systems with affinity and consistence degrees, separated and combined, distributed on composition levels (Flexible Manufacturing Cells – FMC and Flexible Manufacturing Line - FML) is shown by Figure 2.

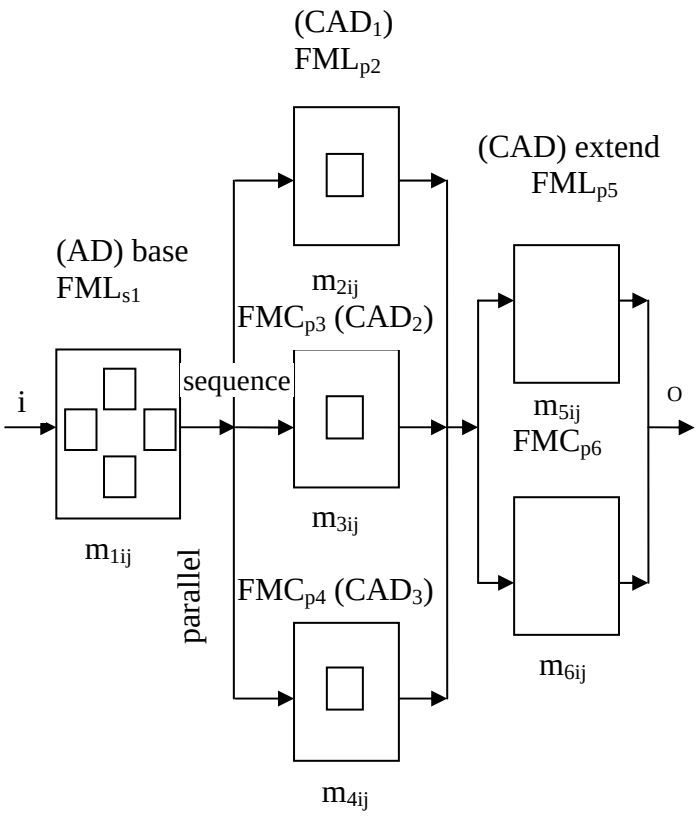


Fig. 2 The structural draft

The modelling of flexible manufacturing systems functioning represents currently the most dynamic and controversial research area in the domain. Mathematical modelling of complex systems, so of flexible manufacturing systems as well, leads in general to large dimensions models. There are problems concerning the model dimension, more precisely, even if this model is very large it can't include all the interactions between component subsystems and between them and the exterior environment.

If a larger model is wanted to be realised, and its precision degree must be high, it can be difficult to be realised, and the relevance of the problems to be solved decreases, fact which is mentioned in the speciality literature, [1].

3. GRAPHIC MODEL OF FMS

The assembling technology was divided into a minimal number of elementary tasks (activities) - T_{ej} and for each of them, a processing time - t_{Pej} and precedence conditions were fixed (Table 1).

Elementary task is real, minimum and rational, individually defined as a technological entity having the least possible practical points of view.

The former draft is a graphical representation of elementary task sequences S_{Pej}, which are defining the process precedence restraints, regarding product and process type. Any manufacturing / assembling process imposes its own precedence conditions, which are imposing restraints in process execution.

Table 1Former draft

Item	Elementary tasks - T_{ej}	Preceding Condition
1	Frontal milling	-
2	Centering	1
3	Chip removing	2
4	Centered boring	1
5	Extricate, chamfering milling	4
6	Bore screwing	5
7	Teeth milling	3
8	Channel milling	3
9	Boring – flange boring	3
10	Motion screw screwing	3
11	Heat treatment	7, 8, 9, 10
12	Screw cleaning	11
13	External cylindrical grinding	11, 12
14	Teeth grinding	13
15	Teeth range shaving	13
16	Conical grinding	13
17	Spherical grinding	13
18	Moving screw grinding	12
19	Final control	14, 15, 16, 17, 18

For establishing coupling relations (interdependence) the graph procedure (fig. 3) is used, were: elementary tasks T_{ej} (processing type) are placed in knots and arches connecting the knots, show the order of their execution; the arch value is given by percentage of the machine numbers on which technological operation are executed (%: αa, βb, γc, δd, …,ωz).

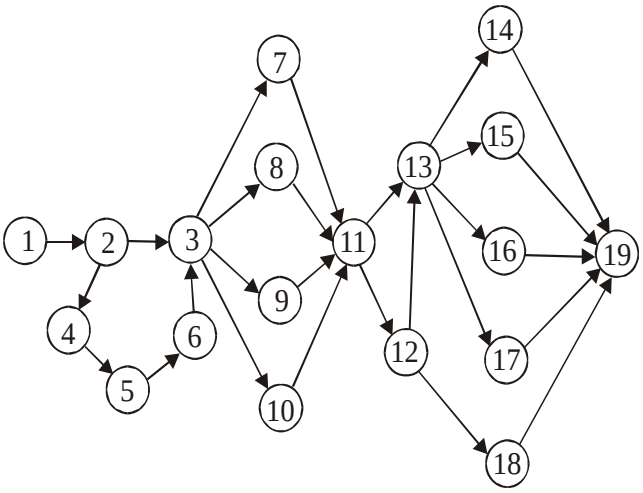


Fig. 3 Graph procedure.

The first elementary task T_{ej} produced are placed in the left of the graph, than following the processing sequences, successively placed on to right.

On grounds of the above presented model, and following to the affinity degree and consistence degree determination, according to the methodology presented in paper [3], the graphic model of the system is obtained, expressing the composition (structure) and functional connections of the system, Figure 4.

It is resulting a graphical synthesis and analysis model of flexible manufacturing systems for circular shafts processing.

Knowing the generalized item, on grounds of the typological nucleus, generalized technologic sheet, named also as technological routes plan is elaborated, out of which operating times and technological operation types/stages are resulting.

Each elementary geometric compound of the item needs for its generation a certain technological operations type, determining the processing process structure. Hence, the variation of elementary geometrical compound's number drives to the process variation, which on his turn, being an exomedium, influences the FMS composition and structure.

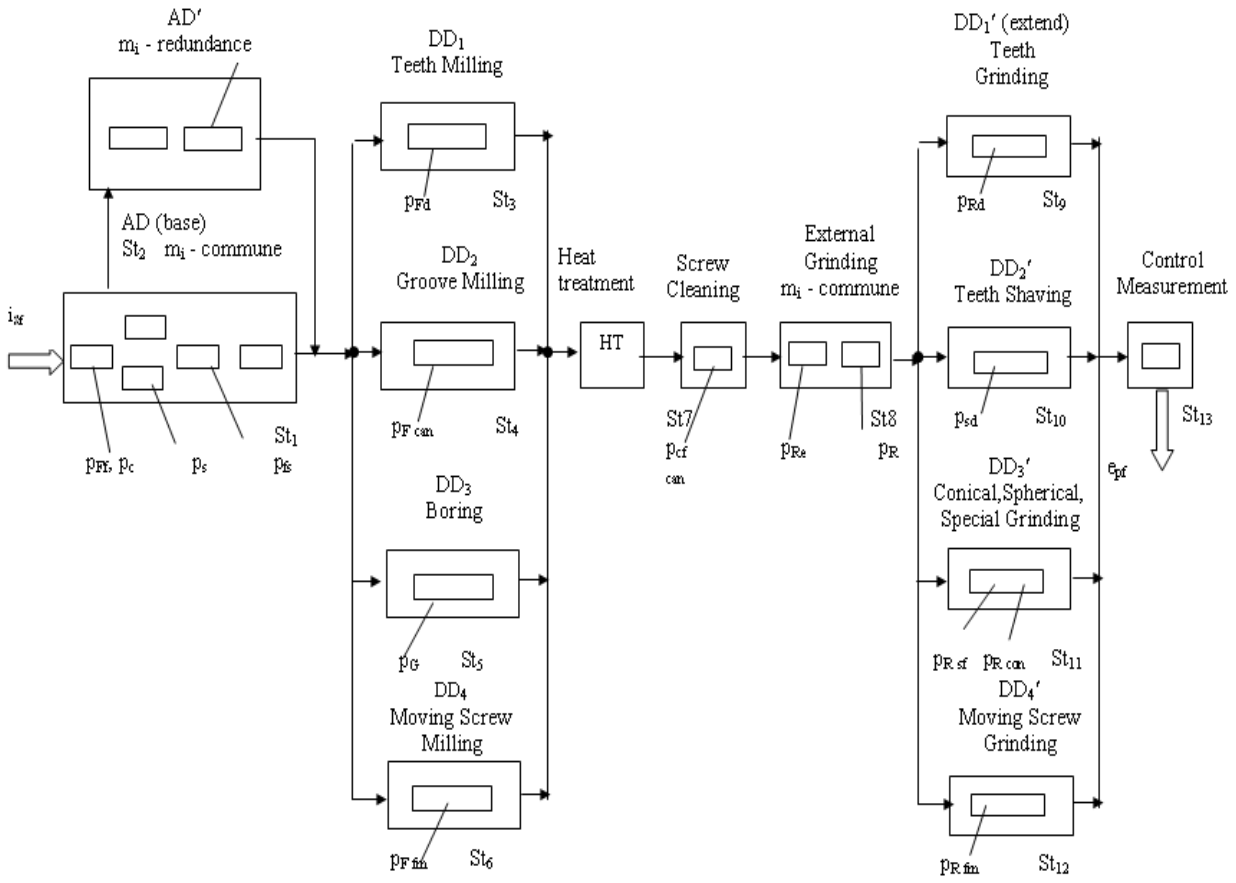


Fig. 4 General structural draft of the system.

4. CONCLUSIONS

Using research methods from the "systems theory", applicable to flexible manufacturing systems, as large dynamic, complex systems, there will be performed the analysis of FMS for circular axles' process. In the structural analysis, there will be used two types of schemes: the location scheme (the system layout) and the structural decomposing scheme (structural block scheme, with each internal coupling and those from the outer environment of entrance and exit). This is useful in elaborating the functioning algorithm of the whole system, which will also be realized by using modern methods and techniques of modelling and simulation. There will be defined and analysed affinity degrees, the consistence and the differentiation of the fabrication task resulted. Then there will be performed the research and the issue of a dynamic model, a graphic analytical one, for dimensioning and representation of flexible manufacturing systems. There will result the location generalized plan of the flexible system for circular axles process, which will have a highly applicative character in this domain.

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MULTIROTOR, MULTIFUNCTIONAL VTOL FLYING PLATFORM

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Abstract: *The purpose of the present work is to present a new concept for VTOL flying platform. This aerial vehicle is developed in the PAMMDAV project under national research program PN II. The maximum take off weight for unmanned experimental vehicle is 70 kg and estimated velocity in horizontal flight is 20 m/s.*
The particularity of PAMMDAV is given by its form, maneuverability and simplicity in use. The central part with axial symmetry are surrounding by 8 independent electrical FAN units simultaneous controlled for obtaining stability and movements around the main axis. The aircraft maneuverability is made by automat control (stability at fix flying point) and manual control (movement and rotation of the vehicle) of thrust for each FAN unit. The rotational speed of half of the FAN's rotors is clockwise and half counterclockwise two by two.
The achievement of the multifunctional pilot flying platform, capable of VTOL and having fix flying point for applicability to surveillance activities and taking information (audio, video, chemical, radiations, etc), monitoring and real time interventions, disaster zones, interventions for saving lives and supply, sportive fly with new acrobatically capability.

Key words: *unmanned experimental vehicle, VTOL, FAN Units, electrical engines*

1.INTRODUCTION

The project was developed under PN2 research program and it is results as cooperation between Politehnica University of Bucharest – Research Center for Aeronautics and Space, Aeronautics and Cosmonautics Romanian Association (ARCA), "Gheorghe Mihoc-Caius Iacob" Institute of Mathematical Statistics and Applied Mathematics (ISMMA), Institute for Theoretical & Experimental Analysis of Aeronautical Structures (STRAERO SA), In Flight Research & Test Center (CCIZ).

The achievement of the multifunctional pilot flying platform, capable of VTOL and having fix floating point for applicability to: surveillance activities and taking information (audio, video, elm, chemical, radiations, etc), monitoring and real time interventions, disaster zones interventions for saving lives.

The initial technical characteristics desired (under 750kg category): take off mass max 590 kg, utile charging max 190 kg, total power units max 285 HP, mass/ power min 2 kg/HP, velocity max 30 m/s, range min 1 h, diameter aprox 5 m. Unfortunately, the project budget was reduced and the main objective remains to realize a demonstrator of this VTOL concept.

2.DESCRIPTION OF VTOL FLYING PLATFORM

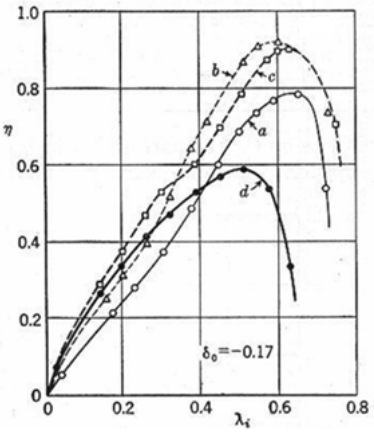
2.1 Propulsion

Study existing models, both in class UAVs and piloted vehicles in class there are two trends in use propeller for sustentation / propulsion namely: free propeller and ducted propeller.

Free rotors raises problems in terms of flow, especially when used a number greater than or equal to 2 rotors. A series of

experiments and numerical calculations have revealed some deficiencies of free rotors:
-Interactions between wakes generated due to the relative position of the rotor from one another. To limit the effects of interaction between the rotor, unmanned aerial vehicles (UAVs) are preferred spacing to a minimum 1.5-2 rotor diameter, leading to relatively large overall dimensions.
-The procedure for takeoff/landing, recirculating flow occurs with negatively impact performance on the rotors.
-In forward flight, the location of a rotor in the wake of the other rotor increase the nonuniformity of the flow and the initiation of undesirable aeroelastic phenomena such as vibration amplification of plunging**.**
-If it used orientable rotor, the problem of transitional regime due to tilt rotor, so when there is transition from horizontal flight to climb flight, leading to a loss of stability of the system generally longitudinal channel, which may cause losing control on aerial platform.

Ducted propeller (axial ducted fan) has some major advantages, namely: high driven mass flow, compression ratio is low and yield high efficiency approx. 90% to 75-85% of free propellers (Fig.2 and Fig.3). Another important feature is that the noise produced by a ducted propeller is about 5 to 15% less to the free propeller. Other possible benefits: the tubular structure is part of the structure of the aerial platform, providing increased rigidity to the structure and protects the propeller of possible collisions.



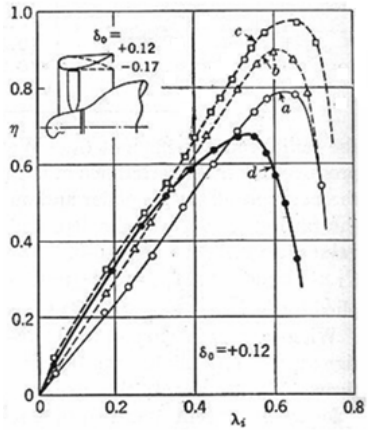


Fig.2. Ducted fan efficiency. Curve a – only propeller, b- ducted fan, without taking into account the forces due nozzle; c- ducted flow without nozzle drag ; d – total efficiency of a ducted flow (λ - pitch blade) .

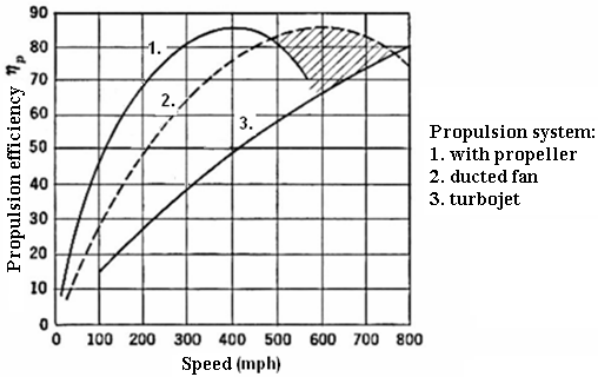


Fig.3. Fan propulsion efficiency as function of horizontal speed

There are a number of disadvantages, namely:
-a large number of blades involve a high frequency noise
-a large space between the blade and tube increases the noise level
-the possibility of separation on the edge of the inlet, particularly in flight advance
-tube length should be as small as to reduce structural weight.

In a climb flight or forward flight the problem of propeller-nozzle system must take into account the geometry of the intake and thus that it contributes to achieving an additional thrust (Fig.4).

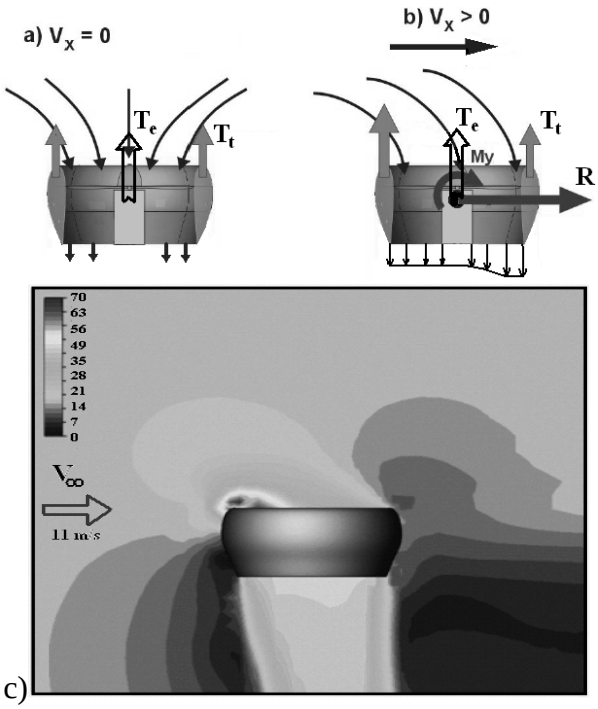


Fig.4. (a) Operating regime at fixed point, (b) the operation regime with the sideways displacements (T_t - traction due to the intake device, T_e - the propeller thrust, R - drag) and (c) 3D CFD "side" flow simulation; through and around isolated nozzle (no blowing effect).

Fig.5. Constructive solution with stator.

If the system is moving sideways that is an unfavorable case for the operation of a propulsion unit because there is a pitching moment to destabilize the unity and obviously flow through the propulsion unit. Performed numerical simulations reveal the emergence of asymmetrical suction force causes a pitching moment opposite the desired direction of displacement of the propulsion unit.

Flow through the fan with stator (Fig.5) has several features:
-the continuity equation shows that the axial speed in wake remains constant;
-the fan thrust is manifested by an increase in pressure and the energy of rotational motion, induced to flow in the same direction with fan rotation, there is not a loss of energy, it contributes to increasing of absolute speed and is recovered as static pressure through the stator.

Experimental tests. Since the flow through the fan unit is very complex, calculation to determine the functional characteristics based on simplified models, is pretty rough. One solution would be the numerical simulation of flow, but to catch the phenomena that occur in the gap between the propeller and tube, plus the mutual interference between the wakes generated by blades and stator fan interference, it takes an expansive computer network or an adequate software.

In this case, experimental methods are only satisfying in terms of accuracy and in terms of simplicity. It is understood that attempts aimed at fully equipped fan as mounted on the flight deck. For this work was built a pilot plant for experimental determination of the characteristics of a propeller (Fig.6).

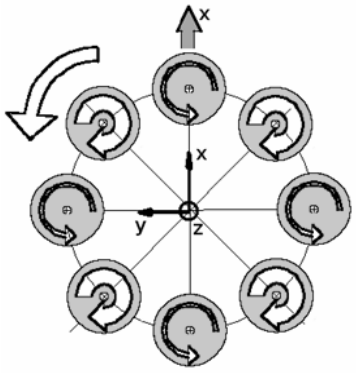
Fig.6. Testing equipment for propeller

2.2. Flight control

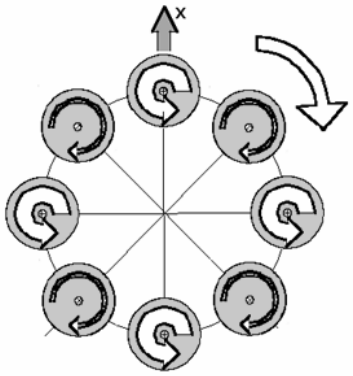
Primary requirements for flight control device with a vertical takeoff-landing include: vertical thrust, angle of the aircraft attitude, angle of side attitude (last two angles for an axially symmetric configuration is reduced to one), directional control and yaw moment control. Because these devices evolve at low speeds, where aerodynamic control surfaces are not efficient, the effective control should be obtained only with the propulsion system. For multirotor systems, in which the propeller has fixed pitch blades, the control is assured by changing rotor speed on each part. Differential traction of rear-front engine will control the aircraft angle after the pitch axis, while changes in speed of lateral engine will control the movement of roll / yaw.

The engines are arranged in pairs with opposite rotation directions. One possibility would be to control the direction of deflection arrangement for venting jet propulsion units. For multirotor system to have greater stability, is preferred mounting of propulsion units with a small angle (few degrees) to vertical axis of the aircraft, the resulting point total applied thrust of the aircraft is located above the center of gravity.

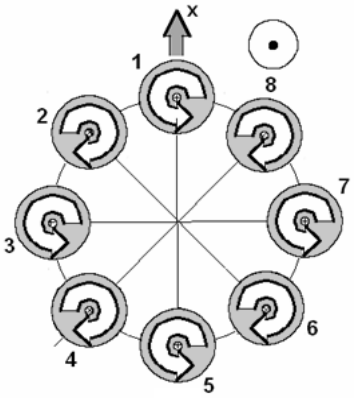
For PAMMDAV, the direction of rotation of the eight engines alternates, and by varying the rotational speed on each engine or engine group, sustentation force can change and make moving platform (Fig.7). Black arrow indicates the direction PAMMDAV.



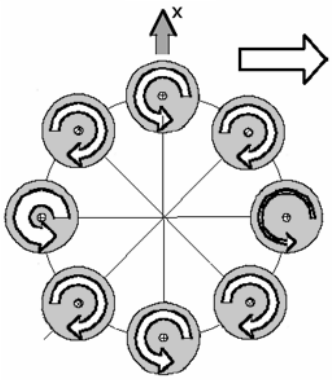
rotation to the left



rotation to the right



lift



lateral movement to the right

Fig.7. Moving direction. The engine arrow thickness is proportional with revolutions per minute.

By increasing the propeller speed once the eight propulsion units occurs climbing of platform at the desired altitude. Reducing speed of the 1-3-5-7 group and increasing speed of the 2-4-6-8 group propulsion units will get rotation to the left of the platform, according to conservation of angular momentum theorem. If reverse the two groups, increased speed propulsion units will get rotation to the right of the platform.

If the rotational speed decreases on unit no. 7 and increases on unit no. 3, other units

retain the speed, we get a rolling motion of the platform coupled with lateral movement. If the rotational speed decreases on unit no. 1 and increases on unit no. 5 we obtain a forward motion coupled with inclination change after pitching axis.

Generalizing, if you change the rotational speed by increasing, respectively decreasing on the two propulsion units located on a diameter of the platform will get a change of inclination and motion system in the direction of corresponding diameter.

For an active control of the platform can be used actively robust control theory which has input parameters linear and angular accelerations measured by accelerometers stands on platform ($\ddot{x}, \ddot{y}, \ddot{z}, \ddot{\theta}_x, \ddot{\theta}_y, \ddot{\theta}_z$) and / or sensors for determining the attitude angles (inertial measurement unit in three axes) respectively altitude platform (ultrasonic sensors). We designed the eight speed commands n_i (i = 1...8) of the propulsion units. Control system will be fitted with programmable microcontroller, implemented with active control laws, which will communicate with sensors, respectively will control the platform stability in various controlled pilot evolution (Fig. 8).

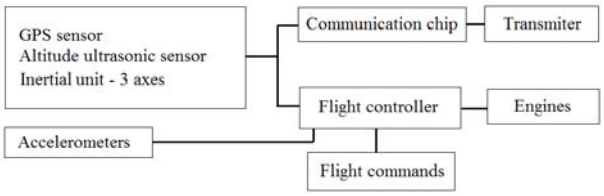


Fig.8. Block scheme of flight control system

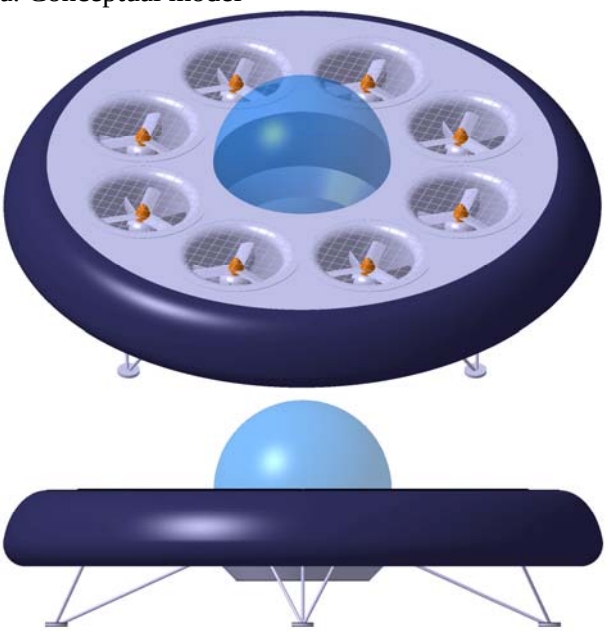
2.3 PAMMDAV Structure.

Is a mixed structure that incorporates metal structural elements (in particular for the primary structure) and composite elements for the secondary structure (eg. skin). Usually combining structural elements that compose the primary resistance structure is made by riveting or removable screw assembly (where applicable), while for secondary structure is chosen for adhesion assembly (riveting as the second option) or by screws.

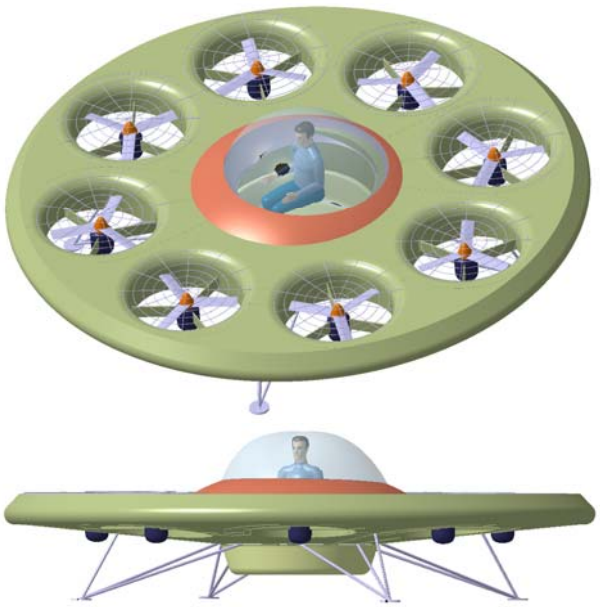
3. PAMMDAV concept evolution

The three phases of the design process: conceptual design, preliminary and production are shown in Fig. 9. Because the project budget was drastically reduced, the model will remain only a scale model to be tested experimentally.

a. Conceptual model



b. Preliminary model



c. Experimental model/ final model

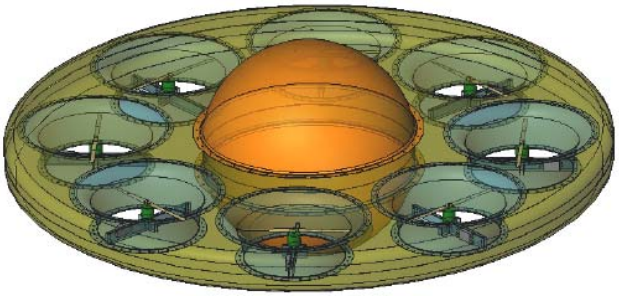


Fig. 9. Conceptual model (a), preliminary model (b) and, experimental model (c)

The experimental model (scale model) is currently in execution phase, but at the end of September 2010, the operational model will be made for the execution of demonstration flights.

Acknowledgement: The project was supported by de National Research Program PN 2 (81055/2007 code).

NUMERICAL AND PHYSICAL EXPERIMENTS FOR HIGH SPEED FAILURE MODELS OF COMPOSITES

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Abstract: One of the most interesting aspects of technical progress in the military domain is the competition between the projectile and armored vehicle, compete to influence the continuous improvement of projectiles and armored vehicles, tilting the balance of the first, when the other, but never one of them definitive. Human protection in operational theaters carried on in various tactical missions conducted in hostile environments is an absolute priority. Under this concept, protecting the vulnerable areas of the air platform by arming against projectiles covers a substantial part of this objective. The work deals with the defining aspects of the design steps and estimate for a solution that meets the requirements of ballistic protection for a fighting helicopter against infantry small guns, solution ensuring a satisfactory level of protection in terms of acceptable influence on flight performance.

Key words: ballistic protection, ceramics, composite panels.

1. INTRODUCTION

The paper deals with simulation and virtual simulation of helicopter ballistic behavior against infantry small caliber guns. The paper is a theoretically evaluation of ballistic protection behavior against infantry small caliber guns, which compared with experimental results made in same conditions with theoretical ones, may allow extrapolate other ballistic models, without necessity experimental confirmation of whole domain solution.

2. PSYCHICAL MODEL

Fire is executed by infantry small caliber guns. A small caliber projectile was taken into account according to AEP-55, volume 1 (First edition).

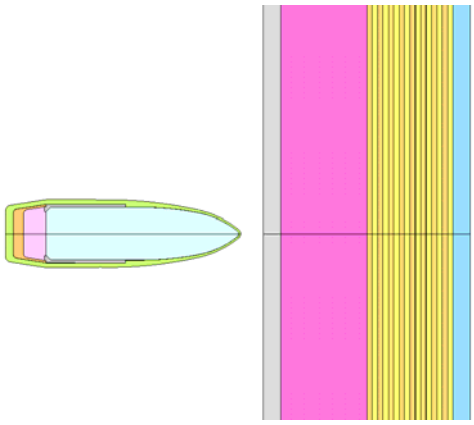

Fig. 1. Geometric model

The simulation will be done considering that the ballistic panels whose response will be virtually studied, are presented as panels with following characteristics:

- Shape of panel: square 300x300 mm, thickness is a result of components layers of different materials according to Fig. 2.

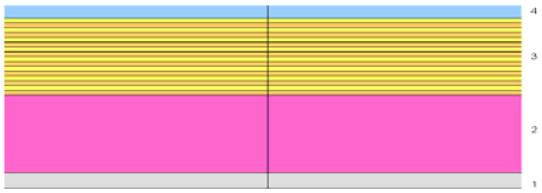

Fig. 2. Arrangement of layers of ballistic panel

1 – Aluminum panel
2 – Ceramic layer
3 – Dyneema layers
4 – Steel panel

- Two types of ballistic armors will be considered with different ceramic plates.
Mechanical characteristics of ballistic panel components are briefly presented in the following table:

Table 1 Mechanical characteristics

Material / Prop.	Al 2324	Ceramic type 1	Ceramic type 2	Dyneema	Steel
Thickness [mm]	2	10 to 20	10 to 20	10 to 20	2.5
Density [gr/cm^3]	2.77	3.8	3.2	1.3	7.8
Elasticity modulus [GPa]	0.7	337	450	1.5	2.1
Breaking tensile strength [MPa]	370			800	250
Break elongation [%]	8	0.6	0.6	4	7
Hardness [kg/mm^2]		1451	2300		

High elastic module values as well as ultimate stress ones can be noticed for ceramic materials. The high values of break elongations for the material used for backing layer (dyneema) will assure a strong dumping of the projectile at low speeds together with the brittle parts of ceramic.

3. FINITE ELEMENT MODEL FOR CONSIDERED COMPONENTS OF NUMERICAL SIMULATION

3.1. Problem formulation

In order to simulate the impact of experimental firing for each component the following steps will be performed:

1) Geometrical design of each element involved in impact phenomenon;
2) Material model;
3) Finite element model;
4) Boundary conditions model;
5) Schematization of impact phenomenon;
6) Resolving the problem
7) Presentation and analysis of crucial aspects of impact phenomenon:
   (a) bullet velocity during impact phenomena;
   (b) the bullet effect on each element that comes into contact.

(Through ANSYS code using data on material properties and structural characteristics of available elements: bullets, ballistic panel, will be simulated the impact of the bullet and the ballistic panel.)

3.2. Working hypotheses

- problem is axially symmetric;
- impact occurs normally to the surface;
- initial velocity of bullets are identical to those of specific documentation;
- al materials that are involved are considered homogeneous;
- behavior of involved materials are considered nonlinear (special constitutive laws will be considered);
- material models used: plastic – cinematic, Johnson – Cook, Johnson – Holmquist.

3.3. Finite element model

There are considered Plane elements for plane state problem with axially symmetrical option, isoparametric with two degree freedom per node.
Finite element model for the bullet:

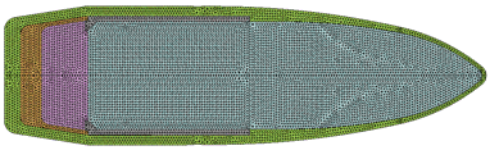

Fig. 3. The caliber bullet MEF

Finite element model for ballistic panel, noticed that the elements are smaller in contact area then the rest area of panel.

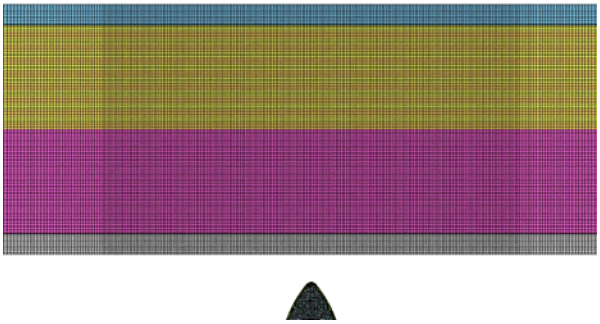

Fig. 4. Ballistic panel MEF

3.4. Material model

1. Plastic – cinematic: Is one must used, is characterized by following parameters: s_y (yield limit) and E_T (tangent modulus), yield function expression is:

$$s_y = \left[1 + \left(\frac{e_p}{C}\right)^{\frac{1}{P}}\right] \cdot \left(s_0 + \beta \cdot E_P \cdot e_p\right) \qquad (1)$$

where: s_0 – initial yield limit; e_p – effective plastic specific strain; E_p - hardening plastic modulus; β - hardening parameter of the type of plasticity; C, P – strain rate parameters.

2. Johnson – Cook: evaluate the behavior of viscous-elastic-plastic materials, can be done using Johnson – Cook formula, is a connection between tensile state and plastic deformations, strain velocity and temperature. Also useful in strain deformation of high speed bodies involved with heating. Heating source can be external or internal, the transformation plastic mechanical work into heat:

$$\sigma_y = \left[A + B \cdot \left(\bar{e}^p\right)^n\right] \cdot \left(1 + c \cdot \ln \dot{e}^*\right) \cdot \left[1 - \left(T^*\right)^m\right] \qquad (2)$$

Where: A, B, C, n and m – input constants; $\bar{e}^p$ – effective plastic strain, e^* - effective plastic strain rate for $e_0 = 1 \cdot s^{-1}$; T* - homologous temperature $= \left(\frac{T - T_{room}}{T_{melt} - T_{room}}\right)$.

3. Johnson – Holmquist – useful for ceramic panels, glasses and other fragile materials. The equivalent stress for a ceramic – type material is given by:

$$\sigma^* = \sigma_i^* - D\left(\sigma_i^* - \sigma_f^*\right) \qquad (3)$$

where

$$\sigma_i^* = a\left(p^* + t^*\right)^n \left(1 + c \ln \dot{\varepsilon}\right) \qquad (4)$$

represent the intact, undamaged behavior,

$$D = \sum \Delta\varepsilon^p / \varepsilon_f^p \qquad (5)$$

represent the accumulated damage based upon the increase in plastic strain per computational cycle and the plastic strain to fracture

$$\varepsilon_f^p = d_1\left(p^* + t^*\right)^{d_2} \qquad (6)$$

σ_f^* - damage behavior, '*' indicates a normalized quantity, the stress being normalized by the equivalent stress at the Hugoniot elastic limit, the pressures by the pressure at the Hugoniot elastic limit and strain rate by the reference strain rate.

3.5. Input date for the problem

In firing polygon were captured images with a high speed recording camera, used for bullet velocity determination, input and output from ballistic armor for penetration case.

$$V_i = \frac{\Delta s_i}{t_i},\ i = 1,2 \qquad t_i = \left(f_2 - f_1\right) \cdot \frac{t_{tot}}{f_{tot}} \qquad (7)$$

were: V – input or output velocity; Δs_i - distance range performed by the bullet, t_i – corresponding time; f_i – corresponding frame numbers; f_{tot} – taping speed (frame/sec – 10 000).

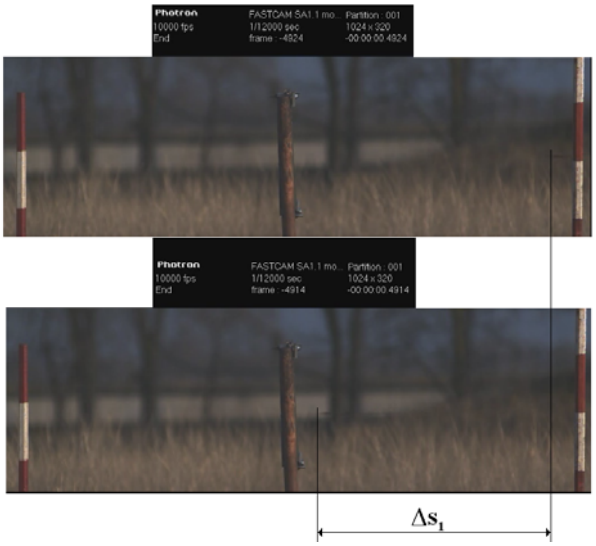

Fig. 5. Input velocity determination

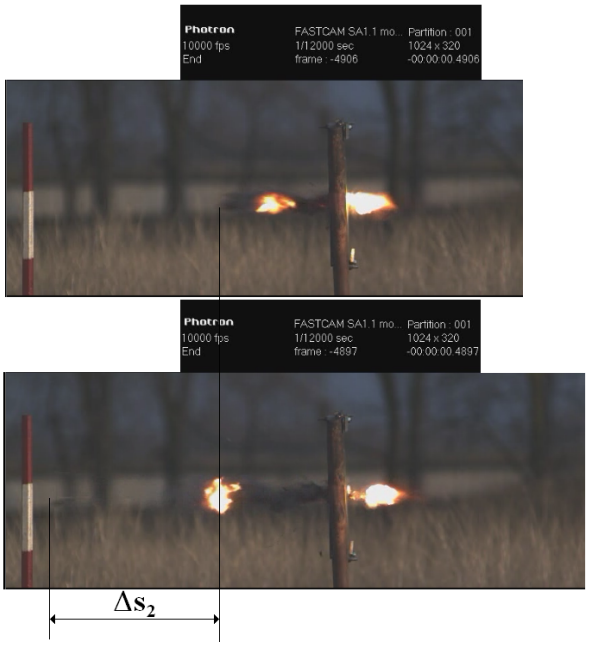

Fig. 6. Output velocity determination

4. NUMERICAL SIMULATION RESULTS

4.1. Impact of bullet with first ceramic panel ballistic armor.

Components of ballistic panel: aluminum layer 2mm thick, first type of ceramic plate 10mm thick, dyneema layers 10mm thick and steel plate 2.5mm. Initial velocity of bullet is 817.7 m/s.

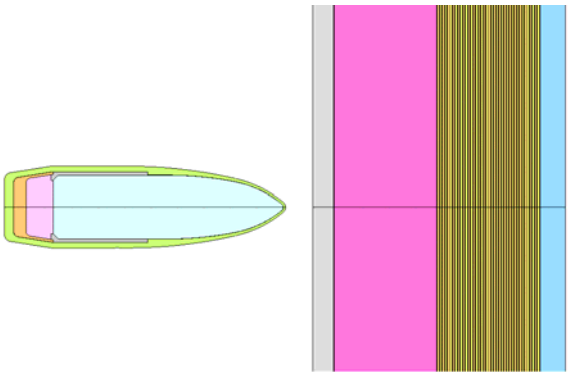

Fig. 7. First step of the simulation

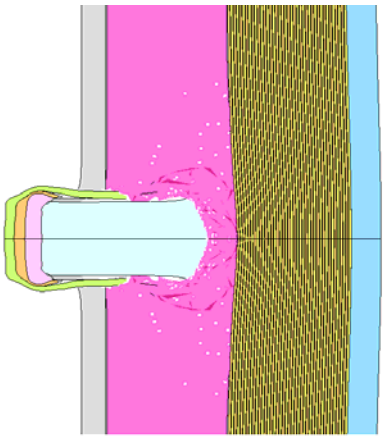

Fig. 8. Intermediary phase at time t=3.0e-005 sec.

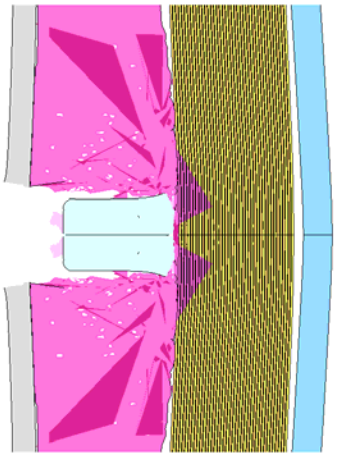

Fig. 9. Intermediary phase at time t=8.0e-005 sec.

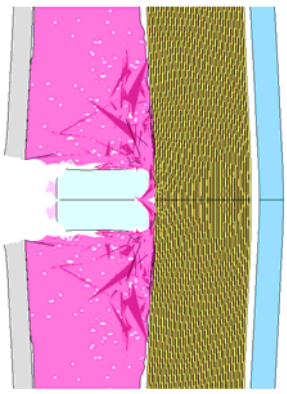

Fig. 10. End phase of experiment at time t=1.0e-004 sec

In the following graphic the variation of velocity with respect to time of penetration was presented:

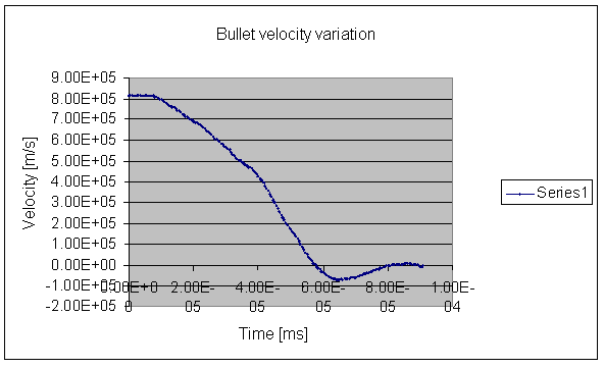

Fig. 11. Bullet velocity variation for the first type of ceramic

As it can be seen in the fig. 11 the velocity of the projectiles is abruptly decreasing in the interval [0; 5.8e-005] seconds towards 0 m/sec. Then the bullet continuously moves forwards grace the elasticity of the remaining armor material. At 6.5e-005 seconds moment the bullet stops and is following the downwards displacement until 9.0e-005 seconds when it stops.

4.2. Impact of the bullet with second ceramic panel ballistic armor.

Components of ballistic panel: aluminum layer 2mm thick, second type of ceramic plate 10mm thick, dyneema layers 10mm thick and steel plate 2.5mm. Initial velocity of bullet is 786 m/s.

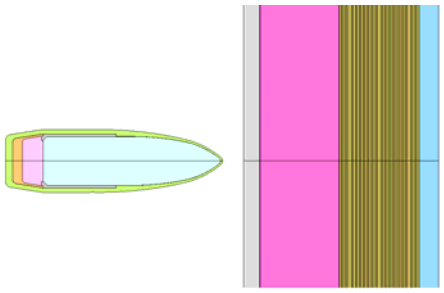

Fig. 12. First step of the simulation

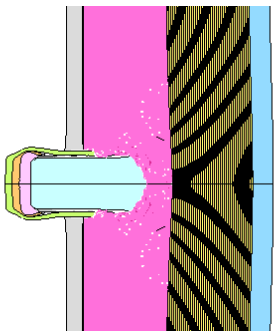

Fig. 13. Intermediary phase at time t=3.0e-005 sec.

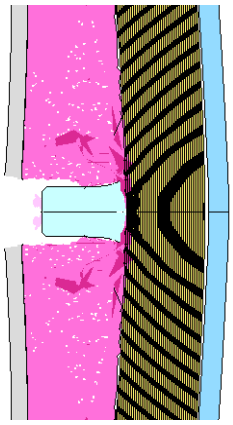

Fig. 14. Intermediary phase at time t=8.0e-005 sec.

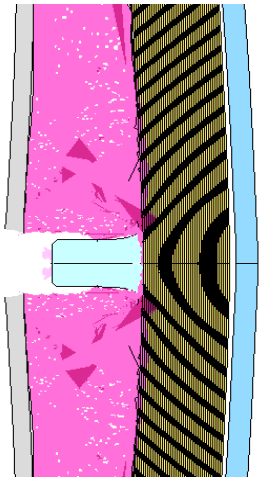

Fig. 15. End phase of experiment at t=1.0e-004

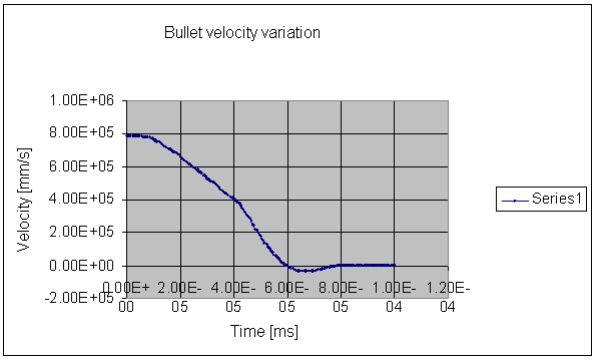

Fig. 16. Bullet velocity variation for the second type of ceramic

Analyzing the graphic represented in fig. 16 with respect to the fig. 11 one the first observation can be done is that the velocity of the projectile becomes zero later and the rewards movement is sensitively attenuated.

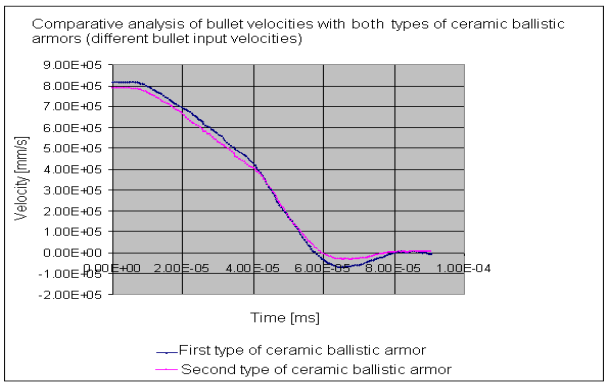

Fig. 17. Comparative analysis of bullet velocities with both types of ceramic ballistic armors.

Comparative analyses of numerical simulations for different initial conditions were presented in the graphics of fig. 17. The main difference of the experiments analyzed in fig. 17 and fig. 18 is that initial velocities are different (fig. 17) or equal (fig. 18). The different velocities considered in fig. 17 were 817.7 m/s respectively 786 m/s.

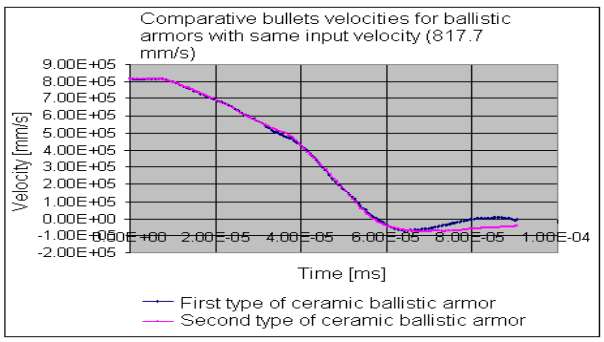

Fig. 18. Comparative analysis for similar initial velocities

A similar behavior of two types of ceramics can be noticed. The main difference consists in the different velocity of relaxation. The first type of ceramic assures a quick time of damping.

5. CONCLUSIONS

1. The two solutions were satisfactory. The small caliber bullet was stopped at the level of first dyneema layer;
2. The mechanical behavior of the armor panels was quite similar as shown in fig. 17, 18;
3. The simulations were performed in the most adverse conditions (perpendicular incidence);

The weight and the price will be the decision criteria for the chosen solution.

ACKNOWLEDGEMENTS

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RESULTS OF SCIENTIFIC RESEARCH ON BULLET VELOCITY MEASUREMENT

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Abstract:
The purpose of this paper is to analyse results of scientific research efforts focused on a highly significant parameter for the performance of a weapon system or ammunition: the bullet velocity of small arms ammunition. The paper will point out the results of experiments on 9x19mm and 5.56x45 mm NATO standardized ammunition. The chronometric and Doppler Radar methods will be presented, as well as details on the testing procedures and achieved results.

Key words: *ammunition, safety, performance, bullets, velocity.*

1. INTRODUCTION

Ammunition is a mechanical and pyrotechnical compound designed to produce a wide range of effects: neutralizing human forces, causing material damage, etc. In order to fulfill the goal for which it was developed and manufactured, ammunition is made up of explosive materials, which generate large amounts of gas at temperatures and pressures capable of propelling projectiles and shards at high velocity and kinetic energy levels [10].

In the case of kinetic ammunition, the bullets or projectiles are propelled by the powder charge, which, if properly calculated, ensures the fulfillment of the main performance- and security-related requirements.

The process of development, acquisition and use of a certain type of ammunition is underpinned by the operational requirements, as established by the armed forces services. Operational requirements comprise a large number of technical and tactical features, among which safety and performance are paramount.

While safety features are meant to ensure that the weapons can be safely used under certain environmental conditions and are not likely to generate major accidents, performance features are designed to meet a number of criteria that guarantee the fulfillment of the missions. Ammunition safety may be ensured by keeping within the admissible limits of the pressure of the gases produced by the burning powder charge, while performance is directly associated with the penetration of a target placed at a certain distance from the weapon.

In certain situations, the performance and safety features become interchangeable [10]. For instance, velocity is a performance feature in the case of lead bullets, as it directly influences their penetration capacity. However, in the case of frangible bullets used for special missions aboard airplanes, velocity is safety-oriented, since the bullet must have the necessary kinetic characteristics to allow for rapid fragmentation, with no ricochet and without penetrating the airplane's fuselage.

Regardless of the situation, we are concerned with controlling the values of the various physical, chemical, thermodynamic, kinetic or other types of ammunition-specific features, so as to ensure that the ammunition meets safety requirements and is capable of fulfilling the missions it was designed for [11].

This article intends to explore some of the results of the experimental scientific studies aimed at determining an extremely important feature for the performance of weapon systems and ammunition: the velocity of small-caliber bullets. The results described herein were obtained by studying the 9x19mm and 5.56x45mm NATO standardized ammunition.

The velocity of a projectile determines many other specific features, such as the kinetic energy, momentum, trajectory, stability, accuracy or dispersion, penetration capacity or terminal ballistics effect.

At the same time, the velocity of the bullets or other projectiles depends on the type of powder charge, the type and mass of the projectile, the characteristics of the weapon and of the barrel, the range, etc.

The velocity of the bullet is therefore the result of the interdependency among various factors or parameters, which need to be controlled in order to obtain the expected weapon system performance.

2. BULLET VELOCITY REQUIREMENTS

A number of security, performance and compatibility requirements were set forth for the NATO standardized ammunition used by the armed forces [1, 2, 3, 4]. Out of these, the velocity of the bullet and other associated features are specified under the STANAG or MOPI ammunition-related provisions. For instance, the 9mm cartridge specification is stipulated under STANAG 4090, and for the 5.56mm ammunition under STANAG 4172. Manuals of Proof and Inspection Procedures (MOPI) have also been developed for each standard cartridge, such as the D/170 MOPI Manual for the 9mm NATO ammunition or the D/8 MOPI Manual for the 5.56mm NATO ammunition.

The MOPI guidelines [1, 2] detail the types of tests to be carried out in order to ensure that the ammunition complies with the corresponding STANAG requirements. The standard testing methods, as well as the inspection procedures and the equipment needed are specified under MOPI.

2.1. Velocity Requirements for the 5.56x45mm Cartridge

The following requirements regulate the velocity and kinetic energy of 5.56mm ammunition:

- *Kinetic energy*

Each NATO cartridge should produce an average kinetic energy of more than 1500 J as it is expelled from the muzzle of a firearm.

- *Velocity*

The average adjusted velocity from 24m should not vary by more than 4% compared to the ideal velocity achieved during the production control tests or by more than 5% compared to the ideal velocity achieved during the stock periodical monitoring tests.

2.2. Velocity Requirements for the 9x19mm Cartridge

- *Kinetic energy*

The average kinetic energy measured at the muzzle of a firearm should be between 542 J and 813 J.

Knowing that the bullet mass should vary between 7 and 8.3 grams, it is possible to establish the bullet's initial velocity.

3. EXPERIMENTAL METHODS AND PROCEDURES USED FOR MEASURING THE VELOCITY OF BULLETS

The bullet's initial velocity is the main performance feature, which determines the terminal ballistics effect, the accuracy or dispersion of hits and the similarity of the bullets' trajectories. Within the Technical Military Academy, the Laboratory for the testing, evaluation and certification of the safety and performance features of firearms and ammunition (LTECAM) uses two different methods to test the bullets' velocity:

- *the chronometric method* – that employs three sensors for the identification of a moving bullet; it determines the interval necessary for the projectile to cross the distance between the sensors (photocells, reel)
- *the Doppler radar method* – that establishes the instantaneous velocity Vx of the projectiles, at X distance on the trajectory, by recording and interpreting the frequency variation of the received signal that is proportional to the velocity of the bullet.

This section will give a brief presentation of the two methods and procedures employed in experimental studies: the chronometric method using the Oehler 43 ballistic lab and the Doppler radar method using the BR- 3502 Doppler radar.

3.1. Measuring the velocity of bullets by the chronometric method

The chronometric method employs the Oehler 43 [8] personal ballistic lab in order to measure the velocity of the bullet. The equipment is a device made up mainly of [8] a ballistic computer (Figure 1), 3 photocells set on a stand (Figure 2) and a PC with specialized software (Figure 3).

Figure 1. Ballistic computer

Figure 2. Sky screen detectors

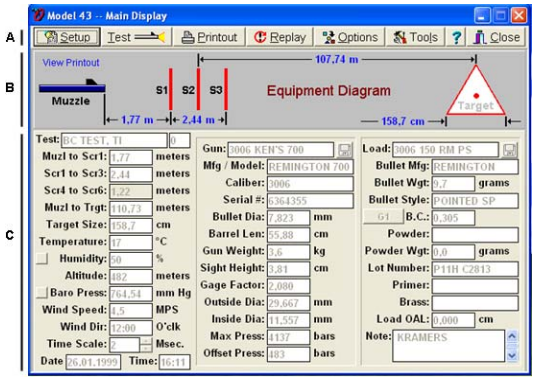


Figure 3. The main Oehler software window [8]

3.2. Measuring the velocity of bullets by the Doppler radar method

The Doppler radar method establishes the instantaneous velocity Vx of bullets or projectiles, at X distance on the trajectory, by recording and interpreting the frequency variation of the received signal that is proportional to the velocity of the projectile. In order to identify this frequency variation one needs to mix the signal received or transmitted by the aerial of the Doppler radar [8, 9].

The BR-3502 radar which is part of LTECAM is a device made up of the following main components: the signal supply and amplification unit fitted with the radar aerial (Figure 4) that transmits and receives the Doppler signal and the trigger enhancer which is set on the weapon. The JUNCTION BOX 500 is added to this system. It represents the Doppler signal receiving and software processing unit – TestCenter LC5.0.

Figure 4. BR/1502 Doppler radar fitted with an aerial

The S1 photodetector starts the timer, while S2 and S3 are independent photodetectors which stop the timer. That is how the time interval necessary for the bullet to travel from S1 to S2, and from S1 to S3 is determined. By knowing the distances between photodetectors, the Model 43 ballistic computer can easily calculate the bullet velocity when passing the S2 photodetector. Irrespective of the distance between the S1 and S3 screens, S2 shall always be positioned at mid-distance between the other two photodetectors.

The BR-3502 radar can be used to measure the translation and radial velocity of every moving object within the radar beam. The

measured velocities range between 10 and 3,000 m/s, and the precision of the measurement is <0,1% [5].

The radar radiation is an analog signal whose frequency and amplitude are proportional to velocity and the distance to the moving object.

The software used for the analysis of the Doppler signals emitted and received by the BR-3502 radar is TestCenter© [7], whose main window is shown in Figure 5.

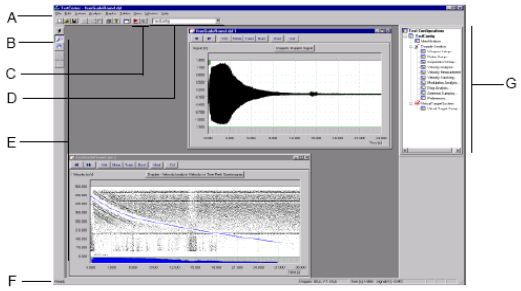


Figure 5. The main window of TestCenter© [7]

We describe below how to work with this specialized software, which is used for signal acquisition and analysis, as well as for obtaining graphs that show velocity variations as a function of time and distance.

The Doppler analysis of the TestCenter© software relies on the availability of a Doppler document. A new document can be created only as a result of a manual or automatic (triggered) signal acquisition process.

The main stages of the manual data acquisition are [6]:

- the selection of an active test configuration;
- the performance of the manual data acquisition.

The main stages of the synchronized automatic (triggered) acquisition are:

- the selection of an active test configuration;
- the verification of the acquisition set-up parameters (sampling frequency and trigger specifications);
- the arming of the acquisition system;
- the performance of the acquisition as synchronized by the trigger.

The acquired data will be recorded and will automatically create a new Doppler document, which can be used immediately or saved on the disk for subsequent analyses.

The data acquisition is performed by TestCenter© through an independent process, thus being able to perform other operations even if the acquisition is under way. The existing documents can be retrieved from the disk with a view to analyzing these data at any moment in time, and following such analysis they can be saved together with the analyses and the results thereof.

Once the information or data have been saved in a Doppler document, TestCenter© can perform further analyses of the acquired signals. In order to carry out an effective and precise analysis, the following information should be defined:

- radar set-up;
- position;
- frequency;
- weapon set-up;
- barrel length;
- elevation angle.

The results of the acquisition and signal processing can be presented under different formats [6.7]:

- Radar Doppler Signal (Figure 6);
- Peak Spectrogram (Figure 7);
- Color Peak Spectrogram (Figure 8);
- Waterfall Spectrogram (Figure 9)

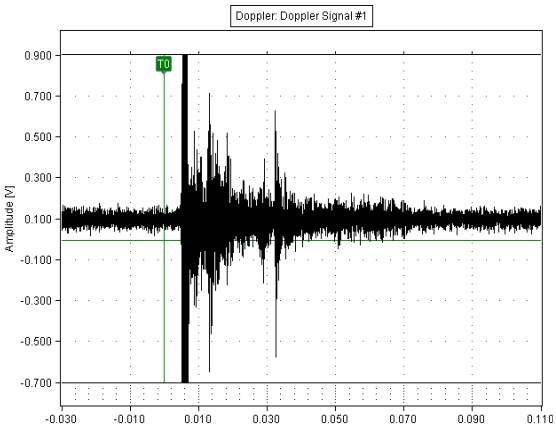


Figure 6. Radar Doppler Signal

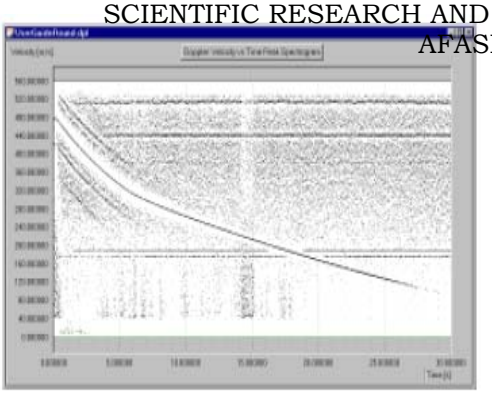


Figure 7. Peak Spectrogram [7]

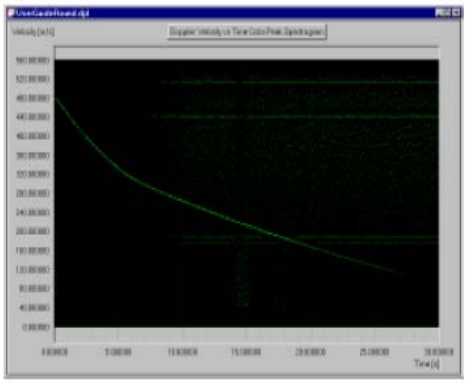


Figure 8. Color Peak Spectrogram [7]

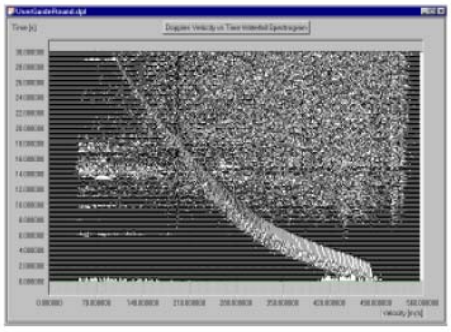


Figure 9. Waterfall Spectrogram [7]

Once a velocity itinerary is identified, all the other velocity specific graphs will be available. The results presented in these graphs shall be calculated taking into account the existence of the chosen velocity itinerary. The TestCenter© displays the following graphs of velocity variation:

- Velocity vs Time
- Acceleration vs Time
- Distance vs Time
- Velocity vs Distance
- Acceleration vs Distance.

The next section gives examples of graphical representations for the results of velocity measurements.

4. EXPERIMENTAL RESULTS

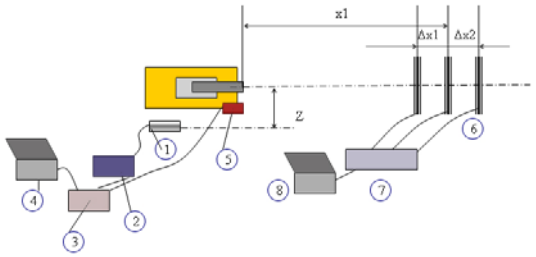
The ballistic characteristics of weapons' systems and of small caliber ammunition are:

- the muzzle velocity of cartridges expressed as the average velocity at a given distance from the muzzle; or the muzzle velocity calculated at the muzzle of the barrel;
- the maximum average pressure inside the barrel;
- the maximum average port-pressure and its dispersion;
- the action time.

For ammunition, these characteristics are established with the help of ballistic weapons.

You can see in the following some of the results of the experiments for determining the bullet velocity for caliber 9x19mm ammunition.

The experimental configuration used is sketched in Figure 10.



1. Aerial Radar Doppler
2. Radar Doppler model BR/3502
3. Junction Box JB-500
4. PC with TestCenter software
5. Signal triggering generator (acoustic or for shocks)
6. Photo-detector (skyscreen)
7. Oehler Ballistic Laboratory
8. Oehler software PC

Figure 10. Experimental Setup [9]

The trials were carried out in the LTCAM of the Military Technical Academy, according to the PO-LTCAM-03 and PO-LTCAM-14 procedure. The cartridges used for trial were provided by SC UM Sadu SA Gorj.

The main objectives of the experiments were:

- developing and implementing an experimental procedure for determining the projectile velocity, which would take into account the requirements of the NATO reference documents;
- establishing the bullet velocity by two different methods (chronometric and Radar Doppler), and comparing the resulting values.

For the purpose of these trials the following types of cartridges were chosen:

- 9x19mm cartridge with lead bullet, lot 3/2009 (M1);
- 9x19mm cartridge with subsonic bullet, lot 1/2008 (M2);
- 9x19mm cartridge with safety bullet, lot 1/2008 (M3);
- 9x19mm cartridge with frangible bullet, lot 6/2008 (M4).

The shooting was carried out with a 9x19mm caliber ballistic weapon, and the bullet velocity was measured using the two techniques: with the Oehler ballistic laboratory at a 5 meter distance from the muzzle, and with the BR-3502 Radar, the velocity was continuously measured on the 0 – 20m interval. Images of the configuration used can be seen in Figure 11.

The experimental results for bullet velocity measured with the chronometric method are shown in Table 1. Figures 12, 13, 14 show a few examples of recording with the Doppler Radar method.

Figure 11 Ballistic weapon shooting station

Table 1 Experimental results

Target shooting no.	M1	M2	M3	M4
Bullet mass (g)	7.2	8.0	5.51	4.12
	Bullet velocity V_5 (m/s)			
1	382	302	434	522
2	383	297	445	520
3	387	300	436	526
4	386	301	448	520
5	379	307	437	522
average	383.4	301.4	440	522

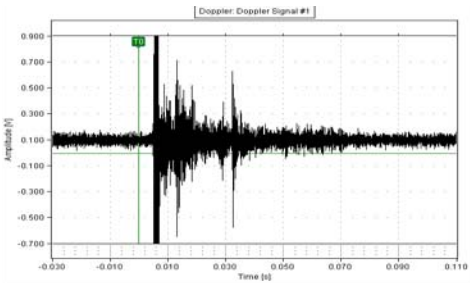


Figure 12 Lead bullet Doppler Signal

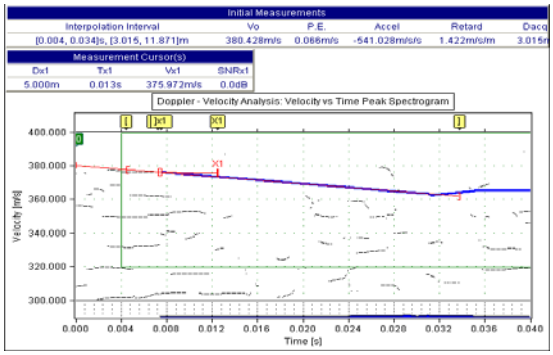


Figure 13. Peak Spectogram for lead core bullet

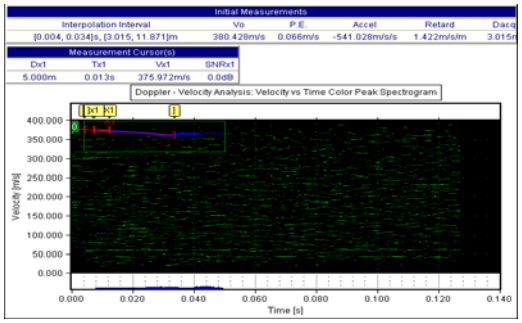


Figure 14. Color Peak Spectogram for lead core bullet

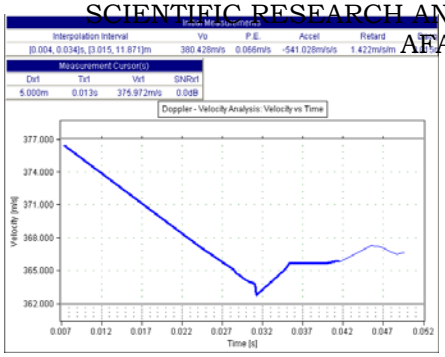


Figure 15. Velocity vs. Time for lead core bullet

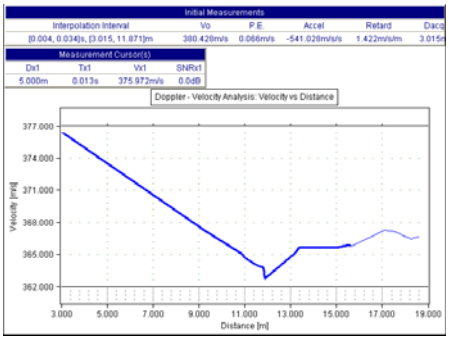


Figure 16. Velocity vs. Distance for lead core bullet

5. CONCLUSIONS

The theoretical studies regarding the safety and performance features of the weapon systems and ammunition, as well as the research meant to determine the velocity of the bullets, allow us to draw the following conclusions:

- the bullets' / projectiles' velocity is one of the most significant parameters characterizing and influencing the performance and safety of a weapon system or ammunition;
- there are two basic methods for measuring the bullets' /projectiles' velocity: the chronometric one and Radar Doppler;
- the chronometric method establishes the bullets velocity at a certain distance from the barrel and the measured value depends on several factors: the type and number of the used sensors, the distance between sensors and from the weapon, the accuracy of the electronic system used for measuring time; in order to determine the initial velocity, one must theoretically compute the velocity correction to the muzzle of the barrel;
- the chronometric method is difficult or impossible to apply if the elevation angles are too high;
- the Radar Doppler method allows the continuous determination, in space and time, of the bullets or projectiles velocity; the accuracy of this method mainly depends on the radar performance, on the precision of the device receiving Doppler signals and on the test configuration;
- the Radar Doppler method facilitates the gathering of more complex information concerning the evolution of the bullets /projectiles velocity and acceleration, including the impact with different targets and the research on terminal ballistics;
- the processing of Doppler signals is complex and entails the specialized training of the operators;
- the use of both methods during the process of testing the bullets /projectiles velocity offers multiple advantages and is recommended in the development of new weapon systems or ammunition.

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A MATHEMATICAL MODEL OF BULLET MOTION INSIDE BARREL OF A SMALL CALIBER ARMAMENT SYSTEM

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Abstract: *In this paper it is proposed a mathematical model of bullet motion under action of powder gases pressure inside barrel of a small caliber armament system, using the geometrical law of powder burning. In order to obtain this mathematical model was accepted some simplified hypotheses due to the complexity of phenomenon. In order to solve this mathematical model, interior ballistics software was elaborated, which allows study the variation of the powder gases pressure and the projectile velocity versus its displacement inside barrel and versus time. For an extant armament system, the theoretical results obtained with the aid of this software and the experimental data are compared***.**

Key words: *interior ballistics, mathematical model, geometrical law, powder burning, small caliber, armament system.*

1. INTRODUCTION

In this paper is proposed a mathematical model of bullet motion under action of powder gases pressure inside barrel of a small caliber armament system, using the geometrical law of powder burning. Due to the complexity of bullet motion inside barrel, are accepted following assumptions:

- powder burning is in accordance with geometrical law;
- burning rate law is $u = u_1 p$;
- pressure of powder burning is a medium pressure p;
- secondary mechanical works are proportional with main mechanical work and are evaluated with the aid of fictitious mass coefficient φ;
- forcing of rotate band in grooves of barrel is instantly;
- composition of gases does not change, so the powder force f and co volume of gases α are considered constants;
- some mechanical works are neglected;
- motion of bullet inside barrel is studied until the moment when the bullet leaves the barrel.

The significance of parameters and characteristics is showed below:

- p - gas pressure;
- v - bullet velocity;
- ℓ - displacement of bullet inside barrel;
- t - time;
- ψ - burned powder fraction.

2. MATHEMATICAL MODEL

The mathematical model is consisted of following algebraic and differential equations:

a. The relations which express powder burning and gases forming:

- law of powder gases forming

$$\psi = \chi z\left(1 + \lambda z + \mu z^2\right); \qquad (1)$$

- coefficient of powder shape progressivity

$$\sigma = 1 + 2\lambda z + 3\mu z^2; \quad (2)$$

- law of burning rate

$$u = u_1 p; \quad (3)$$

- velocity of gases forming

$$\frac{d\psi}{dt} = \frac{\chi}{e_1} u_1 p; \quad (4)$$

b. Translation motion equation

$$\varphi q \frac{dv}{dt} = \varphi q v \frac{dv}{d\ell} = sp. \quad (5)$$

c. Fundamental equation of interior ballistics

$$sp\left(\ell_\psi + \ell\right) = f\omega\psi - \frac{\theta\varphi q v^2}{2}, \quad (6)$$

where:

$$\ell_\psi = \ell_0\left[1 - \frac{\Delta}{\delta} - \Delta\left(\alpha - \frac{1}{\delta}\right)\psi\right];$$

$$\ell_0 = \frac{W_0}{s};$$

$$v = \frac{d\ell}{dt};$$

$$\Delta = \frac{\omega}{W_0}.$$

3. SOLVING OF MATHEMATICAL MODEL

The used initial conditions for the integration of differential equations correspond to the beginning of projectile motion, when:

$$t = t_0;\ \psi = \psi_0;\ p = p_0;\ v = 0;\ \ell = 0, \quad (7)$$

where:

$$p_0 = 30\,\text{MPa};$$

$$t_0 = 2.303\frac{I_k(1-\alpha\Delta)}{f\Delta}\lg\frac{p_0}{p_a};$$

$$\psi_0 = \frac{\frac{1}{\Delta} - \frac{1}{\delta}}{\frac{f}{p_0} + \alpha - \frac{1}{\delta}}.$$

In order to integrate the differential equations of mathematical model was elaborated an interior ballistics software using the four Runge-Kutta method.

4. RESULTS AND CONCLUSIONS

With the aid of interior ballistics software was obtained the variation of gases pressure and bullet velocity versus time and versus displacement of bullet inside barrel, for an extant armament system.

In Fig. 1 and 2 are presented the graphs of variation of gases pressure and bullet velocity versus time.

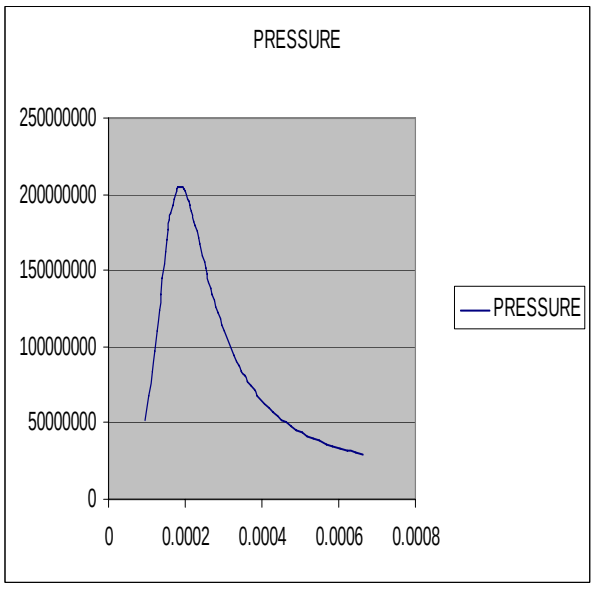

Fig. 1 Graph of gases pressure versus time

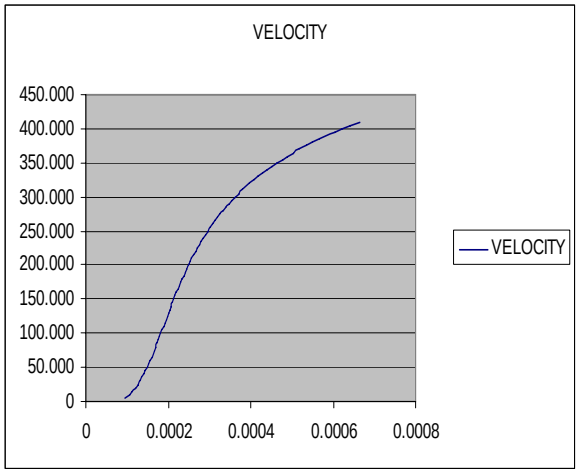

Fig. 2 Graph of bullet velocity versus time

In Fig. 3 and 4 are presented the graphs of variation of gases pressure and bullet velocity versus displacement of bullet inside barrel of armament system.

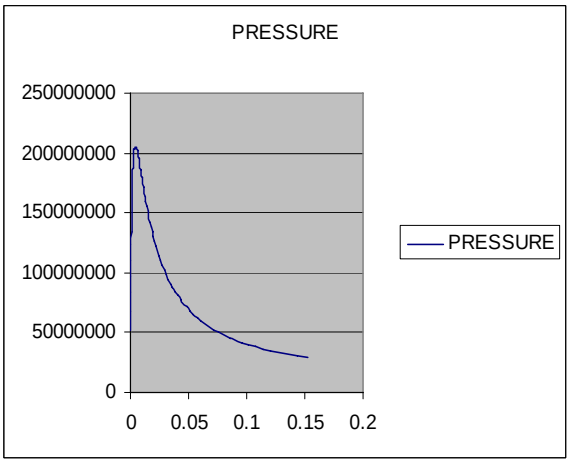

Fig. 3 Graph of gases pressure versus displacement

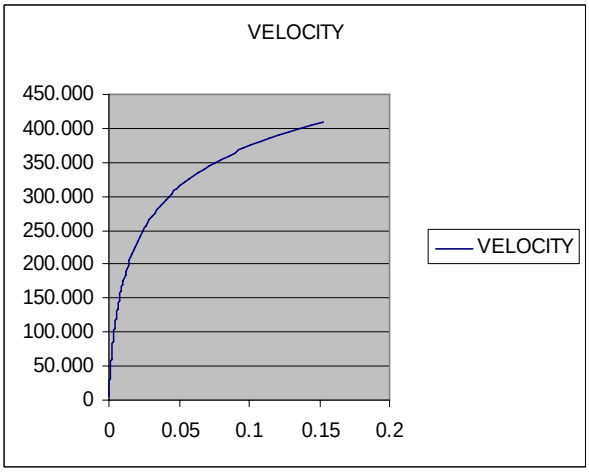

Fig. 4 Graph of bullet velocity versus displacement

For an existent armament system, the experimental and theoretical data are presented in Table 1.

Table 1 Experimental and theoretical data

Data / Magnitudes	Experimental	Theoretical
Maximum pressure [MPa]	196	205.2
Muzzle velocity [m/s]	392	405,1

From the comparing of the experimental data with the theoretical values obtained in the case of the elaborated mathematical model, had resulted that the difference between the muzzle velocity values is approximately 3% and between the maximum pressure values is approximately 4%.

The differences in both cases, especially in the case of muzzle velocity, are great due to accepted hypotheses.

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CONSIDERATIONS ON ENERGY RECOVERY FROM SOLID WASTE IN TIMISOARA

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Abstract: *Waste management is already governed by a substantial number of laws, but there are still opportunities to improve the management of certain important waste streams. Waste collection and transport can be provided by the local health operator, and the incineration facility may be located and operated from a thermo-electric plant. As mentioned, energy recovery from waste by conversion to biogas is a future option. This paper presents such a demonstration facility to simulate conditions that produce biogas through methanogenic fermentation of biodegradable wastes from landfill. In terms of a biodegradable waste landfill, it can be achieved biogas with high efficiency by controlling the methanogenic fermentation conditions.*

Key words*: waste management, environment, waste streams, biogas, methanogenic fermentation.*

1. INTRODUCTION

In the European Union, the continuous development generates large amounts of waste, leading to unnecessary losses of materials and energy, negative repercussions on the environment and adverse effects over health and quality of life. Reducing these negative effects is an EU strategic objective.

Municipal wastes are collected selectively for recovery of recyclable materials (paper, cardboard, glass, metals, plastics), only a very small extent. In the year 2006 in Romania, the total amount of municipal waste collected was recycled only 0.6% [1, 2]. One can say that about 40% of municipal waste is recyclable components, of which approx. 20% chance of recovery, not contaminated. In some cities have set up pilot stations composting of biodegradable waste [5].

To Timisoara city, energy recovery from municipal waste could be a technical solution for long-term economic and social development.

According to data for 2008, the total quantity of waste collected, transported and stored was about 130.7 thousand tons. This is an annual quantity of waste per capita of 425.2 kg. The analyze of the development for waste composition and characteristics of Timisoara shows that by 2030 the total amount of municipal wastes will be ~ 144.6 thousand tons / year with an average low calorific value of 3500 kcal / kg [1, 2].

Table 1 shows data on the forecast of population development over time, index generation and calorific value.

According to the National Waste Management Strategy all types of waste generated on the Romanian territory are classified as (i) municipal waste and similar, (ii) waste production and, (iii) waste generated from medical activities. According to statistics, in Romania, the total quantity of generated wastes has decreased by about 13% in 2003-2006 from 369.8 million tones to 320.6 million tones of wastes [1, 3, 4, 7].

Table 1 Forecast of population over time, index and generating quantity and waste calorific value

Year	2010	2020	2030
Population [no. of people]	304314	295000	285000
Generating index [kg/people/day]	1.183	1.282	1.390
Generated quantity [t/year]	131401	138039	144595
Low calorific value for wastes in mixture [kcal/kg]	~2600	~3000	~3500

2. WASTE TREATMENT TECHNOLOGIES

Solid waste treatment technologies and / or the city can be divided into dedicated technology and advanced technologies. Technologies are established:

- Conversion into compost;
- Incineration;
- Storage in heaps;
-Conversion of agricultural waste into compost.

Advanced technologies are:

- Anaerobic fermentation;
- Production of Alcolea / ethanol;
- Dismantling of used cars;
-Dry waste (useful when the landfill disposal price is reported by weight);
- Gasification;
-Transformation composted in industrial reactors;
- Mechanical and biological treatment;
- Mechanical and thermal treatment;
- Treating the plasma arc (pilot level);
- Pyrolysis;
- Recycling;
- Sewage water treatment;
- Production of compost by aerobic fixed layer;
- Anaerobic treatment of sewage;
- Autoclaving (waste disinfection);
- Obtaining direct energy from waste.

2.1 Landfill gas generation

Known two methods of treating municipal solid waste landfills: aerobic and anaerobic treatment. Anaerobic treatment involves the addition and recirculation of liquids which provide anaerobic conditions accelerate the decomposition of waste, landfill gas production increasing from 2 to 10 times [1,2].

The result is the determination of substantial production of biogas with a few decades earlier. Alongside the benefits that energy must, in terms of environmental impact that methane has a greenhouse ~ 21 times the CO_2. Generating energy from biogas (landfill gas). Municipal waste landfill requires two main steps:

• aerobic degradation immediately following the depletion of waste in landfill, the presence of oxygen in the air and is biodegradation by bacteria growing in the area of waste by hydrolysis of complex organic material in simple, soluble organic structures.

• Next phase anaerobic degradation occurs after the oxygen consumption of landfill bioreactor. In this process biogas is generated substantially containing methane.

The advantage of using bioreactors treating municipal waste landfill can be seen in fig. 1

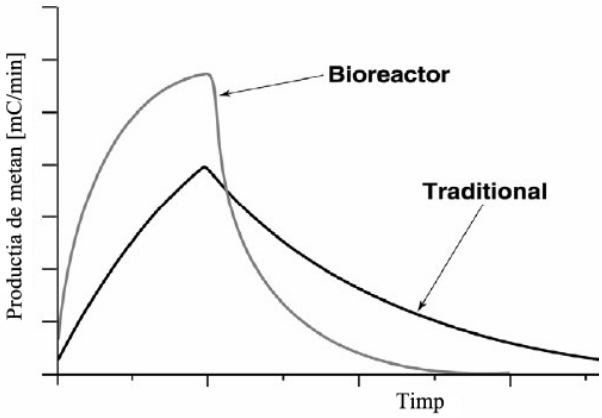

Fig. 1 Graph comparison of the bioreactor landfill biogas and traditionally [10]

As mentioned, energy recovery from waste by conversion to biogas is a future option.

2.2 Plant design and implementation

In terms of a biodegradable waste landfill, it can be achieved biogas with high efficiency by controlling the methanogenic fermentation conditions [3, 4, 6]. Installation of anaerobic fermentation of biodegradable waste from landfill is shown in fig. 2.

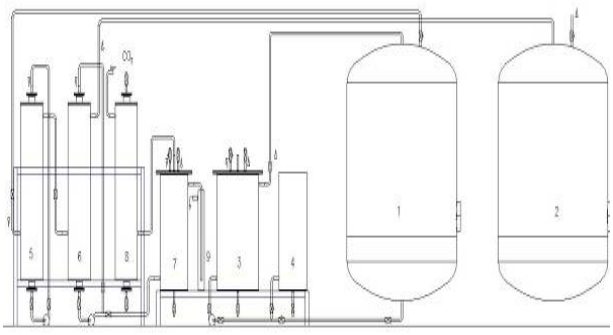

Fig. 2 Technological scheme for the biogas installation [6]

The installation has in it's composition the following: 1 – fermentation reactor; 2 – storage tank for purified gas; 3 – liquid solution recirculation tank; 4 – pH correction tank; 5 – H_2S filter; 6 – CO_2 filter; 7 – CO_2 evacuation tank; 8 – CO_2 buffer tank; 9 – hydraulic valve. Main technical characteristics of the installation are shown in Table 2.

Table 2 Plant's technical characteristics

Description	
Odds Outline: length / width / height	8/8/6 m
Material used	Sorted wastes from the landfill
Grain	20-50 mm
Working temperature	30-40°C
Biogas flow	20-25 m^3/day
Washer pump filter H_2S	1 m^3/h
Washer pump CO_2 filter	1 m^3/h

The demonstrative installation uses a cylindrical reactor, vertical, for methane fermentation. In fig. 3 are presented the installation overview by biogas purification equipment.

Fig. 3 Installation overview [6]

On the methane fermentation reactor's lid are placed connections for: pressure sensors, pressure gauge, exhaust of the biogas from the reactor until a minimum established pressure level, safety valve for evacuation in case of biogas accidental pressure increase.

In fig. 4 are presented the biogas purification technology equipment and control for the fermentation process.

Fig. 4 Technological equipments [6]

In fig 5 presented the equipments (from left to right): H_2S filter, CO_2 filter, CO_2 buffer vessel, CO_2 disposal container, heating leachate container, pH adjustment vessel agent.

Fig. 4 Technological equipments [6]

On the cylindrical virol of the reactor the following connections are located: pressure sensors, thermostat sheath for measuring and controlling the reactor temperature [3, 4, 5, 6].

At the bottom of the reactor there are pre-discharge (recirculation) connectors for the evacuation of the fermented liquid [7, 8, 9].

3. CONCLUSION

Waste disposal is a complicated and expensive activity. Solving environmental problems posed by waste can not be done unless measures are taken are coordinated. Classification of waste as required by law in Romania waste was also presented.

Elements of municipal waste management and waste disposal methods were discussed. Features and benefits bioreactoarelor landfill biogas generation compared with the traditional generation (without increasing waste moisture and leachate recirculation) were listed. Is apparent that the bioreactor landfill gas generation occurs earlier and higher productivity, producing real dump stabilization more quickly.

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EVAPRED - A CODE FOR FATIGUE ANALYSIS OPTIMIZATION

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Abstract: *In the majority of applications, fatigue-safe life design requires prediction of component fatigue life that accounts for predicted service loads and materials. The primary tool for both understanding and being able to predict and avoid fatigue has proven to be finite element analysis analysis (FEA). Computer-aided engineering (CAE) programs use three major methods to determine the total fatigue life: Stress life (SN), Strain life (EN) and Fracture Mechanics (FM). FEA can predict stress concentration areas, and can help design engineers predict how long their designs are likely to last before experiencing the beginning of fatigue.*

Key words*: aircraft, fatigue, optimization, stress, spectrum, fail-safe*

1. INTRODUCTION

Elementary steps in the fatigue analysis and damage tolerance evaluation are:

- Define the Aircraft Missions
- Develop global load spectra
- Select critical locations for each Principal Structural Elements (PSE)
- Calculate nominal stress levels for PSE's and local stress levels at critical locations
- Calculate fatigue life and Margin of Safety

A most relevant question now is, how well are we equipped with knowledge and tools to deal with all steps above ?

If S-N data are available the Miner rule may be adopted to calculate the fatigue life under spectrum loading. Figure 1 shows mission profile and stress distribution for IAR-99.

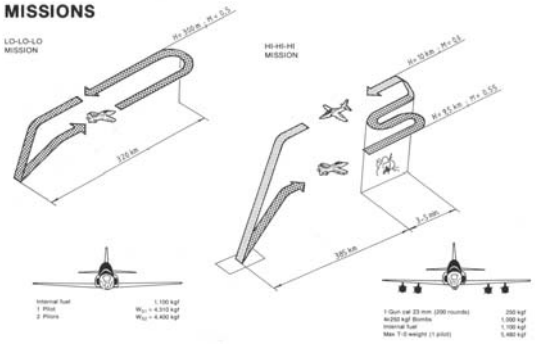

Fig. 1 Mission profile

Figure 2 shows mission profile and stress distribution for civil aircrafts.

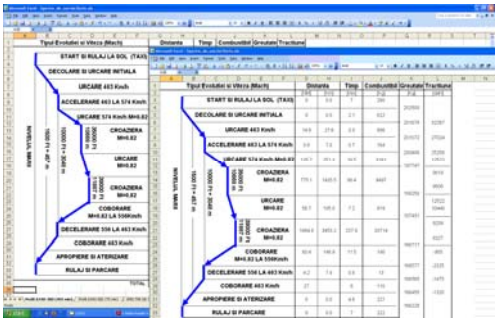

Fig. 2 Spreadsheet determining mission profile

2. GLOBAL LOAD SPECTRUM

Figure 3 shows associated load spectrum examples.

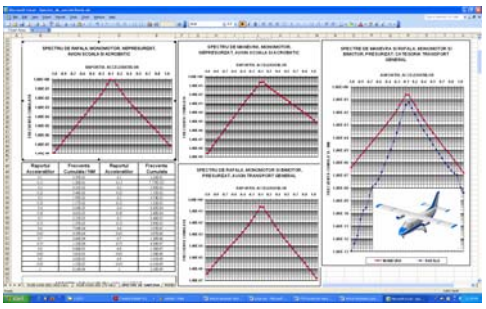

Fig. 3 Spreadsheet determining load spectrum

3. FEM ANALYSIS

Stress analysis is performed to determine the distribution of stress within a component, and usually involves relatively detailed models of airframe sub components.

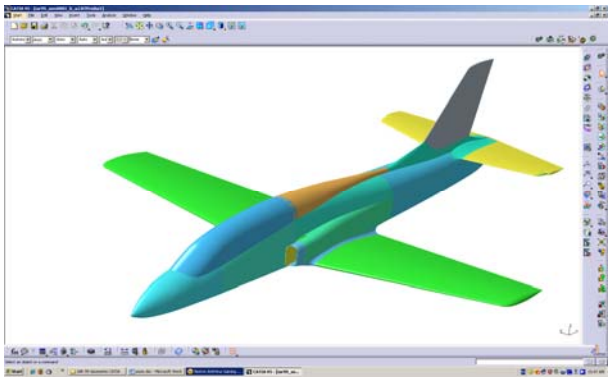

Fig. 4 IAR-99 - CAD

The principal normal stresses and maxinum shear stress and the angle of the principal axis can be determined from the applied stresses (fx, fy and fs) using the equations, [3, 4].

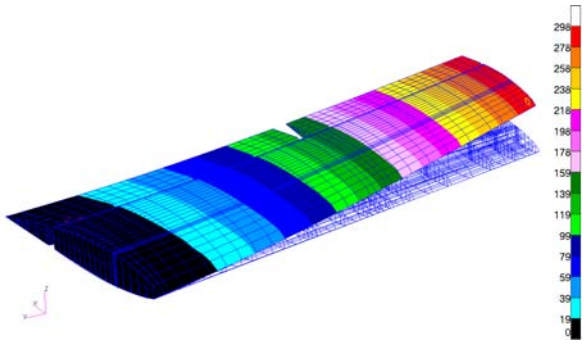

Fig. 5 IAR-99 – Wing FEM

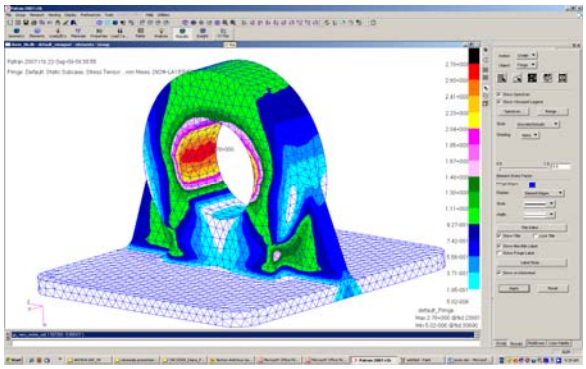

Fig. 6 FEM Results (example)

4. FATIGUE LIFE CALCULATION

Constant and variable amplitude loading may be considered in calculating fatigue life. By using an SN curve, designers can calculate the number of such cycles leading to component failure quickly

This theory also assumes that the damage caused by a stress cycle is independent of where it occurs in the load history, and that the rate of damage accumulation is independent of the stress level.

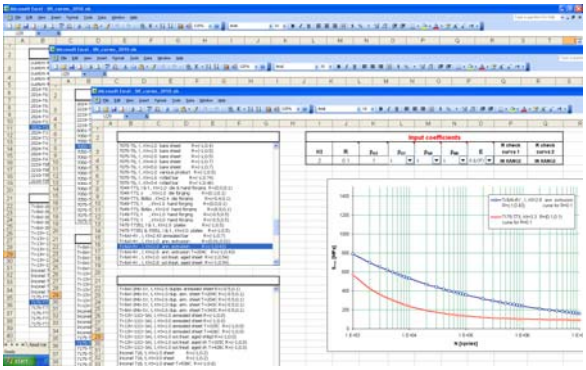

Fig. 6 Spreadsheet determining SN curve

The result, or Damage (D), is expressed as a fraction of the failure. Component failure occurs when D = 1.0, so, if D = 0.85 then 85% of the component's life has been consumed.

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SIMULATION OF THE DYNAMICAL SYSTEM APLLYED ON THE INSTALLATIONS FOR THE DETECTION DEVICES TESTING

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Abstract: *The paper presents the first attempt of the scientific research from N.B.C. defence domain to achieve a simulator. The endorsed objective for simulation is represented by the installations designed to detection devices testing, with using of the real chemical toxic agents.*

The very high dangerous grade, the necessity of a long time an very specific training, the complexity of the testing installations, obtaining of a testing operations perfect reproduction are the serious reasons for which the achieving of this simulator was an ambitious, difficult and stimulating objective.

There are presented the structures of the two types of testing installations, the theoretical principles of the dynamical systems simulation, the modalities to design and effective working of the simulator.

1. INTRODUCTION

In present, the world is confronted, much more like anytime, with the threat of the mass destruction guns. When it appears or when is imminent such attack, the most difficult problems which the decision's personnel confronts are the determination of the incident type and the chemical toxic agents that was used.

On the modern battlefield or in case of disasters, because of the each intervention particular character, it isn't enough time to lead and elaborate a unique detection procedure. The effort must be guided to minimise the identification errors, to realise a parallel detection with different devices type, ensuring – in this way – the obtaining results truthfulness. To obtain more efficient endowment is necessary to realise a best correlation between tactical–technical performances – detection limits, number of the toxic agents that can be identify, the interference limitation, gauge – and logistic and financial reasons – cost price, the consumption materials' number and value, training resources. A very important criterion is the detection capacity, respectively the toxic agents number that can be identify and the minimum level that these agents can be detected.

To realise this goal is imposed to achieve performance and sure testing installation, which allow to obtain checked up chemical toxic agents concentrations, in checked up temperature and humidity conditions. All these conditions must be similar with battlefield real situations. We propose to design and to achieve such installations – relative complex and "universal" buildings – that allow the detection devices testing in very various conditions.

The achieving of the installations for chemical warfare agents testing doesn't start from "zero point". We have taken in consideration: the conceptions and efforts from two–three decades ago, efforts of our institute' researches; the present achievement of the similar institutes from economical development countries and, also, the views from chemical detection and decontamination.

In '70 years, a community from our Centre designed and achieved a *testing installation for military chemical toxic agents*. This installation, very performance in that period of time, allows a good homogenization of the toxic agent – air mixture and a relatively good tight. A great disadvantage consisted in the temperature inside installation can't be adjusted and, especially, can't be constant maintained at the same time, the concentration

of the toxic mixture diminished when the mixture escape from the installation. The airtight of whole edifice wasn't perfect, especially after a long period of using. Another great disadvantage consisted in the impossibility of efficient installation premise decontamination. In spite of these impediments, we must emphasize that the installation has demonstrated its capability for a long period of time, contributed to achieve great numbers of chemical detection and decontamination devices, which were unanimous appreciate and that had entered in Romanian army endowment.

The study of the similar installations existing all over the world was a difficult apply, the majority of these installations type being non-accessible for documentation, by safe a competitive reasons. Nevertheless, from the little accessible data results that the using variant consists in closed and tight circuits, in which are distributed air – toxic agent mixture (constant flow or flow with adjustable possibilities), in controlled proportions and in temperature and humidity strictly known conditions. The mixture realised in this way is leaded to the admission system (specific to each detector type) and introduce inside device, being effectuation the proper testing. We consider that this variant confers a lot of *advantages*: the realisation of a very controlled toxic agent concentration, possibility to adjust the temperature and humidity of the air – toxic agent mixture, creation of a contaminated mini-atmosphere, lead the contaminated mixture flow directly inside testing apparatus, quickly installation decontamination and, also, some *disadvantages*: the contaminated atmosphere is a "synthetic" one – the temperature and/or humidity values being, often, incompatible with the usual conditions, the leading of the contaminated mixture flow directly inside detector involve a "punctual" measuring and not a volume testing (that is happening in real conditions), the cost price is prohibitive, is necessary complex apparatus for the flow, temperature an humidity adjusting and measuring an, also, for intimate mixing of the air with contamination agent. Taking into account these considerations and, also, our previous experience in laboratory and in chemical range testing, was designed an installation that combine the advantages of the world existing installations with our old testing installation.

The conceiving and achieving of the installations for detection and decontamination devices testing (with real warfare toxic agents using) start to the necessity of obtaining **close battle field conditions**, best **results' truthfulness an reproduction**, all this with **strictly respect of the work safety and personal and collective protection**, and, also, to respect technical specifications of the testing apparatus. To realise parameters close battlefield involve a larger mixing space, a perfect air tight, and, also, the possibility to adjust the temperature, humidity and flow in reasonable limits. At the same time, we considered that is necessary to conceive two different installation types: an installation for toxic agents with high volatility and another for non-volatile toxic agents. The both installations have some identical components – the system for air-toxic agent mixture homogenization, the device for temperature and humidity adjusting, the device for toxic compound spraying –, but, also, different elements – external circuit for mixing/spraying, recirculation pump, the contaminated mixture exhausting method, decontamination variant. Another new aspect consists in **increasing of the security level** by mounting of the close circuit video system, that allows permanently visualization of the activities that take place in the installations, the intervention in case of unexpected incident or to ensure supplementary apparatus and materials, and, also, to pursuit all process by interested and authorized personnel who can assist to such tests.

The achieving of conclusive testing imposes – as we previous presented – to conceive and finalise two installations. The both installations are presented like tight premises, parallelepiped shape, with 1 m^3, respective 100 l capacity. The volume and shape was in such way selected to ensure the precise achieving of the toxic agent concentration an to allow the mixture afterwards homogenization.

The principle schemes of these two installations are presented in figure 1.

At the tight premise (*1*) is attached a control panel (*2*). The diaphragm pump (*3*) ensure the contaminated mixture change of place through admission circuit (*4*), respectively through evacuation circuit (*12*) with help of one-sense valves (*5*), flow indicator (*10*) and three ways cocks (*11*). Inside premise is mounted an electrical resistance (*6*) and a fun (*7*). Inside premise and, also, outside premise are positioned two thermo-hygrometers (*8*) and two digital thermometers (*9*).

The toxic agent is introduced inside premise with help of a spraying device (*14*) and the detection apparatus (*16*) is putting into contact with mixture contaminated air through the agency of a connection (*13*). To control the toxic agent concentration on the installation' external circuit is mounted a gas-chromatograph (*15*). After test, the air-toxic agent mixture is conducted to the evacuation recess, through the agency of exhausting circuit (*17*).

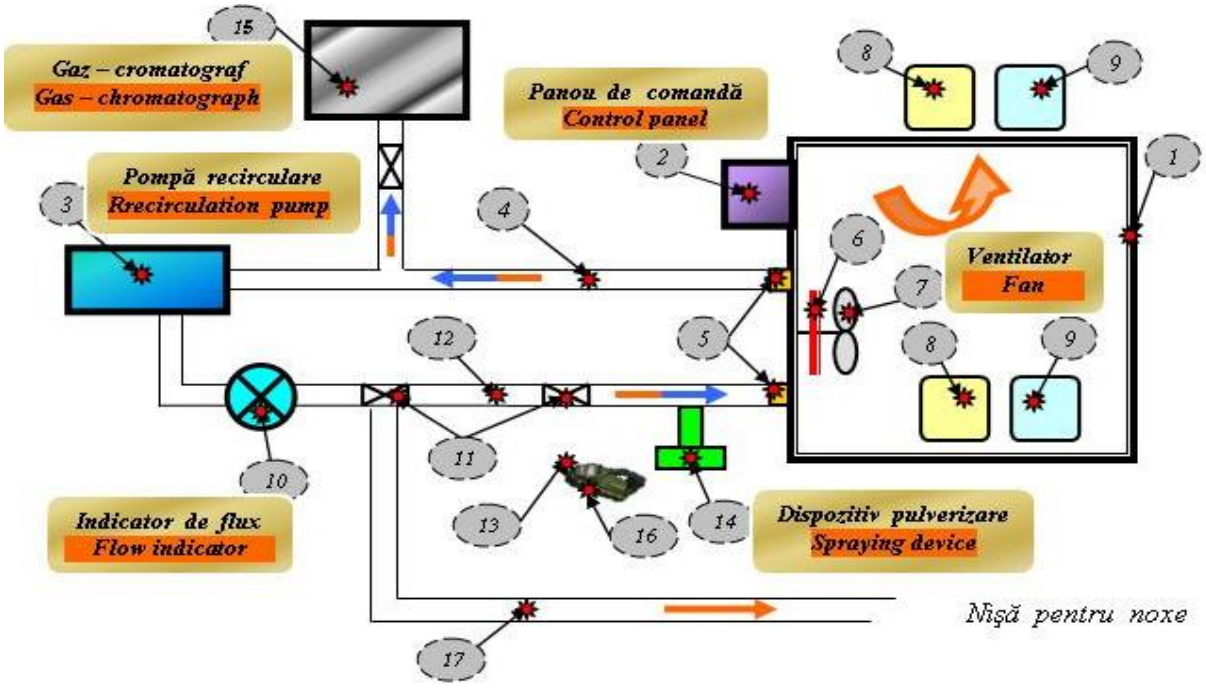

Fig. 1: Installation for volatile toxic compounds testing – principle scheme

2. THE TESTING PROCEDURE MODELLING

The testing installations for the detection devices presented can be used through components like switches, taps, valves and pistons. Each of them has a lot of states that can act over the systems in a specific way. The elements that provide the dynamic of the systems are:

1. the diaphragm pump (3) – P;
2. the 3 taps, by gas chromatography (15) - R1, the recess (17) or the route of recirculation (12) - R2, that the detector (16) or weathertight enclosure (1) - R3;
3. control panel (2) – C;
4. injector (14) – I.

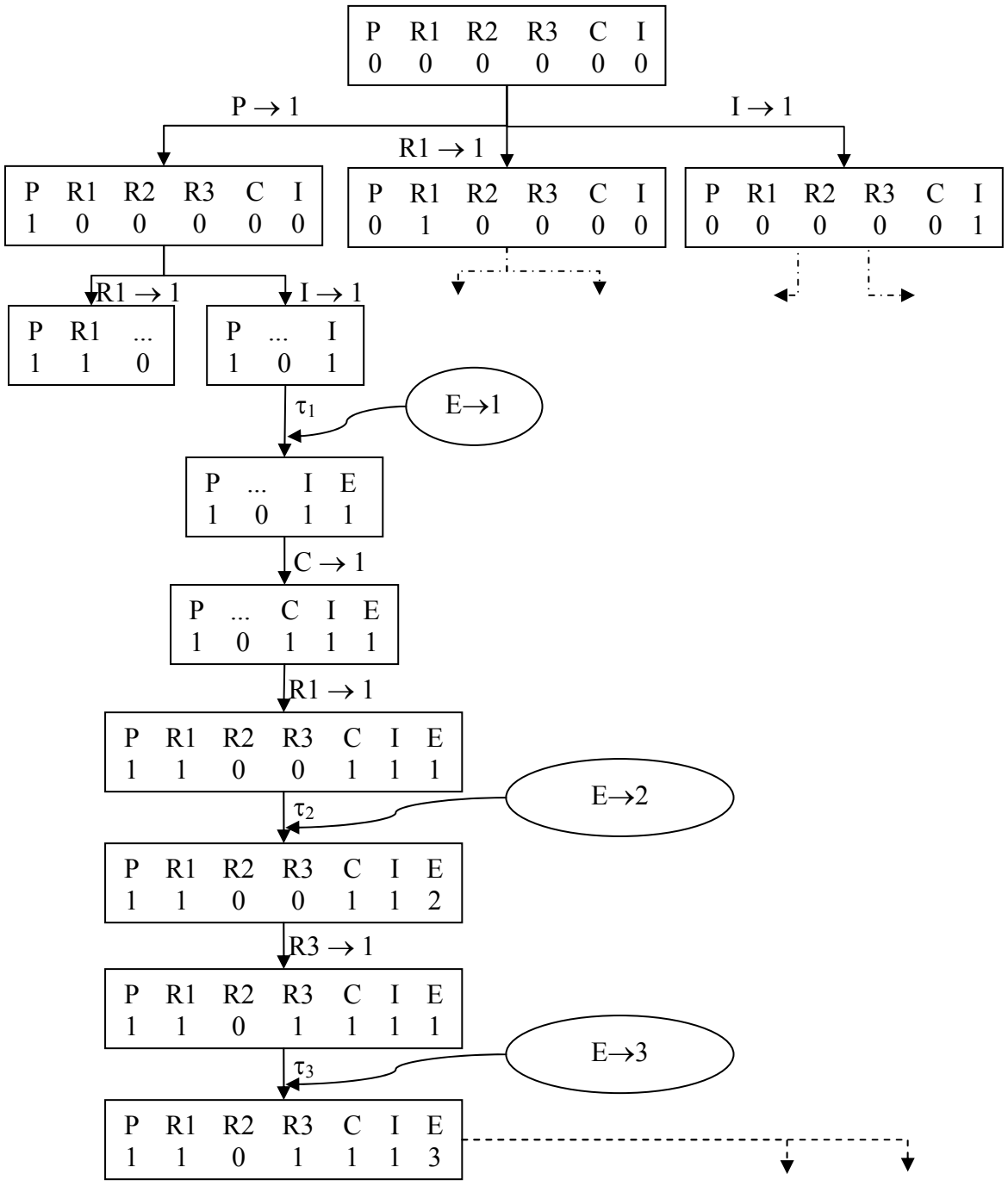

Fig. 2: Sequence from the flow diagram of the system states

Each component has 2 available states (pump - states stopped / started; taps - closed / open by gas chromatograph, closed / open niche for the closed / open to the detector, control panel - off / on and injector - waiting / launched) resulting in 2^6 combined states of the dynamic elements of the system. Depending on the system dynamics is occurring events such as the concentration of the toxic homogenization throughout the recirculation path, eliminating toxic in the laboratory, to eliminate toxic exhaust niche, detection and measurement of toxic concentrations in the gas chromatography or to detect toxic level detector. Possible developments of the system by altering the states action items can be played at a cycle time via a graph of the form below, where:

$P \rightarrow 1 \Leftrightarrow$ start pump; $R1 \rightarrow 1 \Leftrightarrow$ valve opens to allow flow of moving air (contaminated or not) to the gas chromatograph; $I \rightarrow 1 \Leftrightarrow$ toxic agent is injected through the recirculation; $E \rightarrow 1 \Leftrightarrow$ diffusion event is complete / uniform toxic agent

in the system (after τ_1 minutes after injection); E $\rightarrow$ 2 $\Leftrightarrow$ the event of detection and measurement of toxic agent inside the system by gas chromatograph (after τ_2 minutes from opening the valve R1 to gas chromatograph); E $\rightarrow$ 3 $\Leftrightarrow$ the event detection device tested by a toxic agent in the existing facility, whose concentration was checked by gas chromatography (15).

Combinations of events and states listed below (figure 2) are only few of all the possible occur. By representation of the states, the dynamics of each element and events that appear in order to obtain the flow diagram of the system states, which determine the optimal sequence of operations in terms of operator safety and the degree of fairness of the testing procedure.

3. THE TESTING PROCEDURE SIMULATION

The testing procedures of the detection devices, procedures that use real chemical warfare agents, involves a very high risk level for all personnel rallying in proper experiments an, also, for all personnel near testing laboratory proximity. Because of this, it's necessary a very attentive and continue training of all that participate to such activities.

One of the training methods consists in simulator using. This method is very useful especially for the personnel that never works in such dangerous conditions or that has low experience in specific operations.

The advantages of this training system are obvious:

- no direct contact with toxic agent;
- possibility to present the installations components and, also, the working principle;
- emphasize " the dangerous areas" from installations structure;
- possibility to take again activities (in simulate way, evidently) how much is necessary, upon to the serious assimilating, without contaminating threat;
- variant to insist – in training process – to the possible dangers, to the inexact shunting, to the repercussion of the activities that are different those strictly necessary to make correct testing.

Starting with the two installations' structure and with working principle, was realised a soft in Visual Basic programming environment that allows to simulate the main activities that take place in testing process.

The installation components scheme, afferent circuits achieving, the actions temporisation, the graphics, colour and sound emphasize of the working stages was the main objectives of the simulator. To conceive such simulating programme is a very difficult task, being necessary a permanent and crammed plural-disciplinary collaboration between the specialists with high experience in testing activities, respectively in information technology.

Starting with the base functional principles, it was achieved a simulator that allows the whole process presentation, in very intuitive terms.

Thus, each installation parts was accordingly "labelled", the component name can be visualized by simply closing of the computer mouse to the proper frame. In this way, every potential user of the testing installation will can recognise and quickly learn both the equipment name and its logic functional successive in the whole ensemble.

Another "strong point" of the simulator consists in the computer mouse action – that was, beforehand, positioned on the desired equipment – "is released" the specific action of the proper device: the recirculation pump start / stop; the introduction of the toxic agent inside tight premise; the position modification of the two or three ways cocks; the flow indicator operate; the modification of the gaseous mixture circuit; the fan start and stop.

To understand the phenomenon that take place in testing installation during whole procedure and, also, for an easer learning, was choose the variant of the user' visual stimulation, through two different ways. The first modality consists in the colour differentiation between non-contaminated atmosphere (blue) and the atmosphere with toxic agent (orange). The second way consists in the modification of the gas-chromatograph "indication", at the check up of the gaseous mixture contamination („**OK air**", respectively „**OK toxic**").

In the same idea to create the simulator user sensitiveness, at the put in contact

moment of the detection apparatus with contaminated air mixture, appears both „**TOXIC**" indication and a discontinuous sound (likewise with the detection devices' sound alarm).

Another simulator advantage is its large "availability" to the subsequent modifications of the installation structure, that allows the continuous improvement of the training procedure and, especially, of the effective working, in conditions of full safety, accuracy and professionalism.

4. CONCLUSIONS

The approach of ***the simulation in research N.B.C. area*** is ***new at the national level***, the single applicative soft being realised at the *Training Base for N.B.C. Defence* from Câmpulung.

The simulator constitutes a ***"cold" training base***, very efficient and, especially, that doesn't involve any kind of risks for users.

The simulator structure is a ***flexible soft*** that allows its continuous modification and improvement, by ***adapting*** to new working modalities and to different type of testing equipments.

We propose to ***improve*** the simulation soft by introduction of the ***interactive elements***, by "multi-mediatization" – images during real experiments, ideograms that present wrong actions in installation manipulation, movies that allow the user' "intervention" for correct learning of the specific activities or to avoid mistaken actions.

The program represents a first step in switching to automation testing facility for the detection means, including means that can bu used for NBC defence on ground and aerial military vehicles (armours, infantry fighting vehicles, helicopters) in order to secure a higher level as of this activity.

The simulator achievement is a ***reference soft*** to produce similar systems dedicated to the activities with very high - risk level.

DIMENSION OF THE CONTACT PATCH AREA

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Abstract: *The paper presents important observation have been made regarding contact area dimensions, static and dynamic vertical stiffness and characteristics at different speeds of rolling, static longitudinal stiffness of the standing tire, tire radius growth with speed, hydroplaning, rolling resistance, effective rolling radius and rolling resistance couple.*

Keywords: *tire, tire - ground interaction, contact patch, film of fluid*

1. INTRODUCTION

In this paper I depicted how to determine print of contact patch and how is influenced interaction tire ground when on the road is a film of fluid.

2. CONTACT PATCH

Aside from aerodynamic and gravitational forces, all other major forces and moments affecting the motion of a ground vehicle are applied through the running gear-ground contact. An understanding of the basic characteristics of the interaction between the running gear and the ground is, therefore, essential to the study of performance characteristics, ride quality, and handling behavior of ground vehicles.

The running gear of a ground vehicle is generally required to fulfill the following functions:

*to support the weight of the vehicle;

*to cushion the vehicle over surface irregularities;

*to provide sufficient traction for driving and braking;

*to provide adequate steering control and direction stability.

Pneumatic tires can perform these function effectively and efficiently; thus, they are universally used in road vehicles, and are also widely used in off-road vehicles. The study of the mechanics of pneumatic tires therefore is of fundamental importance to the understanding of the performance and characteristics of ground vehicles. Two basic types of problem in the mechanics of tires on hard surfaces, which is essential to the study of the characteristics of road vehicles. The other is the mechanics of tires on deformabile surfaces (unprepared terrain), which is of prime importance to the study of off-road vehicle performance.

Prints of the contact patch may be obtained by using ink or carbon paper [2]. The shape appears to change from an oval shape at very low normal loads to a more rectangular shape, at higher values of the load. An effective rectangular contact area may be defined with an area equal to that of the envelope of the actual print. The ratio of the width and length of the rectangle is taken equal to that of the actual contact area. The effective half length and half width are denoted as a and b. The dimensions depend on the normal load F_N and the following formula have been found to give a good approximation. [1,3]

$$a = (q_{a1}\sqrt{F_{N0}}/F_{N0} + q_{a2}\,F_N/F_{N0})r_0$$

eguation 1

$$b = (q_{b1}\sqrt[3]{F_N}/F_{N0} + q_{b2}\,F_N/F_{N0})r_0$$

equation 2

r_0- denoting the free tire radius
F_N- denoting normal load
a-denoting half length

b-denoting half width

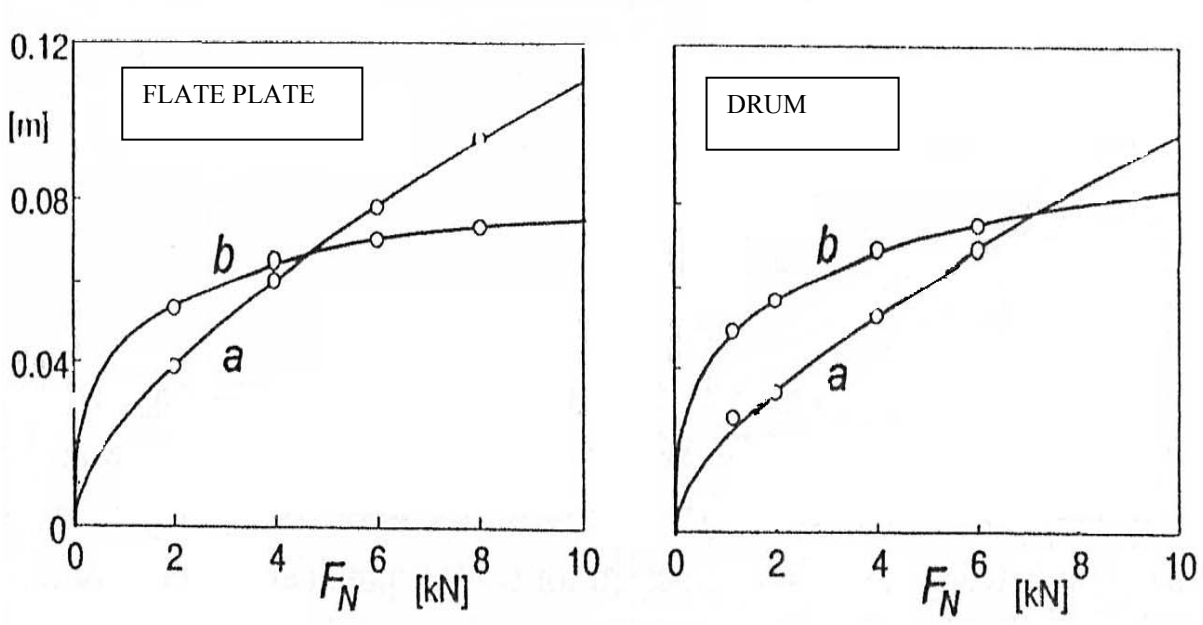

Fig. 1 Measured half length a and half width b of the contact patch vs wheel load [1,3]

3. PERFORMANCE *OF TIRES ON WET SURFACES*

The behavior of tires on wet surfaces is of considerable interest from a vehicle safety point of view, as many accidents occur on slippery roads. The performance of tires on wet surfaces depends on the surface texture, water depth, tread pattern, tread material, and operating mode of the tire (i.e. free rolling, braking, accelerating, or cornering). To achieve acceptable performance on wet surfaces, maintaining effective contact between the tire tread and the road is of importance, and there is no doubt about the necessity of removing water from the contact area as much as possible.

To maintain effective contact between the tire and road, the tire tread should have a suitable pattern to facilitate the flow of fluid from the contact area, and the surface of the pavement should have an appropriate texture to facilitate draining as well [2,4]. To provide good skid resistance, road surfaces must fulfill two requirements: an open macrotextures to facilitate gross draining, and microharshness to produce sharp points that can penetrate the remaining water film [4].

When a pneumatic tire is braked over a flooded surface, the motion of the tire creates hydrodynamic pressure in the fluid. The hydrodynamic pressure acting on the tire builds up as the square of speed of the tire, and tends to separate the tire from the ground. At low speeds, the front part of the tire rides on wedge or a film of fluid. This fluid film extends backward into the contact area as the speed of the tire increases. At a particular speed the hydrodynamic lift developed under the tire equals the vertical load, the tire rides completely on the fluid and all contact with the ground is lost. This phenomena is usually referred to as “hydroplaning” and is shown in fig. 2. [6]

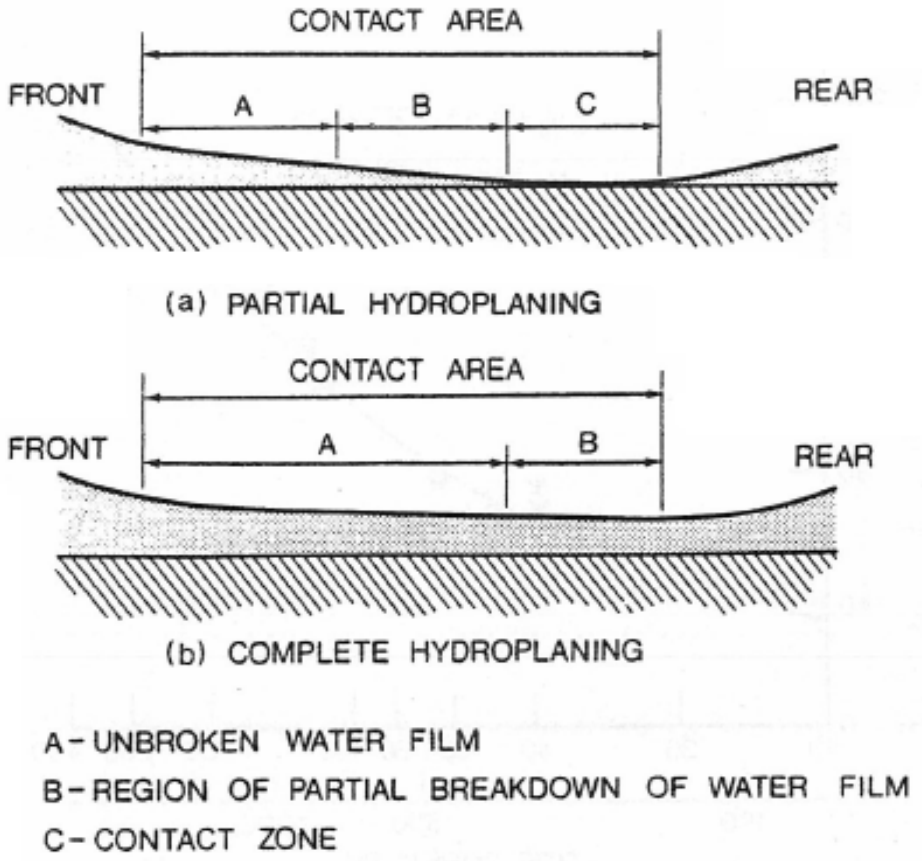

Fig. 2 Hydroplaning of a tire on flooded surfaces [5,6]

For smooth or close-patterned tires that do not provide escape paths for water and for patterned tires on flooded surfaces with a fluid depth exceeding the groove depth in the tread, the speed at which hydroplaning occurs may be determined based on the theory of hydrodynamic force F_h is proportional to the tire-ground contact area A, fluid density ρ_f, and the square of the vehicle speed [3, 4, 6].

$$F_h = \rho_f A V^2$$

When hydroplaning occurs, the lift component of the hydrodynamic force is equal to the vertical load acting on the tire. The speed at which hydroplaning begins, therefore, is proportional to the square root of the nominal ground contact pressure W/A, which is proportional to the inflation pressure of the tire p_i. Based on this reasoning and on experimental data shown in fig. 3, the following formula is proposed by Horne and Joyner for predicting the hydroplaning speed V_p:

$$V_p = 6{,}34\sqrt{p_i}\ \text{km/h}$$

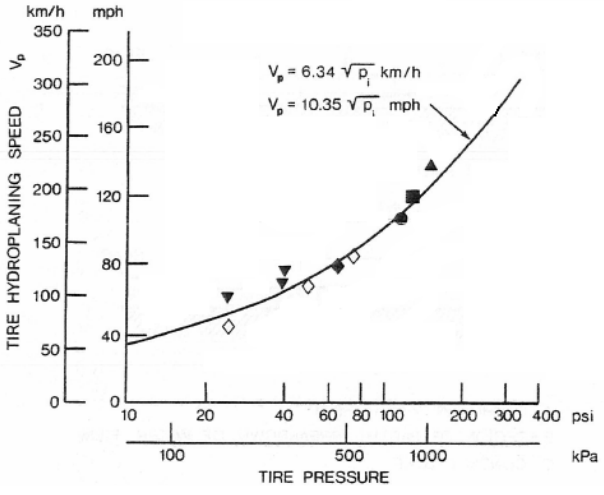

Fig. 3 Variation of hydroplaning speed with inflation pressure of tire [4,6]

Hidroplaning may not be possible for heavy truck tires under normal circumstances [5]. However, the tractive

performance of truck tires is still significantly influenced by the presence of fluid on wet pavements.

For patterned tires on wet surfaces where the fluid depth is less than the groove depth of the tread, the prediction of the hydroplaning speed is more complex, and a generally accepted theory has yet to be evolved. The parameters found to be of significance to hydroplaning are pavement surface texture, pavement fluid depth, fluid viscosity, fluid density, tire inflation pressure, tire normal load, tire tread pattern and tire tread depth.

The most important effect of hydroplaning is the reduction in the coefficient of road adhesion between the tire and the ground. This affects braking, steering control and directional stability.

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VARIATION OF ROLLING RESISTANCE WITH LOAD AND INFLATION PRESSURE

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Abstract: *The paper presents variation of rolling resistance with load and inflation pressures and steady-state dynamic tire-pavement interaction and some experimental results regarding this phenomenon.*

Keywords: *tire, tire - ground interaction, road load*

1. INTRODUCTION

The paper present the rolling resistance in different conditions of pressure, construction tire, temperature, speed or influence different kind of road above rolling resistance.

2. ROLLING RESISTANCE IN DIFFERENT CONDITION

The rolling resistance of tires on hard surfaces primarily caused by the hysteresis in the materials due to the deflection of the carcass while rolling. Friction between the tire and the road caused by sliding, the resistance do to air circulating inside the tire, and the fan effect of the rotating tire on the surrounding air also contribute to the rolling resistance of the tire but they are of secondary importance.

When a tire is rolling, the carcass is deflected in the area of ground contact. As a result of tire distortion, the normal pressure in the leading half of the contact patch is higher than that in the trailing half. The center of normal pressure is shifted in the direction of rolling. This shift produces a moment about the axis of rotation of the tire, which is the rolling resistance moment. In a free rolling tire, the applied wheel torque is zero, therefore, a horizontal force at the tire-ground contact patch must exist to maintain equilibrium. [3,5]

A number of factors affects the rolling resistance of a pneumatic tire. They include the structure of tire and its operating conditions (surface condition, inflation pressures, speed, temperature, etc) [7]

Tire construction has a significant influence on its rolling resistance. Fig. 1 shows the rolling resistance coefficient at various speed of a range of bias-ply and radial ply passenger car tires at rated loads and inflation pressures on a smooth road [6]. Thicker treads and sidewalls and a increase number of carcass plies tend to increase the rolling resistance because of a greater hysteresis losses.

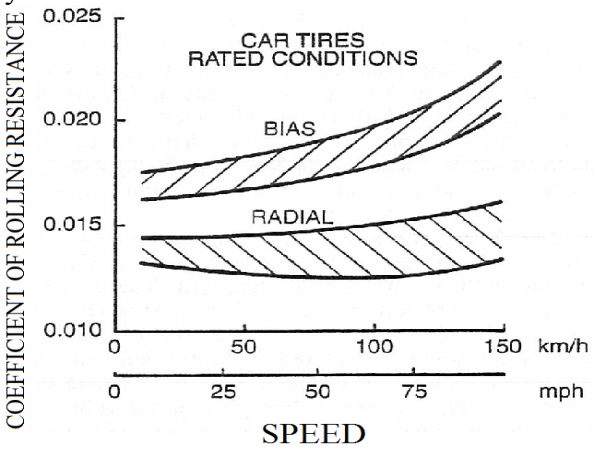

Fig. 1 Variation of rolling resistance coefficient of radial-ply and bias-ply car tires with speed on a smooth, flat road surface under rated load and inflation pressure.

Surface conditions also affect the rolling resistance. On hard, smooth surfaces, the rolling resistance is considerably lower then that on a rough road. On wet surfaces, a higher rolling resistance than on a dry surfaces is usually observed. Fig. 2 shows a comparison of the rolling resistance of passenger car tires over six road surfaces with different textures,

ranging from polished concrete to coarse asphalt [2]

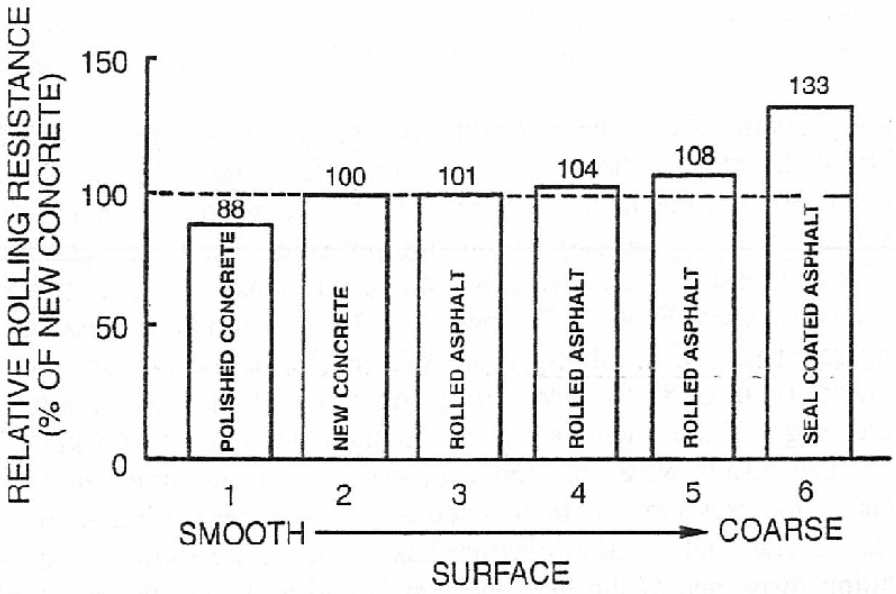

Fig. 2 Variation of tire rolling resistance with pavement surface texture

The profiles of these six surfaces are shown in fig. 3 [4,8]. It can be seen that on the asphalt surface with coarse seal coat the rolling resistance is 33% higher than **that** on a new concrete surface, while on the polished concrete it shows a 12% reduction in comparison with that on the new concrete surface.

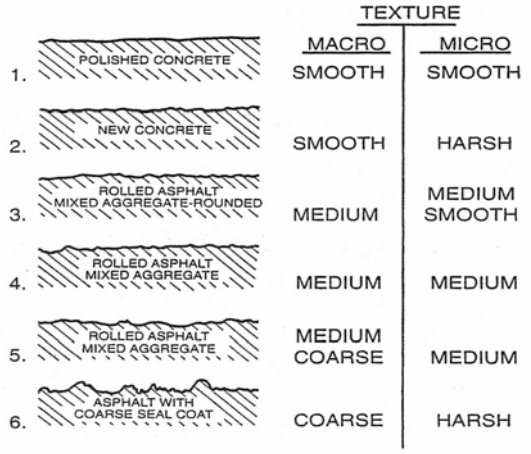

Fig. 3 Textures of various types of pavement surface

Inflation pressure affects the flexibility of the tire. Depending on the deformability of the ground, the inflation pressure affects the rolling resistance of the tire in different manners. On hard surfaces, the rolling resistance generally decreases with the increase in inflation pressure. This is because with higher inflation pressure, the deflection of the tire decreases with consequent lower hysteresis loses [7].

On deformable surfaces, such as sand, high inflation pressure results in increased ground penetration work, and therefore higher rolling resistance, as shown down (fig. 4) [1, 4].

Conversely, lower inflation pressure, while decreasing ground penetration, increases the deflection on the tire and hence internal hysteresis losses. Therefore, an optimum inflation pressure exists for a particular tire on a given deformable surface, wich minimize the sum of ground penetration work and internal loses of the tire

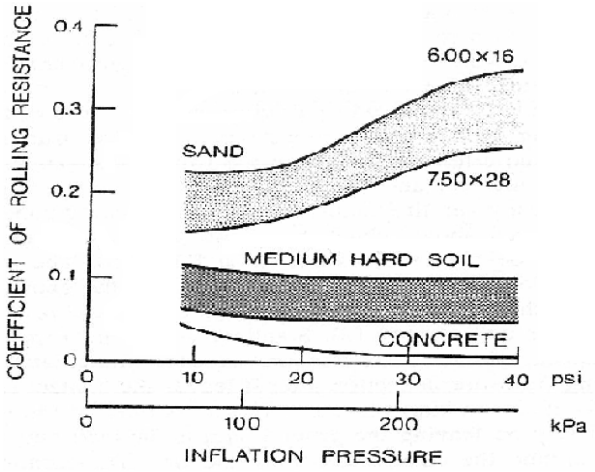

Fig. 4 Variation of rolling resistance coefficient with inflation pressure of tires on various surfaces

Rolling resistance is also affected by driving speed because of the increase of work in deforming the tire and of vibration in the tire structure with the increase in speed. For a given tire under a particular operating condition, there exists a threshold speed above which the phenomenon popularly known as standing waves will be observed, as shown in fig. 5 [2,6]. The approximate value of the threshold speed V_{th} may be determined by the expression

$$V_{th}=\sqrt{F_t / \rho_t}$$

F_t –is the circumferential tension in the tire

ρ_t –is the density of tread material per unit area.

Standing waves are formed because, owing to high speed, the tire tread does not recover immediately from distortion originating from the deflection after it leaves the contact surface, and the residual deformation initiates a wave. The amplitude of the wave is the greatest immediately on leaving the ground, and is damped out in an exponential manner around the circumference of the tire. The formation of the standing wave greatly increases energy losses, which in turn cause considerable heat generation that could lead to tire failure. This places an upper limit on the safe operating speed of tires.

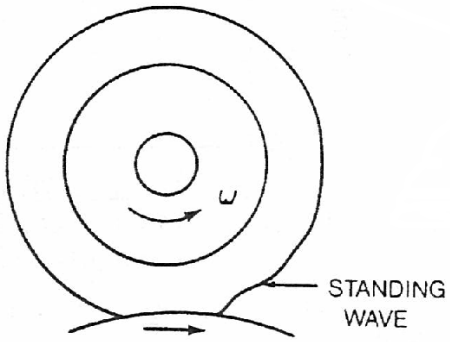

Fig. 5 Formation of standing waves of a tire at high speeds

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CONSIDERATIONS ON THE MATHEMATICAL AND NUMERICAL MODELING OF THE LONGITUDINAL VORTICES

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Abstract: *The wake of the aircraft is composed of several vortices, of which some can persist several minutes in the atmosphere. They can constitute a danger to a penetrating plane in this wake, in particular during the phases of takeoff and landing. This study has like object the validation of the methods and the software used for modelling and simulation of the longitudinal vortices.*

Key-Words*: vortices, wake, turbulence, aircraft*

1. INTRODUCTION

The vortex mechanisms intervene in a large number of flows and in various forms. In the aeronautical mediums, the vortices can be met on very different scales. Any object moving in the air leaves behind him a more or less organized wake. In the case of a plane, this wake results in a rolling up of the flow starting from the ends of wings. This rolling up structure the wake of the plane in two principal contrarotating vortices. It is due to the lift of each wing and the generated vortices will be all the more intense as this lift will be large. As the lift is directly proportional to the mass of the plane, the intensity of the vortices of wake is related to this quantity.

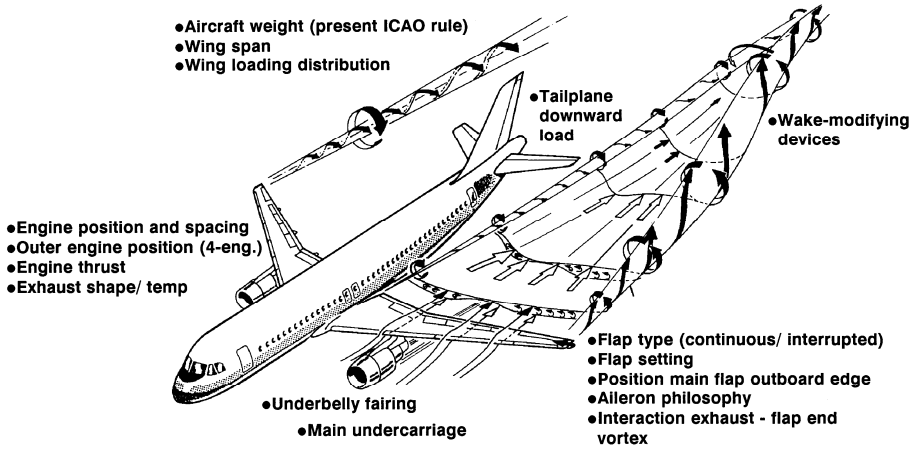

Fig.1. The wake of the planes

2. THE IDEAL MODEL OF A LONGITUDINAL VORTEX

To model *a solitary vortex* we use the model of Oseen having the main parameters, circulation Γ_0 and the ray r_0 which corresponds at a maximum speed of rotation.

The flow of only one isolated vortex admits a symmetry of revolution. One places oneself then in cylindrical coordinates. The equations which govern this problem are the Navier-Stokes equations. They are written here in the cylindrical reference mark for an incompressible Newtonian fluid:

$$\frac{\partial u_x}{\partial x}+\frac{1}{r}\frac{\partial}{\partial r}\left(ru_r\right)+\frac{1}{r}\frac{\partial u_\theta}{\partial \theta}=0 \ ; \tag{1}$$

$$\frac{\partial u_x}{\partial t}+u_x\frac{\partial u_x}{\partial x}+u_r\frac{\partial u_x}{\partial r}+\frac{u_\theta}{r}\frac{\partial u_x}{\partial \theta}= \\ =-\frac{1}{\rho}\frac{\partial p}{\partial x}+\nu(\Delta u_x) \quad ; \tag{2}$$

$$\frac{\partial u_r}{\partial t}+u_x\frac{\partial u_r}{\partial x}+u_r\frac{\partial u_r}{\partial r}+\frac{u_\theta}{r}\frac{\partial u_r}{\partial \theta}-\frac{u_\theta^2}{r}= \\ =-\frac{1}{\rho}\frac{\partial p}{\partial r}+\nu\left(\Delta u_r-\frac{u_r}{r^2}-\frac{2}{r^2}\frac{\partial u_\theta}{\partial \theta}\right) \quad ; \tag{3}$$

$$\frac{\partial u_\theta}{\partial t}+u_x\frac{\partial u_\theta}{\partial x}+u_r\frac{\partial u_\theta}{\partial r}+\frac{u_\theta}{r}\frac{\partial u_\theta}{\partial \theta}+\frac{u_r u_\theta}{r}= \\ =-\frac{1}{\rho r}\frac{\partial p}{\partial \theta}+\nu\left(\Delta u_\theta-\frac{u_\theta}{r^2}+\frac{2}{r^2}\frac{\partial u_r}{\partial \theta}\right) \quad , \tag{4}$$

where $\Delta=\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial r^2}+\frac{1}{r}\frac{\partial}{\partial r}+\frac{1}{r^2}\frac{\partial^2}{\partial \theta^2}$.

An axisymmetric two-dimensional vortex is considered so that all the unknown factors are independent of the variable $\theta\ (\partial/\partial\theta=0)$. We seek a non stationary solution of the following form:

$u_x=0\ ;\ u_r=0\ ;\ u_\theta=u_\theta(t,r)\ ;$

$p=p(t,r).$ (5)

We can simplify the equations (1) - (4), which become:

- *The equation of continuity* is checked:

$$\frac{\partial u_x}{\partial x}+\frac{1}{r}\frac{\partial}{\partial r}(ru_r)=0 \quad ; \tag{6}$$

- *The equation of momentum following the radial axis*, which makes it possible to connect the evolution of the pressure *p* at the speed u_θ by the relation:

$$\frac{\partial p}{\partial r}=\rho\frac{u_\theta^2}{r} \quad ; \tag{7}$$

- *The equation of momentum following the tangential axis* becomes:

$$\frac{\partial u_\theta}{\partial t}=-\frac{\nu}{r^2}\frac{\partial}{\partial r}(ru_\theta)+\frac{\nu}{r}\frac{\partial^2 u}{\partial r^2}(ru_\theta). \tag{8}$$

By using the notation $\varphi=ru_\theta$, the equation (8) can be met in the following form:

$$\frac{\partial \varphi}{\partial t}=-\frac{\nu}{r}\frac{\partial \varphi}{\partial r}+\nu\frac{\partial^2 \varphi}{\partial r^2}. \tag{9}$$

Then we make the change of variable $m=\frac{r}{\sqrt{4\nu t+r_0^2}}$. We can write:

$$\frac{\partial m}{\partial r}=\frac{1}{\sqrt{4\nu t+r_0^2}}\ ;\ \frac{\partial m}{\partial t}=-\frac{2\nu m}{4\nu t+r_0^2}\ ;$$

$$\frac{\partial \varphi}{\partial t}=-\frac{2\nu m}{4\nu t+r_0^2}\frac{\partial \varphi}{\partial m}\ ;$$

$$\frac{\partial \varphi}{\partial r}=\frac{1}{\sqrt{4\nu t+r_0^2}}\frac{\partial \varphi}{\partial m}\ ;\ \frac{\partial^2 \varphi}{\partial r^2}=\frac{1}{\nu t+r_0^2}\frac{\partial^2 \varphi}{\partial m^2}.$$

The equation (9) becomes:

$$\frac{\partial^2 \varphi}{\partial m^2}+\left(2m-\frac{1}{m}\right)\frac{\partial \varphi}{\partial m}=0. \tag{10}$$

$\Rightarrow$ While noting $\psi=\frac{\partial \varphi}{\partial m}\Rightarrow\frac{\partial \psi}{\partial m}+\left(2m-\frac{1}{m}\right)\psi=0$, therefore:

$$\ln\psi=\ln\left(\frac{\partial \varphi}{\partial m}\right)=\ln m-m^2+\ln C_1\Rightarrow$$

$$\frac{\partial \varphi}{\partial m}=C_1 m e^{-m^2}\Rightarrow$$

$$\varphi(m)=ru_\theta=C_2-\frac{C_1}{2}e^{-m^2}\Rightarrow$$

$$u_\theta(r,t)=\frac{C_2}{r}-\frac{C_1}{2r}e^{-\frac{r^2}{4\nu t+r_0^2}}. \tag{11}$$

By imposing the boundary conditions following: $\varphi(0)=0$ and $\varphi(\infty)=\frac{\Gamma}{2\pi}$, we obtain $C_2=\frac{C_1}{2}=\frac{\Gamma}{2\pi}$, and then we obtain:

$$u_\theta(r,t)=\frac{\Gamma}{2\pi r}\left(1-e^{-r^2/\left(4\nu t+r_0^2\right)}\right). \tag{12}$$

Thereafter we note the ray of vortex at the moment t, with $r_0(t)$:

$$r_0(t)=\sqrt{4\nu t+r_0^2}\ . \qquad (13)$$

In the same way, we note viscous time with t_ν:

$$t_\nu=\frac{r_0^2}{4\nu}. \qquad (14)$$

By using viscous time as parameter of reference, thereafter we work with reduced time:

$$T=\frac{t}{t_\nu}. \qquad (15)$$

With this notation, we can obtain a relation for the ray of the vortex:

$$\frac{r_0^2(t)}{r_0^2(0)}=1+T\ . \qquad (16)$$

The tangential speed of a vortex will have the expression:

$$u_\theta(r,T)=\frac{\Gamma}{2\pi r}\left(1-e^{-\frac{r^2}{r_0^2}\frac{1}{1+T}}\right). \qquad (17)$$

Tangential maximum speed corresponds to the ray $r=r_0(T)$

$$u_{\theta\max}(T)=\frac{\Gamma}{2\pi r_0}\left(1-e^{-1}\right)\frac{1}{\sqrt{1+T}}\Rightarrow$$

$$\frac{u_{\theta\max}(T)}{u_{\theta\max}(0)}=\frac{1}{\sqrt{1+T}}. \qquad (18)$$

The vorticity for a vortex will have the expression according to:

$$\omega_x(r,T)=\frac{1}{r}\frac{\partial\left[ru_\theta(r,T)\right]}{\partial r}\Rightarrow$$

$$\omega_x(r,T)=\frac{\Gamma}{\pi r_0^2(1+T)}e^{-\frac{r^2}{r_0^2}\frac{1}{1+T}}. \qquad (19)$$

The maximum vorticity corresponds to the ray $r=r_0(T)$

$$\omega_{x\max}(T)=\frac{\Gamma e^{-1}}{\pi r_0^2}\frac{1}{1+T}\Rightarrow\frac{\omega_{x\max}(T)}{\omega_{x\max}(0)}=\frac{1}{1+T}. \qquad (20)$$

The enstrophy for only one vortex can be calculated with the expression:

$$Z(T)=\int_0^\infty\omega_x^2(r,T)2\pi r dr=\frac{\Gamma^2}{2\pi r_0^2(1+T)}. \qquad (21)$$

Kinetic energy can be calculated by using the enstrophy, with the expression:

$$\frac{dE_c}{dt}=-\mu Z(t). \qquad (22)$$

With this relation, we obtain:

$$\frac{dE_c}{dT}=-\frac{\rho}{8\pi}\frac{\Gamma^2}{(1+T)}\Rightarrow$$

$$E_c(T)=E_c(0)-\frac{\rho\Gamma^2}{8\pi}\ln(1+T). \qquad (23)$$

The Reynolds number who characterizes the studied flow it is based on circulation of the vortex:

$$Re_\Gamma=\frac{\Gamma_0}{\nu}. \qquad (24)$$

The total viscosity of a numerical simulation this composes of a physical viscosity and a numerical viscosity:

$$\mu_{tot}=\mu_{phys}+\mu_{num}. \qquad (25)$$

By using the relation (22) between the variation of energy and the enstrophy, we can obtain total viscosity, and thus numerical viscosity.

3. THEORETICAL AND NUMERICAL RESULTS FOR THE EVOLUTION OF A LONGITUDINAL VORTEX

To initialize simulations we use the model of Oseen having the main parameters circulation Γ_0 and the ray r_0. The position of the center of the vortex is given by the coordinates (y_c,z_c) in the transverse plan Oyz. By using a cylindrical reference mark (x,r,θ) whose origin is the center of the vortex the tangential velocity $u_\theta(r)$ and the vorticity $\omega_x(r)$ of the vortex are given by:

$$u_\theta(r)=\frac{\Gamma_0}{2\pi r}\left(1-e^{-r^2/r_0^2}\right);$$

$$\omega_x(r)=\frac{\Gamma_0}{\pi r_0^2}e^{-r^2/r_0^2}. \qquad (26)$$

We study the case corresponding to an initial circulation $\Gamma_0=1$ and a ray

$r_0 = 0.2$, therefore the parameters of reference will be:

$$U_{ref} = u_{\theta\max} = \frac{\Gamma_0}{2\pi r_0} = 0.79577 \ ;$$

$$L_{ref} = r_0 = 0.2 \ . \qquad (27)$$

The vortex thus defined will be used as initial condition for simulation. The field of calculation, with a regular grid, is defined using the dimensions:

$Lx = 7.5$ with nx=95 points $r_0/dx = 2.54$;

$Ly = 6$ with ny =95 points $r_0/dy = 3.17$;

$Lz = 5$ with nz =64 points $r_0/dz = 2.56$.

The vortex has the center in the field of calculation with $y_c = 3$ and $z_c = 2.5$ (even fig. 2).

The boundary conditions used for simulations, having the goal the validation of the computer code, are:

- periodicity along the axis x (parallel with the axis longitudinal of the vortex);
- periodicity along the axis z (perpendicular to the axis longitudinal of the swirl);
- symmetry along the axis y (axis side).

Figures 3 and 4 watch distributions of the components speed. *Transverse speed* v has a symmetry compared to the axis Z and a anti-symmetry compared to the axis Y. *Azimuth speed* w has a symmetry compared to the axis Y and a anti-symmetry compared to the axis Z.

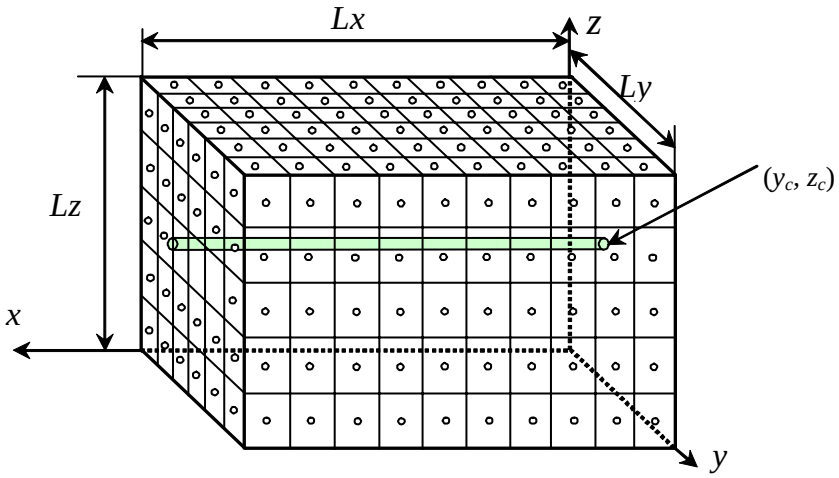

Fig.2. The field of calculation

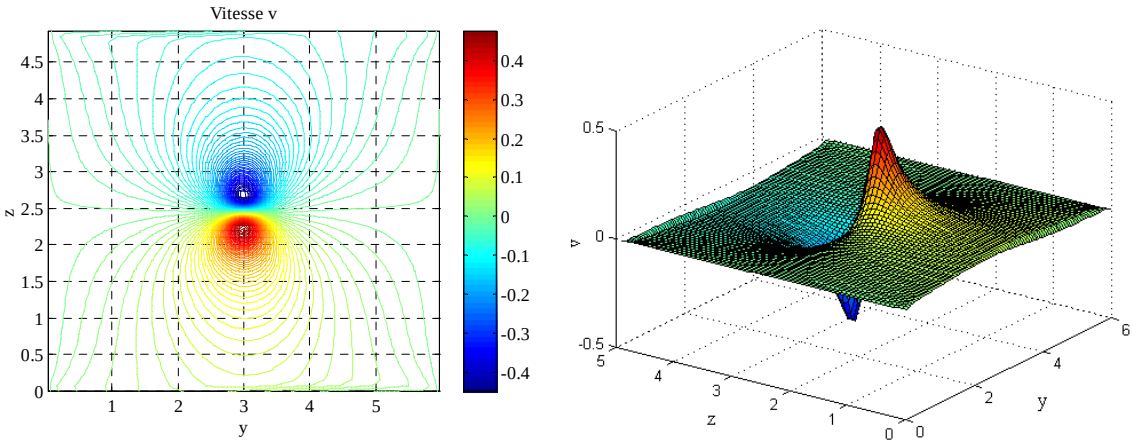

Fig.3. The transverse component the speed of a solitary longitudinal vortex

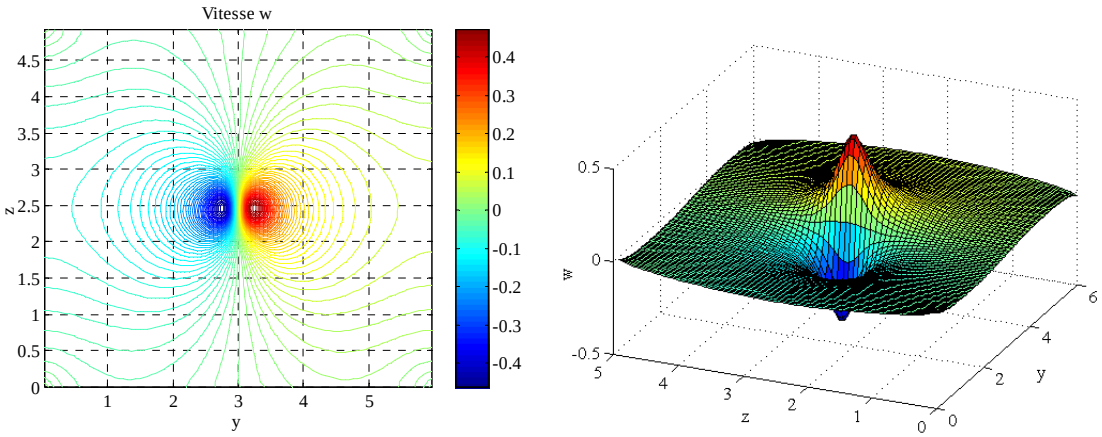

Fig.4. The azimuth component the speed of a solitary longitudinal vortex

The density of the fluid (air) is considered constant, ρ =1.29 kg/m3. We make three direct numerical simulations for an isolated longitudinal vortex (see table 1 with the parameters of simulation used).

Table 1. Parameters of simulations

Re	ν [m2/s]	μ· [kg (ms)]
1000	0.0010	0.001290
5000	0.0002	0.000258
10000	0.0001	0.000129

Figures 5 and 6 presents the evolutions temporal of energy, the enstrophy, maximum tangential speed, and maximum vorticity in times obtained by using a direct numerical simulation with a Reynolds number of 1000.5000 and 10000, by comparison with the results theoretical.

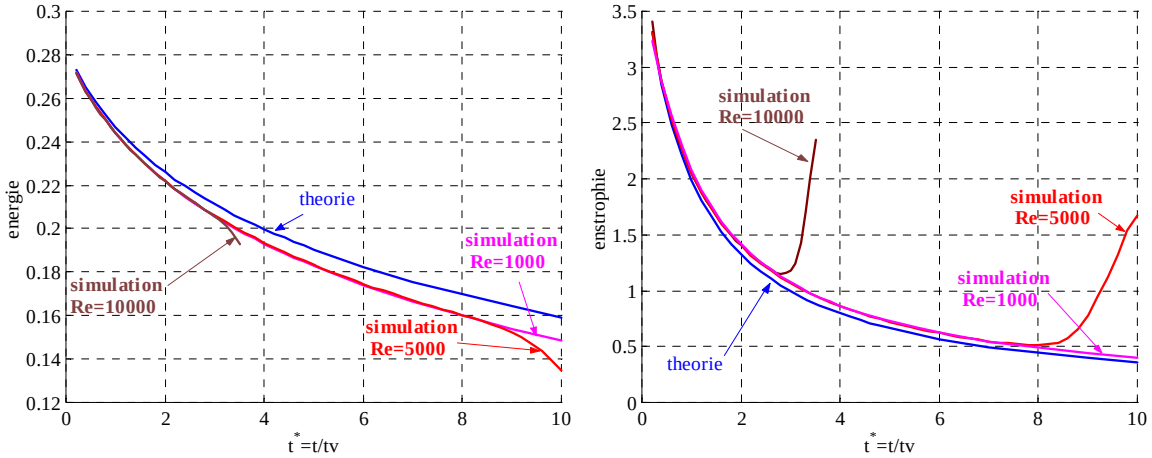

Fig.5. Temporal evolution of energy and the enstrophy

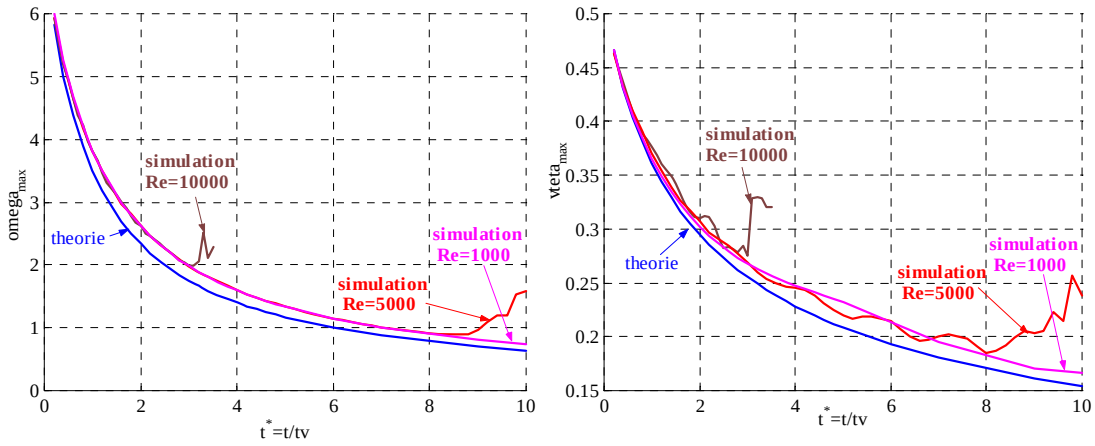

Fig.6. Temporal evolution of the vorticity and maximum speed

It is observed that the important evolutions of the parameters follow the theoretical results rather well in Re=1000, but in Re=5000 only for $t^*<8.5$, and Re=10000 for $t^*<2.7$. Table 2 shows the maximum relative errors between the theoretical results and the results obtained by simulations for different Reynolds number, calculated until a certain characteristic time ($t^*=3$, $t^*=3.5$ and $t^*=10$).

Therefore, for each simulation, the specific parameters for the evolution of a longitudinal swirl, remain near as of theoretical values (see counts it 2 for $t^*=3$). But, for high the Reynolds number there exists a certain critical time from which evolution of the flow parameters studied cease to follow the theory (for Re=5000 there is $t^*=8.5$ and for Re=10000 there is $t^*=2.7$).

Table 2. Values of the errors

Size	$t^*=3$		
	Re=1000	Re=5000	Re=10000
energy	1.41%	1.49%	1.65%
enstrophie	2.18%	2.28%	5.49%
maximum tangential speed	2.66%	3.98%	6.07%
maximum vorticity	5.26%	5.49%	5.78%
	$t^*=10$		$t^*=3.5$
	Re=1000	Re=5000	Re=10000
energy	3.76%	8.65%	4.04%
enstrophie	2.87%	39.64%	44.36%
maximum tangential speed	4.98%	22.32%	18.23%
maximum vorticity	5.58%	16.17%	15.11%

Table 3 present for three Reynolds numbers used, viscous time, E Reynolds number effective of calculation (Reeff), as well as numerical viscosity obtained by the average of the results obtained.

Table 3. Parameters of simulations

Rephys	Reeff	μ_{phys}	μ_{num}	μ_{early}	${}_{\nu}T$
		·[kg (ms)]			[S]
1000	990	0.001290	0.000013 (1.01%)	0.001303	10
5000	4777	0.000258	0.000012 (4.65%)	0.000270	50
10000	9148	0.000129	0.000012 (9.30%)	0.000141	100

It is observed that the numerical viscosity of the computer code is low by report has physical viscosity, but, as soon as one increases the Reynolds number (physical viscosity is decreased), this size is more important.

Table 4. Values of the errors

Size	Re=10000	
		DNS
energy	16.18%	1.65%
enstrophie	56.01%	5.49%
maximum tangential speed	8.21%	6.07%
maximum vorticity	34.50%	5.78%

Table 5 presents numerical and physical viscosity obtained by using two different methods of study, the simulation of the large scales (THEM) and the direct digital simulation (DNS).

Table 5. Physical and numerical viscosity

Rephys	Reeff	μ_{phys}	μ_{num}	μ_{early}	$_{\nu}T$
		·[kg (ms)]			[S]
DNS	9148	0.000129	0.000012 (9.30%)	0.000141	100
	6482		0.000070 (54.26%)	0.000199	

Figure 7 shows the evolutions temporal of the enstrophie and energy for the two methods THEM and DNS. The point where the variation of the enstophie begins one increasing period coresponde with the formation of small the swirling filaments, by marking the transition towards the swirling mode (see figure 8).

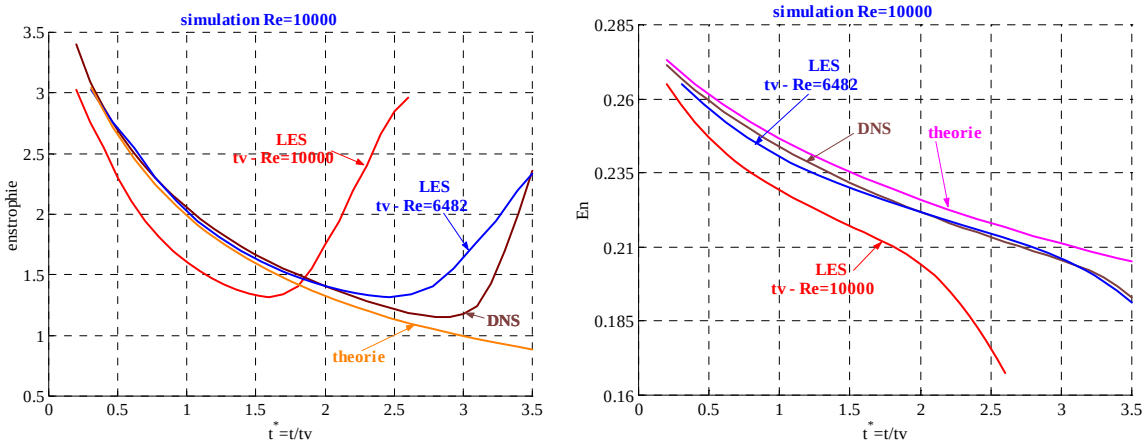

Fig.7. Temporal evolution of energy and the enstrophie

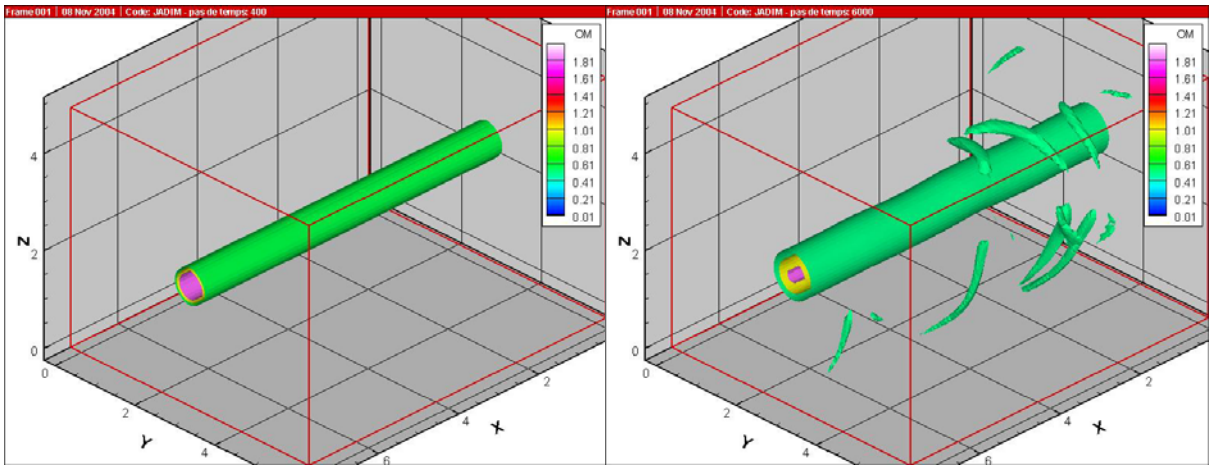

Fig.8. The total vorticity for Re=1000 with t*=4 and Re=10000 with t*=3

4. CONCLUSIONS

This article presents some methods of modelling and simulation of the longitudinal swirls. The results obtained, compared with the theoretical evolution of the longitudinal swirls, allowed the validation of the method of selected simulation and the software used for the simulation of wake of plane.

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SOME EFFECTS OF THE POSTIMPACTING DEBRIS CLOUD ANALYSED BY SPH

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Abstract: *This paper presents some results of the numerical researching work of the authors regarding to the post impacting Debris cloud. Taking into account the usual particle dimension and their velocity range, the paper presents only the case of impacting between a sphere and a plate.*
The velocity range was 0,5 to 7 km/s, the sphere diameter was 6 mm and the target thickness was 1 mm. Two material were considered for the projectile (aluminum and steel), but for the target only one material – aluminum.
For studding the effects of Debris cloud, a secondary plate was considered. This plate was positioned at 25 mm rear the first, and it was modeled by shell elements, and its material was aluminum and steel.
The paper and its conclusions put in evidence debris cloud formation and its effect upon the other plate (rear wall) which could represent a protection wall of an aircraft.

Key words: *debris cloud, smoothed particle hydrodynamics (SPH), FEM*

1. INTRODUCTION

A concentration of particles or fragments in a region, which come from a single source, is referred to as a debris cloud. Such particles concentrations can be met in space by orbital vehicles and they could be dangerous for safety or integrity of the satellites or any orbital aircraft. This is a reason of the preoccupation for studding of debris clouds.

General form of debris cloud is an expanding 3D ellipsoid, in which the fragments are not spread uniformly and even their dimensions are not the same. A high particle density can be noticed around a point, line or sheet.

The same interest presents post impacting debris cloud which represents a real threat upon the rear wall of the structural wall in the case of high velocity impact with a single particle. Impact velocity range is from 1 to 15 km/s. The size of the most numerous fragments ranges from 1 to 10 mm.

Nowadays the most fitted way for a numerical simulation of formatting and for studing the effects of Debris cloud upon a structure is Smoothed Particle Hydrodynamics (SPH) method.

2. FUNDAMENTALS OF THE SPH METHOD

The SPH method belongs to the meshless methods, so the investigated domain is represented by a number of nodes, representing a particle of this domain with its material characteristics. Each particle represents an interpolation point on which the material properties are known.

The problem solution is given by the computed results, on all the particles, using an interpolation function. We can say that the fundamentals of SPH theory consist in interpolation theory; all the behavior laws are transformed into integral equations.

The kernel function gives a pondered approximation of the field variable (function) in a point (particle).

A function $A(r)$ can be so estimated by the relation:

$$A(r) = \int A(r')W(r-r',h)dr' \qquad (01)$$

where the function $W(r-r',h)dr'$ is the kernel function, which has two main properties:

$$a) \int W(r-r',h)dr' = 1, \qquad (02)$$

$$b) \lim_{r->0} W(r-r',h) = \delta(r-r'), \qquad (03)$$

and h is the smoothing length. An intuitive representation of this parameter can be seen in the Fig. 1. The smoothing length defines a domain of the particles of the interaction of the particle i with others. The form of the smoothing function W(r,h)=W(r/h) is presented in the Fig. 2.

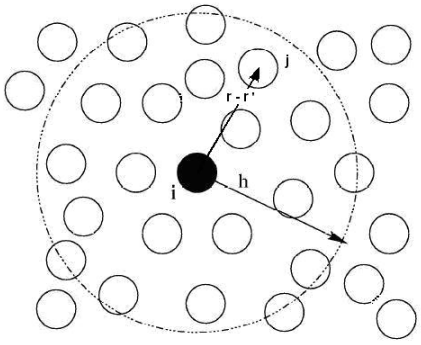


Fig. 1 The smoothing length h

Different kernel function can be used: Gaussian, polynomial, spline etc. The most used function is the cubic B-spline one. Such a function has the form:

$$W(r,h) = \frac{\sigma}{h^n}\begin{cases} (1-\frac{3}{2}s^2+\frac{3}{4}s^3); 0 \le s \le 1 \\ \frac{1}{4}(2-s)^3; 1 \le s \le 2 \\ 0; s > 2 \end{cases} \qquad (04)$$

where $s = r/h$, n is the number representing the spatial dimension and σ is a constant which can have the value: $2/3$, $10/7\pi$ or $1/\pi$ depending on the space with one, two or three dimensions.

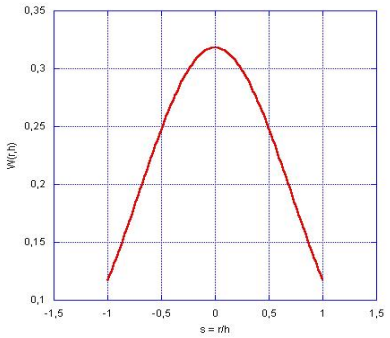
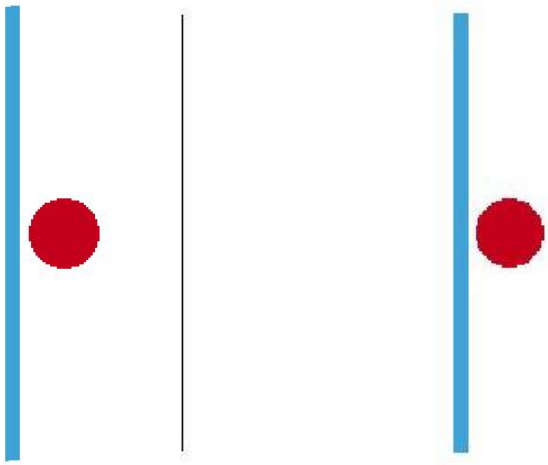


Fig. 2 The kernel function representation

In fact, the kernel function is a delta or Dirac function with some specific requirements, like (2) and (3) relations.

3. POSTIMPACTING DEBRIS CLOUD MODELING

For illustrating the characteristics and the effects of postimpacting debris cloud an impact between a sphere and one, two and three plates was considered, like in Fig. 3 and Fig. 4.



a) b)

Fig. 3 Impact model with one plate a) and two plates b)

The impact velocity was 5 km/s; the projectile is a sphere of 6 mm diameter and the target is a plane plate of 1 mm thickness. Both materials were aluminum 2024. For simulation of the effects of the debris cloud, an other plate, rear the first, was considered, in two cases: the second plate (wall) of the same

material (aluminum) and the second plate of aluminum 1100 or steel 1018.

The sphere and the first plate (circular plate, diameter of 40 mm) were modeled by SPH. The second plate (square plate, edge of 40 mm) was modeled using shell elements.

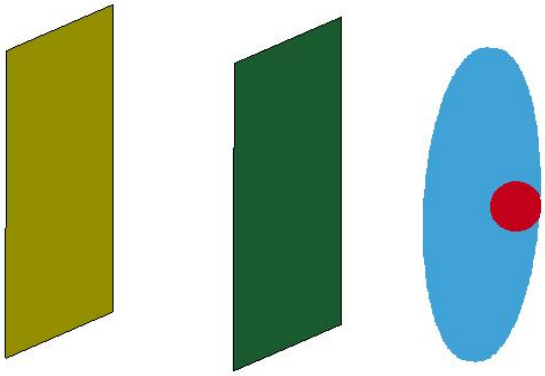


Fig. 4 A model with three plates, the last two plates being modeled by shell elements

The model presented in Fig. 4 has, next to the Fig. 3-b model, an other plate (third plate) having the same geometrical and material characteristics with that modeled with shell elements.

Material models, used in these models, were Johnson-Cook for sphere and first plate and plastic-kinematics for the second and third plate. The sphere was modeled as a rigid body.

4. THE EFECTS OF DEBRIS CLOUD

The main effects, studied in this work, are those regarding to damaging of the second and third plates because the safety measures include, as a rule, more plate layers. These plates would resists to much more particles belonging to both bodies: the projectile (a little sphere having a high velocity) and the first plate.

For an impact velocity of 5 km/s, the second plate of aluminum, with the thickness of 1 mm, is strongly deformed and some particles produced perforation of the plate, as we can see in the Fig. 5 and 6-a.

For the same velocity but with the second plate of 0.50 mm thickness, this is perforated in many places, like in Fig. 6-b.

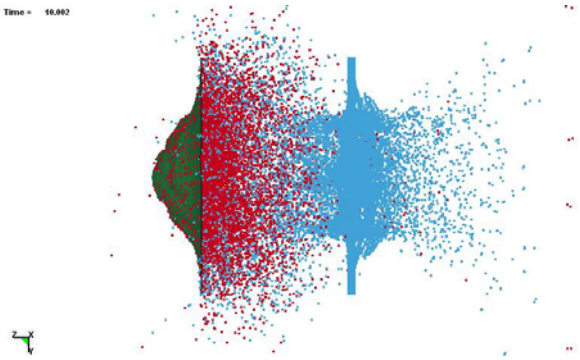
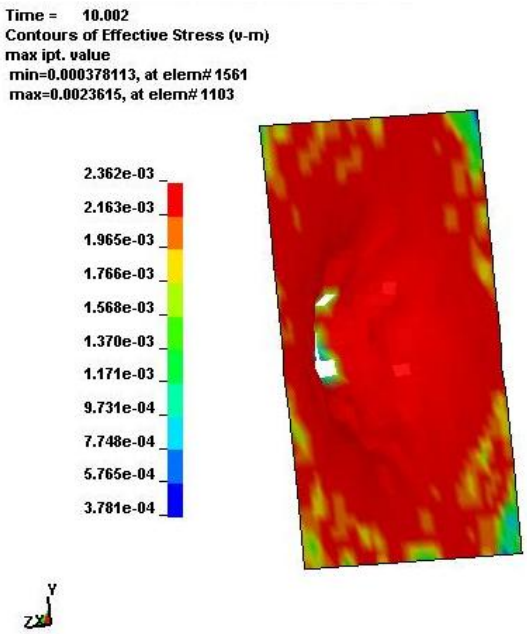
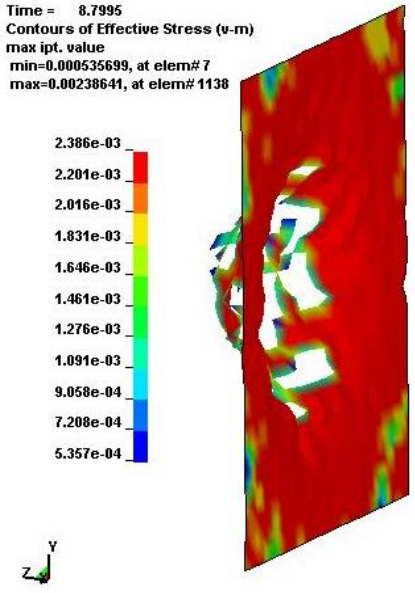


Fig. 5 Deformation state of the system



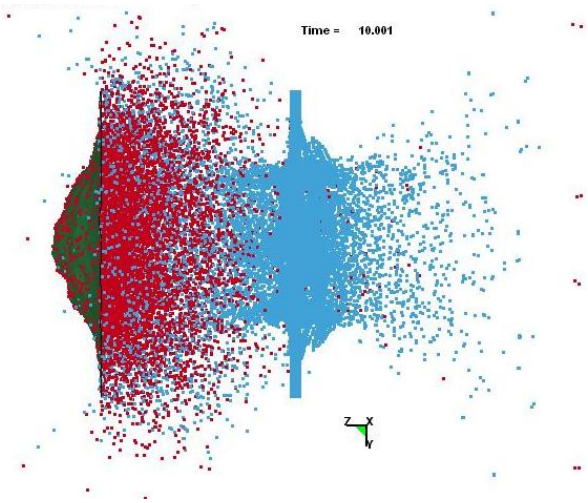
a)



b)

Fig. 6 Deformation state and stress field for two thickness values

For the same velocity, the second plate of 0.50 mm thickness, but of steel 1018, this is not perforated, being strongly deformed only. These effects can be seen in the Figures 7-a and 7-b.



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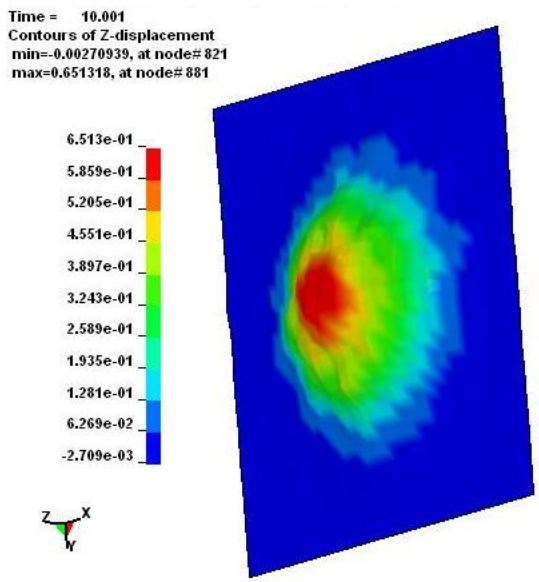

b)

Fig. 7. Deformation state and stress field in the case of steel plate with a thickness of 1 mm

Just at the impact velocity of 7 km/s, the third plate goes on to be not affected, no matter the thickness and kind of material, but the second plate is more deformed and much more perforated.

The explanation of this aspect consist in the fact, that at a moment, under 10 microseconds, the particle velocities, become zero or just change their sign.

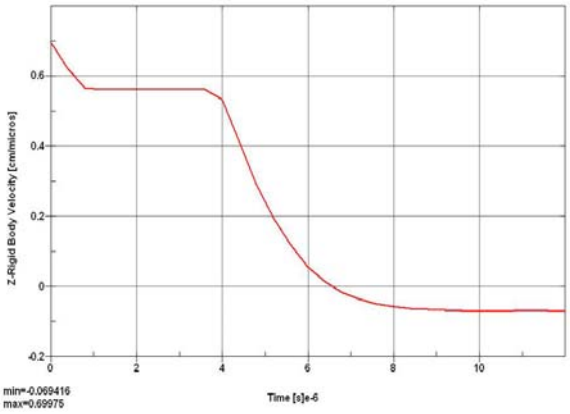

Fig. 8 Variation of particle impact velocity like a rigid body

In the figure 8 the velocity variation of a particle is presented, the particle being considered a rigid body. As we can see, after impact, the velocity has a strong decrease and then the velocity changes its sign.

5. CONCLUSIONS

The effects of such debris clouds have to be studied for avoiding the danger impact of a space aircraft with the particles of a Debris cloud or any other particle with a high velocity. Many other aspects can be studied by such numerical simulation, so the best measures to be implemented for avoiding the threats.

The best appropriate method for studing of debris cloud effects is smoothed particle hydrodynamics (SPH) only.

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COST ESTIMATING FOR SHIPS BASED ON STATISTIC METHODS

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Abstract: *The paper proposes to present an approach that estimate the cost of a ship (merchant or warship) according to the actual international practices in this domain. There are presented basis of detailed estimates costs such as structural costs_ (structural material, structural labour), outfit costs (outfit material merchant ships, outfit material warships, outfit labour costs), machinery costs (machinery material costs - merchant ships, machinery material costs – warships, machinery labour costs).*

Keywords: *structural costs , outfit costs, machinery costs.*

1. COST ESTIMATING

The words cost and price are used colloquially as though they had the same meaning, but as used here they are fundamentally different.

The cost of a ship is the sum needed to pay for all the materials and labor involved in its construction plus the overhead costs incurred.

Costs can be divided into two categories - estimated and actual. The estimated cost is that calculated when the shipyard is tendering; the actual cost is that ascertained to have been incurred at the end of the contract. The price is the sum of money which the shipyard quotes to, and eventually receives, from his customer.

2. TYPES OF APPROXIMATE ESTIMATE

Approximate or budget costs

This is needed to show whether the shipyard is likely to be competitive for particular order, so that the considerable cost involved in preparing a detailed estimate or detailed ship design is only undertaken when there is an acceptable chance of success.

The figures in a detailed estimate will come from quotations for materials and detailed work assessment for labor costs, while those in an approximate estimate are generally derived by the use of costs per tonne or man-hours per tonne from records of recent construction or from figures used in a recent detailed estimate for a similar ship.

3. DETAILED ESTIMATES - BASIS

Cost estimates for merchant ships are generally made in the first instance on the basis of a single ship against which all the first-off costs are charged. If more than one ship is to be tendered, a second estimate for a repeat ship, excluding first off costs is then made.

Warship builders follow a more logical practice by separating first of class (F.O.C.) costs completely from production costs - a practice merchant shipbuilders could adopt with advantage, even though F.O.C. costs are very much smaller proportionally for merchant ships than they are for warships [1].

F.O.C. costs include design and drawing office costs, mould loft or equivalent costs, tank test and similar costs. Depending on the overhead structure of the firm, they may also include buying department and similar non repeating costs.

4. DEMARCATIONS AND SUBDIVISIONS OF COSTS

Material costs

As well as the obvious items of steel, outfit and machinery, the materials cost includes the cost of work carried out by subcontractors working on the ship.

Electrical and plumbing work are the two main activities for which some yards have their own departments whilst others use subcontractors, but there are others as will be mentioned later.

Labor costs

Labor costs by definition include the cost of the time charged to the ship contract by the labor force, including contract labor, employed by the shipyard. This includes all the tradesmen and charge-hands, but shipyards differ in their treatment of the cost of foremen and managers. Both of these are likely to divide their time between several contracts and would find it difficult to record this, so many shipbuilders let them charge to an overhead number.

Overhead corn

Overhead costs include a wide variety of costs incurred in the operation of the shipyard which are not directly chargeable to particular ship contracts. They include such items as interest on bank loans, rates and taxes, insurance, electricity, telephone and postage, salary costs of managers and office staff, etc.

It is usual for one standard overhead rate to be applied to all labor costs.

Subdivision of costs - warship practice

The eight sections used by the British M.O.D. (Minister of Defense) for costing warships are also used for weight estimates and are shown in Table 1. A typical breakdown of the cost of a warship is shown in Fig. 1 [2]. In this the cost is divided into six, rather than eight sections with the costs of the usual Controls and Communications section presumably split between Weapon Equipments and Propulsion and Auxiliary systems with the Variable loads section omitted.

The estimate sheet

An estimate sheet with eight “vertical” sections that can be used for either merchant ship or warship cost estimates is given in Fig. 9 [2]. It will be noted that this estimate sheet uses the unit production cost concept and makes provision for different overheads rates being used for each cost section.

Fig 1. Warship weight and cost

Definitions of the items included in each of the merchant ship outfit sections are given in § 6, while definitions of the items included in the machinery sections are given in § 7.

Definitions of the items in the warship sections are given in Table 1 [1].

5. STRUCTURAL COSTS

Structural material

Methods of calculating the net structural weight have been used according to Watson-*Practical ship design* [2]. The cost of welding rods and gases is normally added to the structural material cost as a percentage of this based on an analysis of completed ships.

Table 1 Warship weight and cost groups

1	HULL	2	PROPULSION	3	ELECTRICAL	4	C³I
10	Hull structure	20	Nuclear propulsion	30	Power generation	40	Navigation systems
11	Superstructure	21	Non-nuclear propulsion	31	Distribution equipment	41	Internal communication
12	Structural bulkheads	22	Propulsion units	32	Distribution cabling	42	Ship & mech. control
13	Structural decks	23	Condensers & air ejectors	33	Lighting systems	43	Weapon control
14	Doors, hatches & scuttles	24	Shafting & propulsors			44	Ship protective systems
15	Seats, masts & supports	25	Exhaust & air supply system			45	External communication
16	Control surfaces	26	Steam systems				
17	Structural castings	27	Water cooling systems				
18	Buoyancy & ballast	28	Fuel service systems				
19	Fastenings	29	Lub. oil systems				
5	**AUXILIARY**	**6**	**OUTFITTING**	**7**	**ARMAMENT**	**8**	**VARIABLE LOAD**
50	Air condition. & ventilation	60	Hull systems	70	Surface to air	80	Officers, crew & effects
51	Fuel systems	61	Boats & life saving equipment	71	Surface to surface	81	Ammunition
52	Sea & fresh water systems	62	Minor hull bulkheads	72	Surface to subsurface	82	Aircraft
53	Air & gas systems	63	Storeroom furnishing	73	Sub launched anti surf/sub	83	Military vehicles
54	Hydraulic systems	64	Living space furnishing	74	Sub launched anti air	84	Victualling stores
55	Aircraft systems	65	Office furnishing	75	Air launched arm.	85	Naval stores & spare gear
56	Waste Disposal systems	66	Galley/workshop equipment	76	Mine warfare equipment	86	Weapon stores
57	Aux. steam systems	67	Superstructure partitions	77	Small arms & rockets	87	Operating fluids
58	Lub. oil systems	68	Portable fire fighting equip.			88	Stowed liquids
		69	Load handling & RAS equip.			89	Cargo

Structural labor

The structural labor cost is the product of the man-hours required multiplied by the labor cost per man-hour.

If sufficient structural drawings are available the estimate can be made by detailed work assessment, which may in turn be broken down into shop man-hours; berth man-hours and afloat man-hours.

When only a total steel weight is available, the estimate must be made by the use of a plot of man-hours derived from completed ships against the total steel weight (either net or invoiced) as shown in Fig. 2 or of man-hours per tonne as shown in Fig. 3. Both plots have advantages but that of man-hours per tonne is the more usual [1].

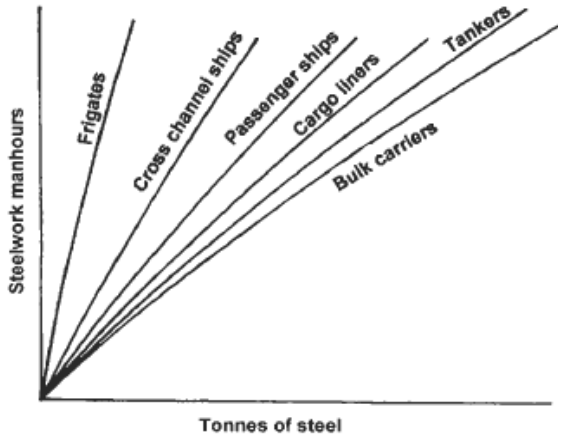

Fig. 2 Steelwork man-hours versus steel weight.

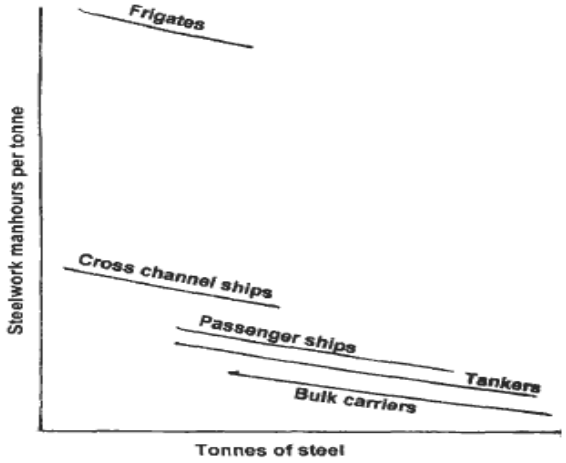

Fig. 3 Man-hours per tonne versus steel weight.

A disadvantage of both these plots is the fact that they fail to distinguish between two ships of the same steel weight, one of which is smaller but heavily constructed and the other larger but with lighter scantlings. The latter ought, of course, to require more man-hours. Fig. 4 fails to show a proper allowance for the steel weight and a plot of man hours per tonne may be better against this base. After much thought about the problems posed by these alternatives, a plot was made of man-hours against the total area of plate used as shown in Fig. 5 [1]. Remarkably, this was found to give a straight line relationship irrespective of ship type, suggesting that area rather than weight was the best criterion for labor man-hours.

Thicker and heavier plates require more work by way of edge preparation for welding and more work to form them if they are to be shaped; on the other hand, the stiffeners on heavier plates are more widely spaced and need less work per unit of area. On balance, therefore, it seemed not unreasonable that the lab our content per unit area might be constant. Following this thesis, Fig. 6 was prepared on the basis of a single fixed figure of man-hours per unit of plate area derived from the original of Fig. 5 [1]. Two assumptions of the percentage of stiffeners (sections) by weight were made and the man-hours per unit weight calculated for a number of plate thicknesses

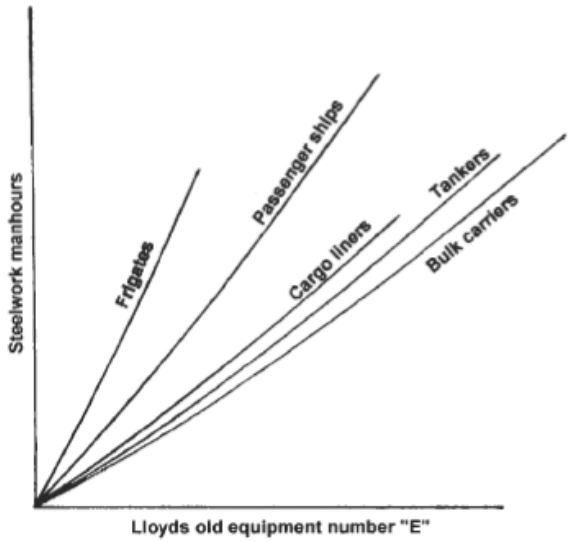

Fig. 4 Steelwork man-hours versus ship size.

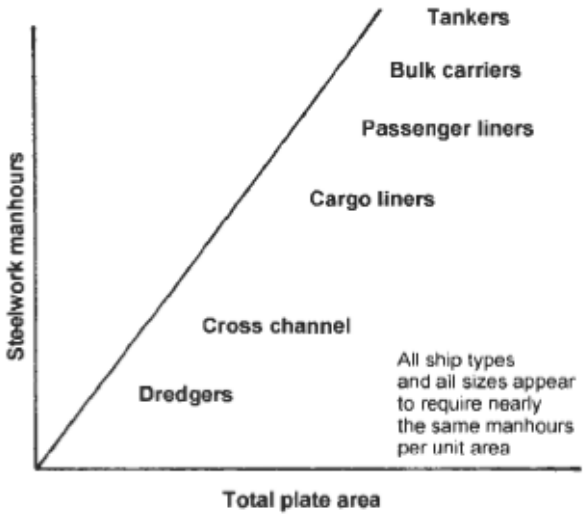

Fig. 5 Steelwork man-hours versus total plate area.

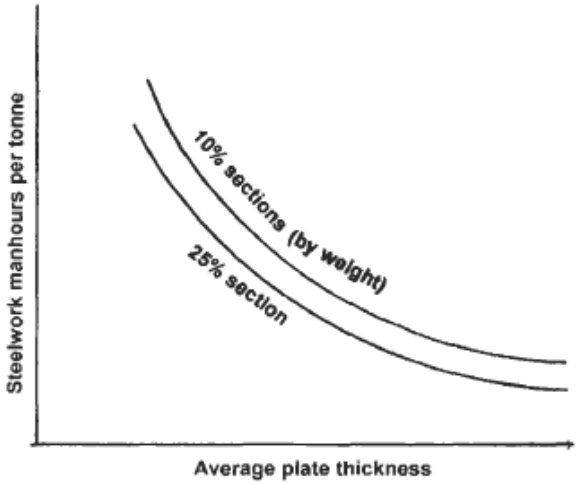

Fig. 6 Man-hours per tonne versus average plate thickness.

6. OUTFIT COSTS

Outfit material merchant ships

The following groupings for weight estimation seem to meet this criterion reasonably [1]:

Group 2. Structure related (steel weight): structural castings or fabrications (rudder and stern frame), small castings (bollards, fairleads etc.), steel hatch covers, W.T. (water tight) doors;

Group 3. Cargo related (cargo capacity or ship size): cargo space insulation and refrigeration machinery, cargo ventilation, firefighting, paint, 3(a) -plumber work;

Group 4. Accommodation related (complement): joiner work, upholstery, deck coverings, sidelights and windows, galley gear, lifts, HVAC-(Heating, Ventilating, and Air Conditioning), LSA- (Life-saving appliances and arrangements), nautical instruments, stores and sundries, 4(a)-electrical work;

Group 5. Deck machinery related (by units or by ship type x size): steering gear, bow and stem thrusters, stabilizers, anchoring and mooring M/C- (Machine (mechanical engineering), anchors, cables and mooring ropes, cargo winches, derricks and rigging, cranes.

A convenient format for estimating outfit material costs for a merchant ship is shown in Fig. 7 - the correlation with the weight estimate should be noted.

Outfit material - warships

Although the term outfit is not used in warship design practice, it has been found convenient to use it in this book defining it as consisting of the warship weight and cost groups 4,5,6 and 7. (see Table 1).

Outfit labor costs

Outfit labor costs can be calculated in two ways, both of which require an assessment of the man-hours and the multiplication of this by an average wage rate per man-hour.

The most accurate method is based on detailed work assessment for each of the trades, work areas or systems involved.

When making a calculation by this method it is vitally important to check that the

SECTION	ITEM	WEIGHT	COST PER TONNE	COST £
2	QUOTED ITEMS WEIGHT COSTED			
	TOTAL			
3	QUOTED ITEMS WEIGHT COSTED			
	TOTAL			
4	QUOTED ITEMS WEIGHT COSTED			
	TOTAL			
5	QUOTED ITEMS WEIGHT COSTED			
	TOTAL			
	TOTAL WEIGHT		COST	

Fig. 7 Outfit material cost calculations

demarcation between work carried out by the shipyard and that subcontracted is to be the same on the ship for which the estimate is being made as it was on the ship used as the basis; The accuracy of an approximate outfit labor estimate can be significantly increased by breaking the total labor man-hours up into the four sections suggested for the material estimate - if the basis ship data is available in this format, and then proportioning these separately using relevant parameters of weight, area or power.

The number of different trades, and indeed their names, differ from yard to yard, but the

Table 2

Trade/ work area	Group	Remarks
Stagers	3	Painters are the main users
Painters	3	
Shot blast	3	
Iron workers	3	Mainly hold ventilation
Carpenters	3	
Plumbers	3 (a)	
Joiners	4	
Labourers	4	Mainly in accomodation
Cleaners	4	
Temp light	4	
Electricians	4(a)	
Deck engineers	5	
Riggers	5	

list given in Table 2 is fairly representative [1].

7. MACHINERY COSTS

Machinery material costs - general

Machinery material costs are obtained mainly from subcontractor's quotations but partly by costing items either on unit, unit power or unit weight basis. Where greater accuracy is required more subcontractor's prices should be used, but where speed is essential the cost per tonne basis is necessarily used for most items.

Machinery material costs

For merchant ships a split into three groups seems to provide a way of bringing together items whose costs per unit weight are fairly similar and which can be related to an easily assessed parameter.

The groups, according to [1], are:
Group 6. Propulsion: main engine(s), gearbox, shafting, propeller(s), main engine controls;
Group 7. Auxiliary machinery: generators and switchboard, pumps, compressors, etc.
Group 8. Structure related: funnel and uptakes, ladders and gratings, pipe work and ventilation trunking within engine room.

A machinery materials estimate summary sheet is similar into Fig. 7.

For the warships, the arbitrary division of the warship weight groups already discussed under outfit, Group 2 propulsion and Group 3 electrical have been defined as the warship machinery weight and cost group.

Some of the items in Group 3 are located outside the machinery space while some machinery related weights and costs are included in Group 4 Controls and communications.

Machinery labor costs

Machinery labor costs are estimated as the product of the man-hours required and the average wage rate applicable. The man-hours can be obtained either by a detailed work assessment - the most accurate way but a lengthy process - or for approximate estimates by proportioning from available data on the man-hours and total machinery power (P) of a suitable reference ship using this in the ratio (P) to the power 0.82, commonly used [1].

8. UNIT PRODUCTION AND FIRST OF CLASS COSTS

Unit production cost

A calculation sheet for the total unit

SECTION	1.	2	3.	4.	5.	6.	7.	8	SERVICES & MISC.	TOTAL
WARSHIPS	STRUCTURE	PROPULSION	ELECTRICAL	CONTOL and COMMS.	AUXILIARY SYSTEMS	OUTFIT $ FURNISH	ARMAMENT	VARIABLE LOADS		
	OUTFIT					MACHINERY				
MERCHANT SHIPS	STRUCTURE	STRUCTURE RELATED	ACCOMOD. RELATED	OUTFIT CARGO RELATED	DECK MISC. RELATED	PROPULSION	MACHINERY AUXILIARIES	RELATED		
WEIGHT TONNES										
MATERIAL COST PER TONNE										
MANHOUR PER TONNE										
MANHOURS										
LABOUR RATE PER MANHOUR										
OVERHEADS										
MATERIAL COST										
LABOUR COST										
OVERHEAD COST										
UNIT PROD COST										

Fig. 8. Cost estimate summary sheet for both merchant ships and warships

production cost is given as Fig. 8. This can be used for either warships or merchant ships and for either detailed or approx. estimates.

The items “services and miscellaneous” which do not involve weight include: classification and DTI- (Debt to Income (ratio)) or similar fees, launch party expenses, dry-docking, port dues trials costs, delivery voyage costs insurance and provision for guarantee repairs, etc.

First of class cost

One item remains to be added to arrive at the total cost and this is the “First of class cost”. Costs included in this are design and drawing office costs, planning department costs, tank tests or similar investigative work.

9. APPROXIMATE COST DATA

Structural cost

The use of a total cost per tonne method for structural costs is made difficult by the large differences that exist in the labor man-hours required for structural work of different types and sizes of ships. At one extreme a small fine lined specialist ship constructed of light plating may require something of the order of 130 man-hours per gross tonne while at the other extreme a large full lined tanker constructed of heavy plating may be constructed at about 25 man-hours per gross tonne. The costs per tonne quoted are based on net steel weights but the basic material costs allow for the gross steel ordered and it was noted that the scrap percentages which the different yards regard as normal also differed quite widely.

Finally, an additional sum was added to the

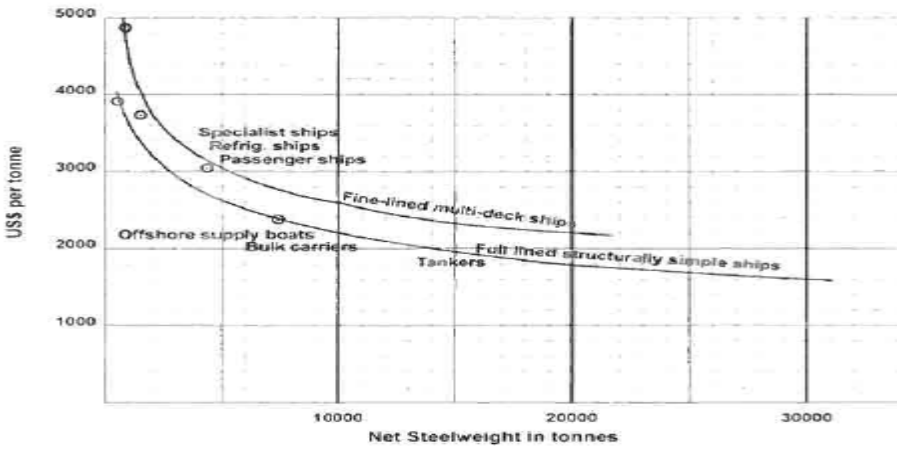

Fig. 9. Approximate costs for structural steelwork per tonne. Costs are on a 1993 basis and include materials, labor and overheads.

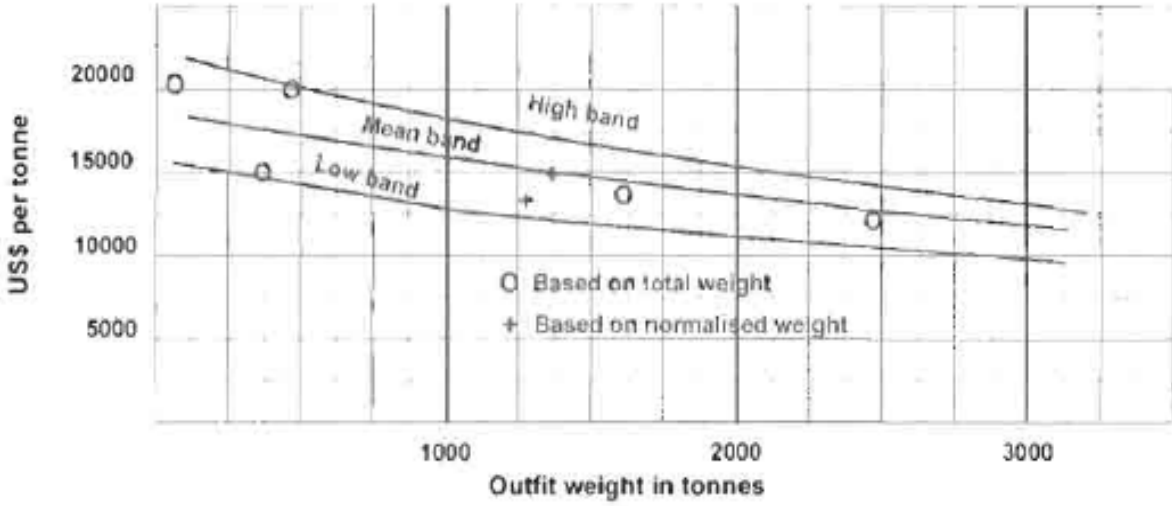

Fig. 10. Approx. costs of outfit per tonne. Costs are on a 1993 basis include materials, labor and overheads.

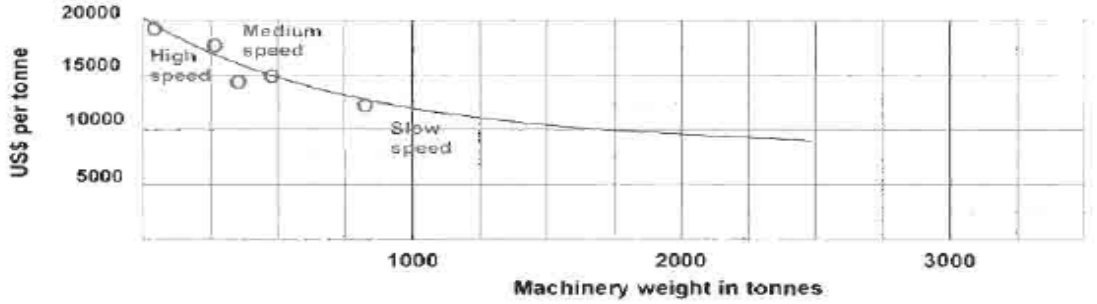

Fig. 11. Approximate costs of machinery per tonne. Costs are on a 1993 basis and include materials, labour and overheads.

steel material cost to allow for the cost of electrodes and miscellaneous steelworkers stores.

The resulting costs in US dollars per tonne of net steel are shown in Fig. 9 [2].

Outfit costs

While the costs per tonne of different items of outfit were found, as expected, to differ quite widely, the costs per tonne of the total outfit (of an admittedly not very large data sample) were found to be much closer even though the ships were of quite different types and sizes.

After some experiments it was found that a closer convergence of the data could be obtained if the cost per tonne was calculated for a "normalized" outfit which excluded any items which would have a major influence on the average cost per tonne either because it had a very high or a very low cost per unit weight - combined in the latter case with a sufficiently large weight to make its influence felt.

Even with this normalization, costs per tonne still seemed to vary quite a lot and it was without much hope of finding a pattern, that the plot given in Fig. 10 was prepared [1].

Machinery costs

Fig.11 shows a graph of the cost per tonne of machinery against the total machinery weight. The trend towards reduced specific cost as the weight increases with a flattening out to a figure of just under $10000 per tonne at machinery weights in excess of 1500 tonnes may be noted [1].

CONCLUSION

The current cost estimating methods are mostly weight based models. Weight is the most commonly used parameter and has been shown in the past to provide good estimates. Nevertheless the weight based model does not reflect or incorporate the effects of productivity changes or the process by which the vessel is built. An example is increasing the “shape” of a hull form by reducing the amount of parallel midbody. The change in actual steel structure weight may be insignificant in terms of the cost estimating relationships, resulting in no change in estimated cost.

It needs that industry to evolve its ship cost estimating capabilities in order to incorporate non weight based parameters into their forecasts.

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ASPECTS RELATED TO THE THERMIC TRANSFER DURING THE PROCESS OF SUPERFICIAL LATERS SETLEMENTS ON TURBINE BLADES.

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Ministry of National Defense. General Staff

INTRODUCTION

The process of settlement through thermic pulverization of a ceramic material on a metalic surface involves the projection on this surface of some melted micovolumes (called drops) and also the dispersal of the drop on the main surface until it solidifies.Over the initial drop before or after it solidifiesanother drop will be projected, the process is to be repeated until a certain thickness.

The cooling speed of each drop represents an essential aspect of thermic pulverization , due to the following aspects:

- determines the structure of the sheating layer;
- the existence periode of the melting period has an essential influence on the dimension of the diffusion processes and chemical reactions;
- the choice of the pulverization technological parameters will ensure the homogeneous application of the imput material, avoiding accumulations and undesired migrations on the piece surface during the melting phase.

The size, the velocity, the temperature , the place and the time when each drop is in contact with the surface have an aleatory character, but they can be characterized from a statistical point of view using technologically controlable parameters .

THE THEORETICAL STUDY OF THE FUNCTIONAL COVERAGE PROCESSES

Such a study requires some simplifications and the creation of a mathematical model, the results of which are to be later corrected on an experimental basis.

The thermically pulverized layers are formed by the accumulation of partially or tataly melted particles, after inpact and solidification on a surface. A description of the process from a quantative point of view, taking into consideration the siye of the particle, the impact angle, the material's composition and the ratio liquid-solid phase, as well as the characteristics of the surface, can be performed only through the development of matemathical models of layer formation..

During the thermical pulverization reactive and difusiv interfaces may. Besides the phenomena related to the formation of several chimical complexes, complexes which can be characterized as penetration and diffusion ones, phisical interaction manifests in the action of the superficial tesion and segragation forces, viscosity and intermolecular forces and in the action of the phenomena related to thernic transfer amonf different or similar phases..

The superficial tension and viscosity establish a dinamic relationship with the inertion forces, relationship which determines the drop to be in a state of superficial expancion or repulsion right after hitting the surface. As the superficial tension and viscosity decrease , the area of the drop's expation and the repulsion effect dicrease as well.

The next images represent the video conditioning of the impact under a 90° angle of an alumina drop, at a temperature of 2550 °C and having a diameter of 100 μm, on a

layer of an inoxidable steel withan initial temperature of 230 °C [2]. In the firs set of four images it is ilustrated the evolution of a drop which hits the surface at a velocity of 20 m/s, and in the second set with a velocity of 77 m/s.

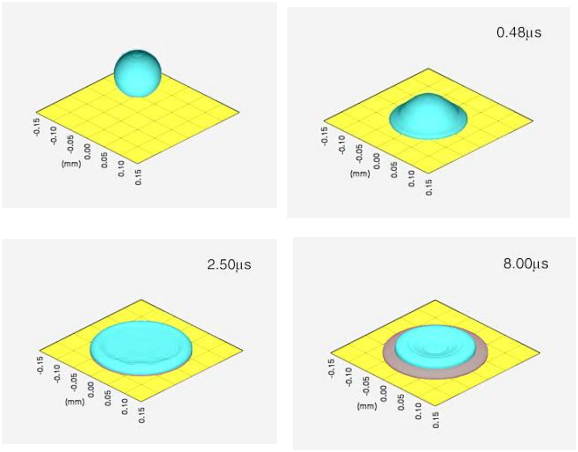


Fig. 2.1 The distribution of an a alumina drop at an impact velocity of 20 m/s [2] .

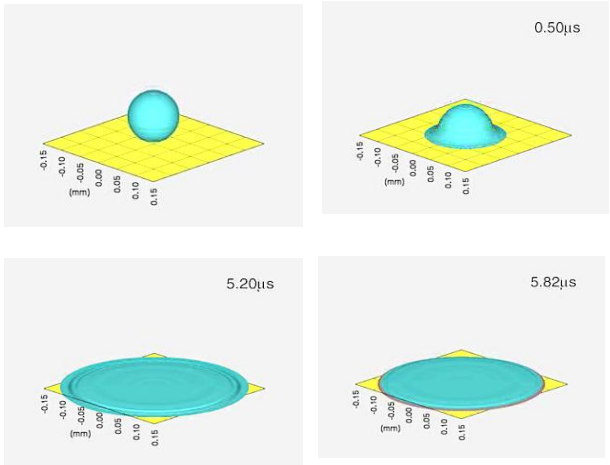


Fig. 2.2. The distribution of an a alumina drop at an impact velocity of 77 m/s [2].

The impact velocity has an important role , its increasement over a certain limit leading to the instability of the fluid drops' periphery shape right after impact. As a consequence, the contour of the liquid phase volume found on the will degenerate from an almost circular shape in an irregular shape having narrowed and extended in a radial direction portions.(„fingers").

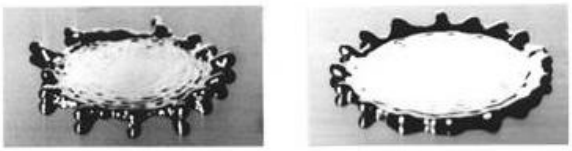


Fig. 2.3 The distribution of an a alumina drop at a higher impact velocity [2].

become instable and result some detachments under shape of small drops positioned round and round ant a short distance.

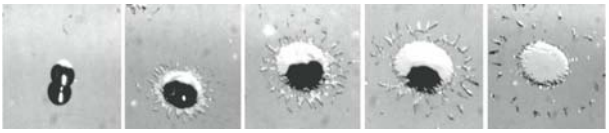


Fig. 2.4. The distribution of an a alumina drop at an impact velocity beyond the permissible limit admisibilă [2].

MODELING THE THERMIC TRANSFER THROUGH M.E.F. IN THE CASE OF SUPERFICIAL COATING [2]

4.1. The model

A volume of cube shaped steel with a 1 cm, which is bordered with a thickness layer of 0,05mm is to be taken into consideration. In figure 4.1 the disparagement of volume elements, the solid type, is displayed. In depth a queue in geometric progression is being used, as it ensures an adequate dimension of the elements near the layer.

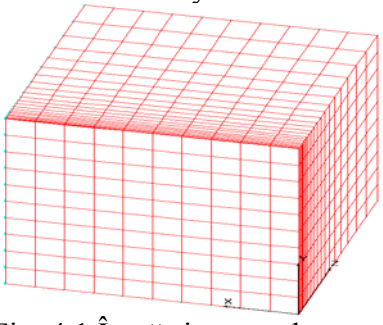


Fig. 4.1 Împărțirea cu elemente

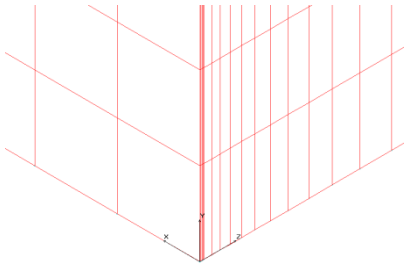


Fig. 4.2 Disparagement detail

In figure 4.2 a disparagement detail is presented, and it shows the disparagement area of the layer in thickness with four elements. The initial temperature in the steel piece is 293° K, and the initial temperature of the oxide is 2350° K.

The analysis was performed in time, at a 10 sec interval. In figures 4.3. – 4.7.fluctuations of temperature for different nodes are being displayed.

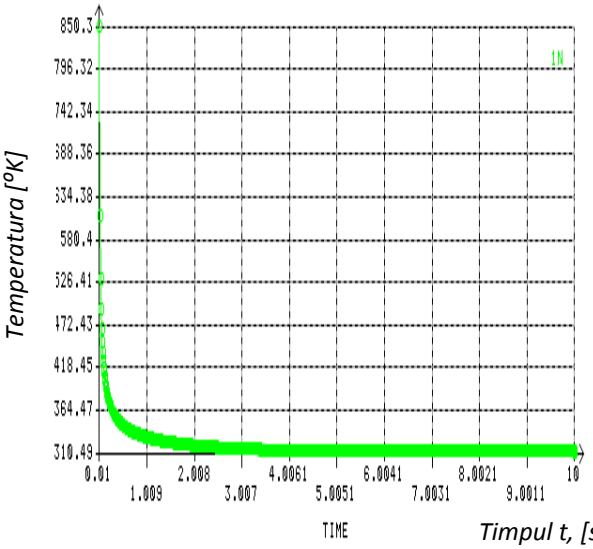


Fig. 4.3. Temperature fluctuation in node 1, found at the oxide layer surface

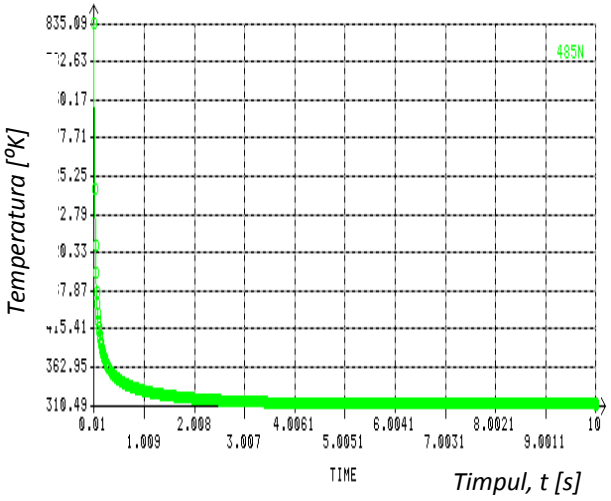


Fig. 4.4 Temperature fluctuation in node 485, found between the oxide and metal layer

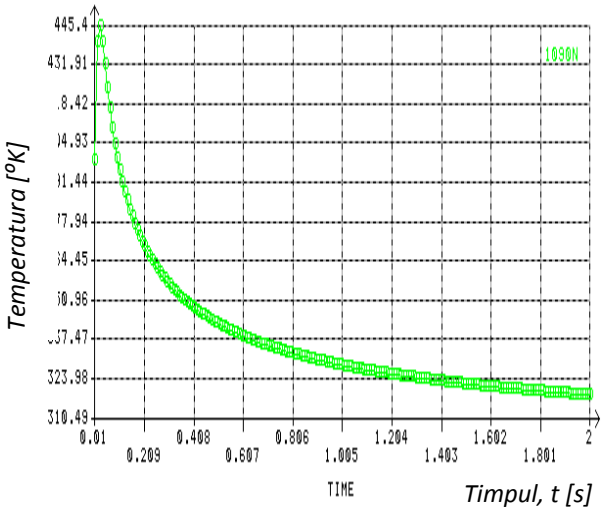


Fig. 4.5 Temperature fluctuation in node 1090, found at 0,5025 mm inside the metal

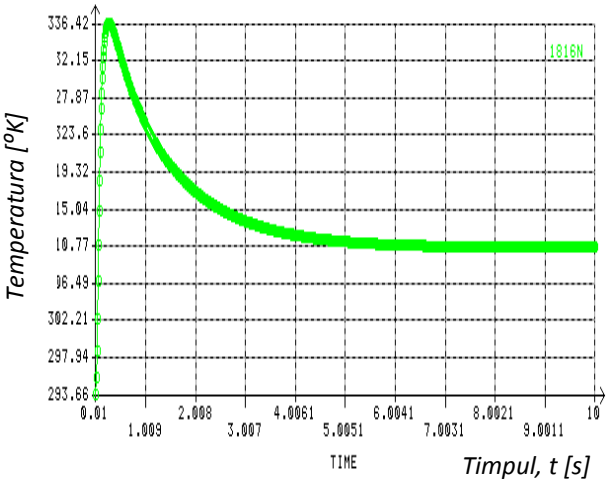


Fig. 4.6 Temperature fluctuation in node 1816, found at 1,9358 mm inside the metal

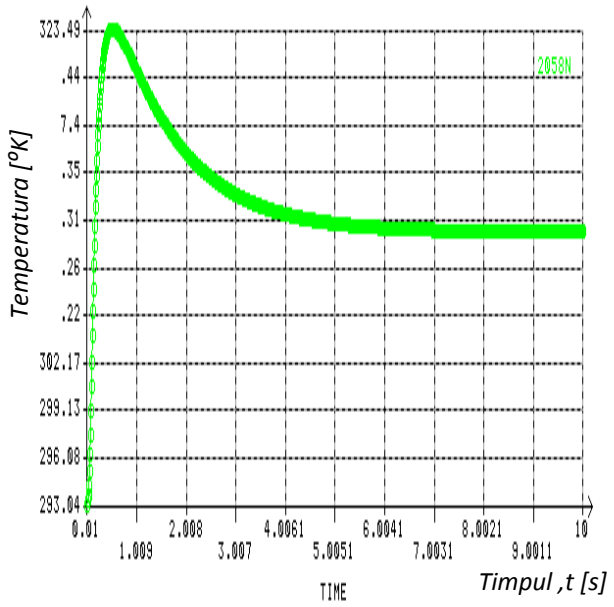


Fig. 4.7. Temperature fluctuation in node 2058, found at 2,7684 mm inside the metal

4.2. The second model

The subject is a parallelepiped steel piece which is swept using a normal jet of plasma alongside its surface.

The sweeping speed is 5 mm/s and the area affected by the flux is a 10mm diameter circle

Due to the geometrical and thermal symmetry only half of the structure is taken into consideration..

In figure 4.8 the dimensions of the symmetry plan, which is the yOz plan, are. In figure 4.9 the disparagement of the solid type elements is displayed.

The deposited layer of oxide is consider to be of 0,05 mm, in figure 4.10 his positioned being mentioned

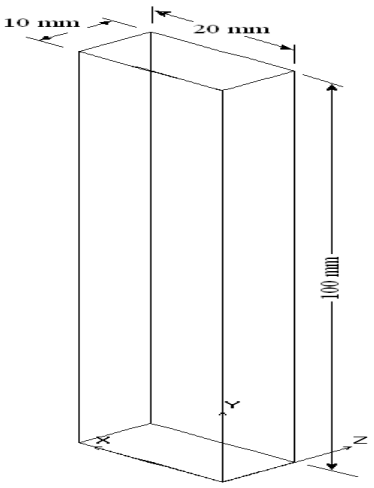


Fig.4.8 Geometry

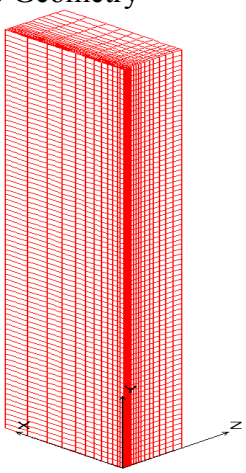


Fig. 4.9 disparagement

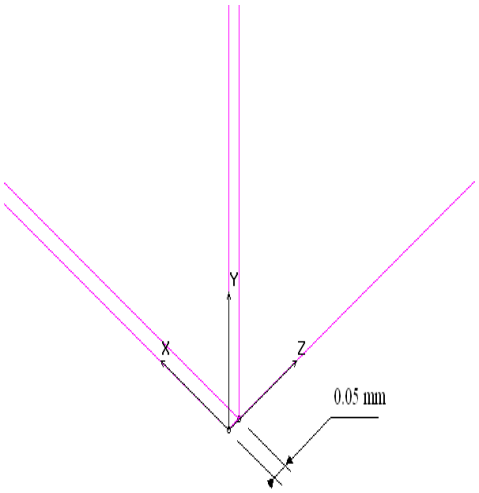


Fig. 4.10 The dimension of the oxide layer

The disparagement of the oxide layer in its thickness was prealised using four elements , in figure 4.11 a detail of the disparagement being presented.

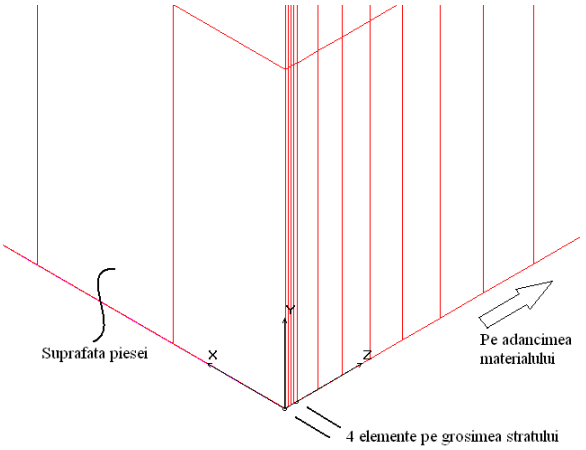


Fig. 4.11 Disparagement detail

In order to model the flux's sweeping on the piece surface , according to the position of the thermically affected area, many lays have been defined. In figures 4.12. – 4.14. three such laws are presented.

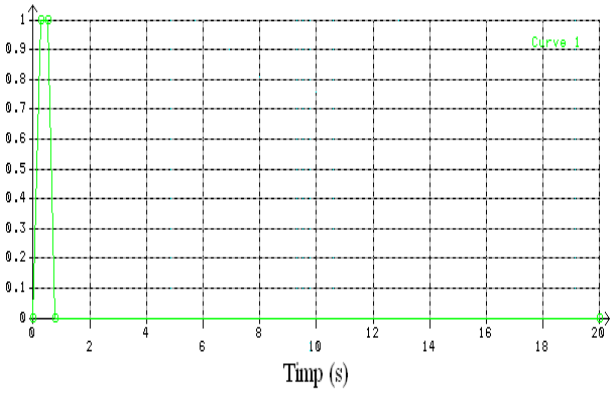


Fig. 4.12

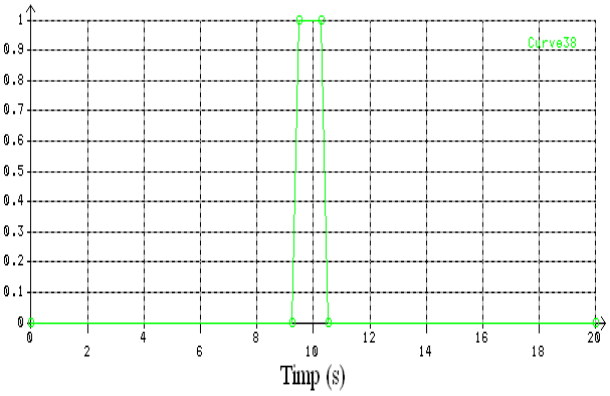


Fig. 4.13

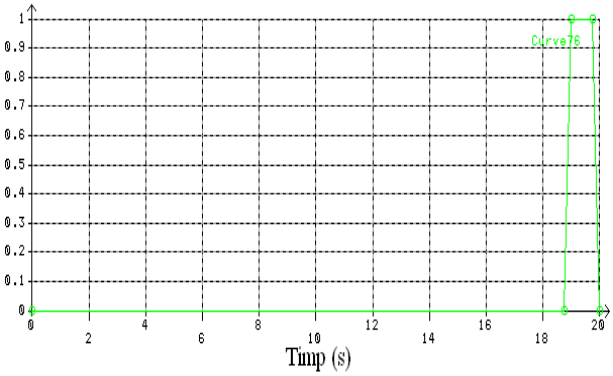
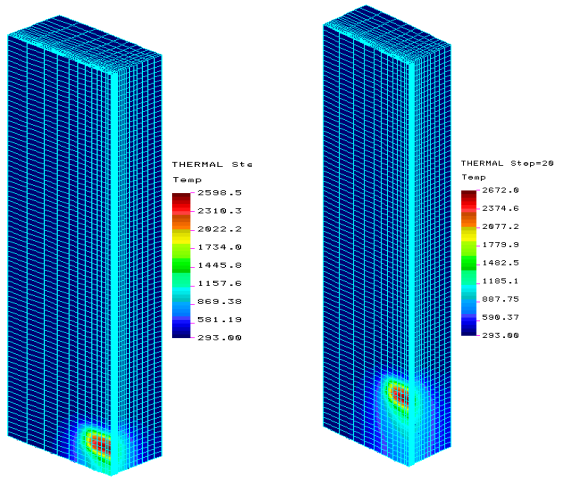


Fig. 4.14

After thermal analysis the following temperature thermal distribution have resulted, as they are presented in figures 4.15 – 4.18,in °K, the time pace being mentioned in each figure. The time interval of the calculations was 20 sec.



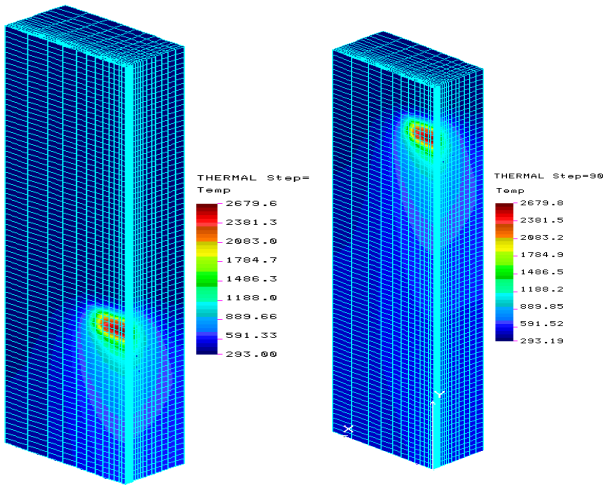


Fig. 4.17. ° K temperature distribution in the surface heat flux swept by 6 sec

Fig. 4.18. ° K temperature distribution in the surface heat flux swept by 8 sec

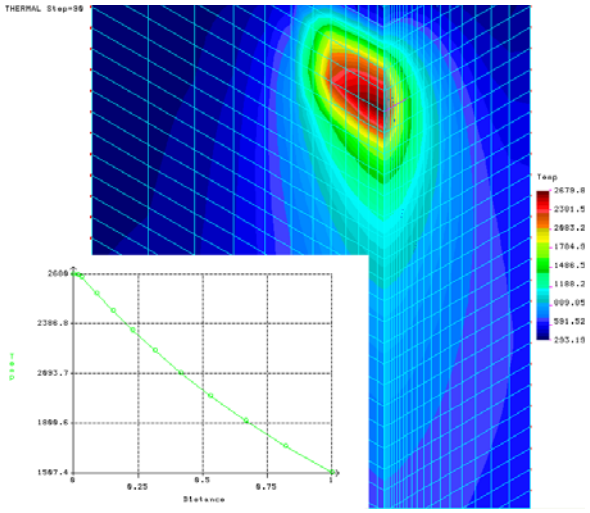


Fig. 4.24. Temperature variation along the scanning direction. the distance of 23.7 mm

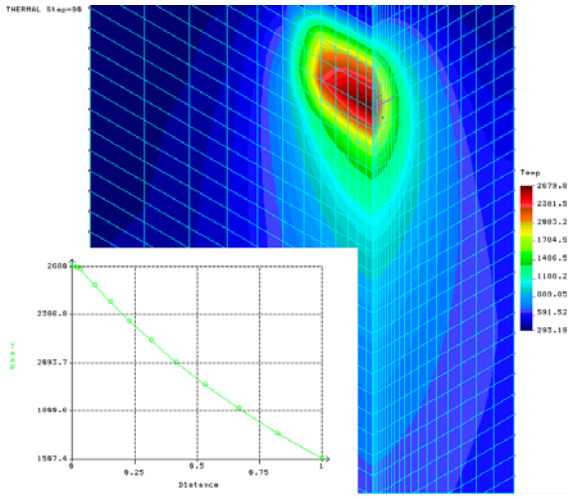


Fig. 4.25 Temperature variation in depth material, the distance of 1.6 mm

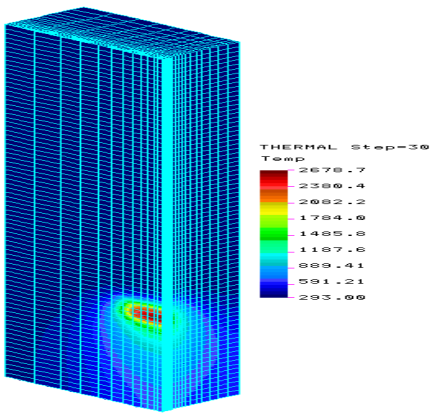


Fig. 4.26 Deposition process, the plasma arc of superficial layers on turbine blades

In figure 4.24 and 4.25 also the temperature destructions are presented, but the ones related to the sweeping direction and the depth of the material in the point of the maximum temperature.

CONCLUSIONS

The mathematic model being used permits the utterance of same considerations from a quantitative and qualitative point of view , against numerous simplifying hipothesis which are being used.

From a qualitative point of view some conclusins may be drown:

- the cooling speed viteza decreases as the thickness of the settled layer increases, this phenomenum could have some consequences on the structure of the deposited material.;
- The temperature of the superficial part of the steel sublayer tends towards a value of 1500 K, which means that at a certain point the majotrity of the energy is included in the volume of the surperficial deposited layer. This thermic dynamic leads to the ideea of the neccessity of a rigurous control of the pulveriyation;
- The heating up of the steel structure on which the deposit is made , manifests during pulverisation only 2- 3 tenth of mm in depth, the method can aso be used for thin pieces..

From a quantitative point of view an estimention of the medium frequency can be made , the frequency at which the drops hit the layer so that under the conditiond of an uniform repartition on the surface, a accurate medium of the time interval at which two consecutive drops hit the some spot.

From the analysis of the presented models a low thermo influence on metals can be noticed, this influence depending on the sweeping speed and the temperature of the plasma scanning and plasma temperature.

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INTELLIGENT INFORMATION TECHNOLOGIES – TECHNOLOGIES OF THE FUTURE

*** Luminița POPA**

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Abstract: *One of the positive aspects of artificial intelligence is that it can solve complex problems.Computers become more useful when artificial intelligence techniques are incorporated both in equipment and programs and the tasks are performed more effectively and at lower cost.*
The possible benefits of artificial intelligence are: increased productivity, expertise aquistion and safer working environments for users.

Key words: *Intelligent hybrid systems, expert systems, intelligent systems technology*

1. INTRODUCTION

The goal of all organizations in a competitive environment can be summarized in four words: to work more efficiently. Business processes is under the imperative of making the best decisions, otherwise they could not effectively pursue the global environment of increasing competitive information society.
Business processes under the imperative of making the best decisions, otherwise they could not effectively pursue the global environment of increasing competitive information society.

Decisions must be made in real time and therefore is necessary to generate the best decisions as quickly as possible.

Intelligence, distribution and cooperation are increasingly felt in the most efficient organizations (Figure.1). Those organizations have used long time their information systems, developed over time, but they needed remote access to numerous information sources, in order to process accessed information efficiently and to make judgments on the results.

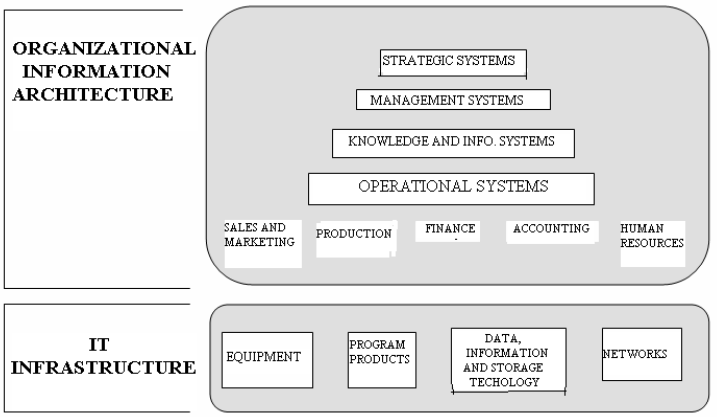

Fig.1 Intelligence, distribution and cooperation are increasingly felt in the most efficient organizations

2. INTELLIGENT SYSTEMS TECHNOLOGY

Intelligent systems show a remarkable evolution, and their applicability will increase spectacularlly.
The most significant example is the current searches of business companies in the direction of systems consisting of expert

systems and other types of artificial systems, combined in order to solve complex problems which can not be settled with existing systems or the so-called decision support systems.
Intelligent systems technology such expert system is the oldest and best finished, in particular rule-based expert systems.
All expert systems are using knowledge called expertise, derived from human experts and its collection process is called knowledge acquisition. The real power of expert systems is the inference engines and the available explanations systems.
Industrial expert systems can provide process diagnostic services for maintenance and repair of robotic production lines or Just-In-Time training for industrial installations safety and security.
Expert systems installed in so-called "electronic kiosks" in big companies,equipped with computer, monitor, touch screen, video disk and printer in places with heavy human traffic are used to inform interested employees in personnel matters, insurance transport, training, new technologies.

Are very useful utility have the expert systems for business, able to assess current information needs of a business man and to automatically provide him the best report in the field of investment, management, marketing, accounting, finance and insurance.

Business management is an important potential area for expert systems because the policies, procedures and techniques used to address the current problems are favored by these smart tools.

I consider appropriate to emphasize the statement of Robert W. Blanning Vanderbild U.S. University: "Expert systems for management are not stand-alone and independent systems, but are integrating on the informal way with other information systems".

It outlined three classification criteria envisaged by the author above: technological criterion (structure of knowledge base, inference engine functions, user interface features, etc..) organizational level at which the system is implemented (strategic, tactical, operational); enterprise functional area in wich the system is introduced (production, finance, accounting, personnel ...).

The general structure of an expert system is shown in Figure 2.

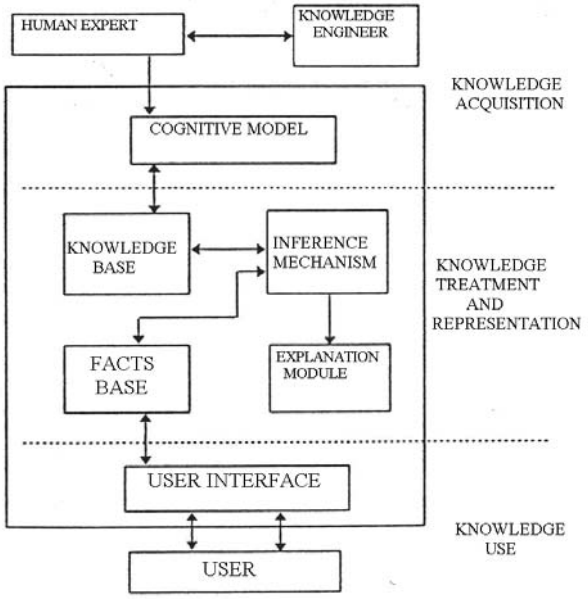

Fig.2 The general structure of an expert system

The database contains two files, one for the list of available industries for investment and acceptable business companies and the other with information about financial and economic performance of each industries and enterprises.

Knowledge Base contains business rules using characteristics (sales, earnings, cash flow per share, profit margins ...) interest rate levels and other data on industries and the economy in general.

The inference engine processes the rules by applying them on a list of all available titles and successively eliminates those not suited to customer requirements, until they get an appropriate portfolio.

User Interface receives "inputs" to describe customer preferences and his situation, and finally prints the recommended portfolio.

3. HYBRID INTELLIGENT SYSTEMS

Hybridization concerns, according to some authors, the functions performed by other incorporated technologies into an intelligent system developed with some initial technology, considered the basic technology.

The various components of hybrid systems communicate the results to each other so as to

obtain the best outcome. These systems cover not only the simple combination of different technologies, but also intelligent technology integration with classical information systems, containing database or spreadsheet.

Intelligent systems consisting of at least two technologies as expert systems, neural networks, fuzzy systems, genetic algorithms, have become an extension of the increasingly large computer applications.

Integrating these state of the art technologies leading causes of so-called hybrid systems, and collection techniques used to integrate these types of systems is known as fusion technology.

The most used combinations in applications are (Figure 3): artificial neural networks in designing fuzzy systems, fuzzy systems for designing neural networks, genetic algorithms for designing fuzzy systems, genetic algorithms in automatic training and generation of artificial neural networks.

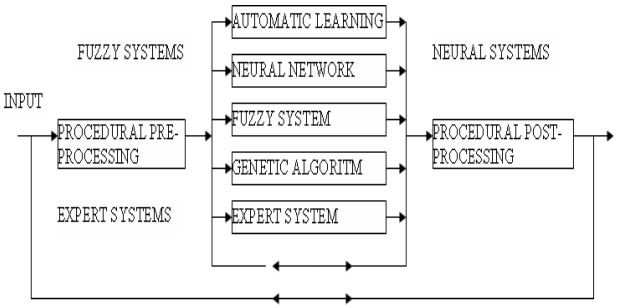

Fig.3 Components of hybrid intelligent systems

Intelligent systems are completely connected to total integration model, and their components work in a virtual harmony, sharing data and knowledge representations and communicating through their dual structure and promoting operative inference.

Such integrated specific systems technologies are merging until they lose their own identity and obtain a new type of system.

Often, the same model can describe the architecture of hybrid systems which are involving other intelligent technologies.

For example, modules of the fuzzy rule-based expert systems can replace or be added to connectionist systems (neural-expert).

Total integration architecture is the highest possible level of integration.

Benefits relate to robustness, excellent execution performance and resource use, no any redundant process or parameter and a improved potential for a much better problem-solving.

Hybridization always seeks smart combination of intelligent technologies so that benefits of one technologies to compensate for disadvantages of other in a real application.

I will use as example a labor forecasting application. In such a model forecast data are subject to a suitable file, used at entrance by an expert system capable of reasoning on the use of labor (Figure 4).

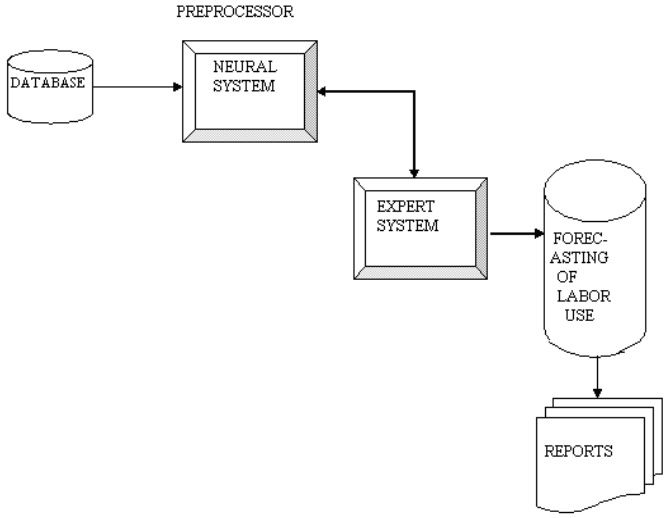

Fig. 4 Intelligent hybrid model

In case of the organizations, the problem arises in the broader context of information technologies, the only one which could provide the real external nervous system that connects individuals and organizations ideas and actions into an increasingly coordinated, informed and corrected better whole.

This explains the modern approaches of authors [] presenting specific functional relationship of total information systems (see Figure 5).

As shown in Fig.5, the five levels of information systems specific functional relationship play each unique and important role, so when there are good connections between them is creating so-called total information system, only one with intelligent features as needed.

So it comes to future intelligent information systems. The five levels form the basic structural components of any modern information system.

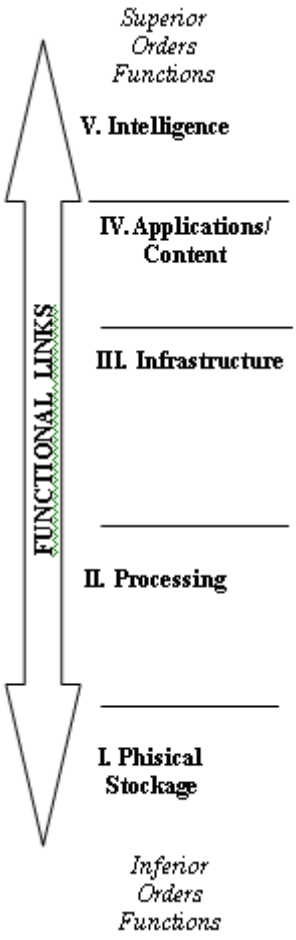

Fig.5 The specific functional link of total information systems

4. CONCLUSIONS

Intelligent systems can assist management in minimizing costs, maximizing benefits, product differentiation and providing unique services to competition, reducing business risk due to consistency increasing of problem solving and quality, decision making documenting and continuous innovation in organizations.

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PRODUCTION DESIGN WITH CONVERGENT ENGINEERING

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Abstract. *Convergent Engineering is a summary of arhemic – systems concepts and was developed in order to substantiate costs at the design stage through a set of management ideas that have changed the serial approach solving into a parallel one.*
Putting into practice the operating ideas of convergent engineering permit shortened design duration, costs substantiation on different levels, ensuring products' quality at competitive market requirements and compliance with products peak within the marketing process.

Keywords: *concurrent engineering; automatic factory*

1. INTRODUCTION

Currently, one of the main problems arising in industry and research laboratories in the United States, Europe and Japan, refers to the attempt to integrate the design process with other issues related to product life cycle, including its assessment in terms of possibilities of development, operation and maintenance. This integration process underlying the definition of concurrent engineering, which involves carrying out activities of a product so its manufacture, can be performed without any problems.

2. USING CONCURRENT ENGINEERING AS PRODUCTION DESIGN TECHNIQUE

In the concept of concurrent engineering, "keyword" is design to manufacture, with the immediate result as the need to involve an entire team of engineers in the design process:
Wee talking about the designer itself, the technician, the responsible people with manufacturing preparing, product launching, manufacturing monitoring and control, namely those involved in product development lifecycle. Convergent Engineering is a summary of arhemic – systems concepts and was developed in order to substantiate costs at the design stage through a set of management ideas that have changed the serial approach solving into a parallel one.

The arhem is open inside system allowing mobilization of natural or modeled human potential to operate at maximum performance, to generate new problems and solve them creatively. Putting into practice the operating ideas of convergent engineering permit shortened design duration, costs substantiation on different levels, ensuring products' quality at competitive market requirements and compliance with products peak within the marketing process.

3. LINEAR MODEL OF PRODUCT'S DEVELOPMENT AND MANUFACTURING

Product life cycle, from the perceived need until its elimination, includes a succession of phases which could be conducted in three main stages: creation, production / distribution, product disposal (Fig 1).

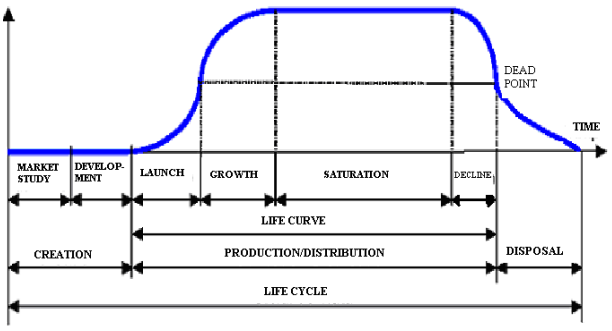

Fig.1. Product life cycle

During the creation of a product, the most of the

manufacturing company still applies a linear approach (Fig. 2).

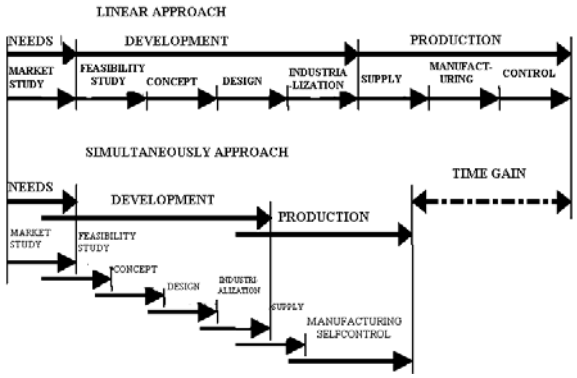

Fig. 2. Linear approach and the simultaneous (parallel) development and manufacturing of a product

We can imagine activities duplication, making borders disappear in the first phase of the stages of product creation. Thus, when an activity comes to have enough information, it may begin before the end of the previous activity.
Implementation of such organization requires that each next activity, must know the status of previous activity, in order to be able to decide its own start. In applying concurrent engineering, the design and achieving time is reduced to a third compared with serial classical engineering (ΔT in Fig. 3) and the costs decreases directly related to the dose of natural intelligence and / or artificial used to substantiate costs.
To reach a convergent design, knowledge integration should be achieved, building model to be produced, detailing the functions performed and the stages of the actual product lifecycle: production, maintenance and recycling.
The difference from the sequential organization is the creation of multidisciplinary project teams, which brings together various professionals involved throughout the project life cycle of production. These teams are the concurrent engineering nerve center.
They allow catalyzing innovation, ensuring an adequate quality level according with market requirements.
The team cooperation energises everyone's responsibility, resulting in increased motivation. This sense of responsibility is reinforced by functions decentralization and restructuring, traditional hierarchical path is broken. In order to design a new product, people from many functional departments work together, from idea to completion, to ensure the most accurate way for reflecting the needs and wants of the customers.

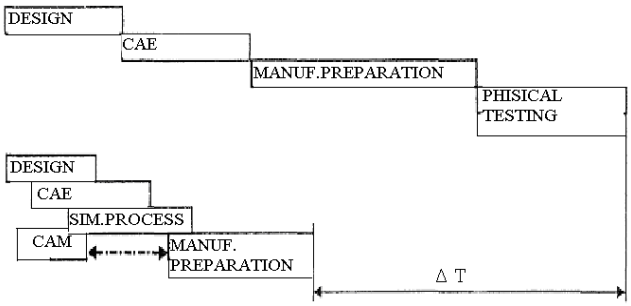

Fig. 3. Reducing a third of design time using concurrent engineering application

The new strategy requires simultaneous pursuit of activities that all converge on the same goal: satisfying customer's needs and desires. Such market, design, production, quality assurance and reliability specialists are parts of multifunctional teams working together from the start, anticipating the problems, avoiding delays in bringing products to market and development cost falls.

4. IMPLEMENTATION IN PRODUCTION SYSTEMS ENGINEERING CONVERGED PRODUCT

Engineer and project engineer have to colaborate in order to make the product for manufacture. Evolution of the interaction between product design and process of obtaining it is shown in Fig. 4:

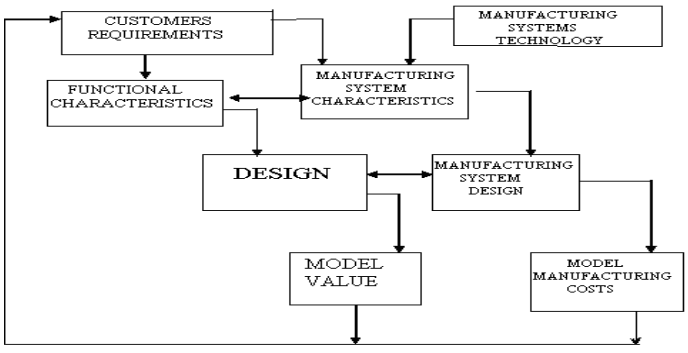

Fig.4. Parallel development strategies of equipments placed on the manufacturing technological flow

Basic rules used in the design for product manufacture are: technological building analysis of the product, the choice of the semifinished pieces

geometric shape as close to finished pieces, using the previous projects, technological equipment minimization, considering kinematic principles during the early stages of product design.

Given these fundamental principles, has outlined a design guide using concurrent engineering approach as follows: determining product character in order to identify the product type and manufacturing and design methods development; product analysis in terms of product function, to make sure that the project is feasible; maintenance and feasibility study realization.

If we want to design a manufacturing and assembly process we need to take into account the product characteristics. This can be done by:

- determining the technological process optimal verssion;
- sub-assemblies identification;
- integration of quality control strategy with the assembly process;
- virtual design of non-standard equipments;
- design each component so that manufacturing costs are compatible with business opportunities .

CHARACTERISTICS	DECREASE	GROWTH
Product development time	30 ... 55%	
Changes dictated by the requirements of engineering projects	50 ... 95%	
Number of prototypes	65 ... 70%	
Restorations of 25 projects in various stages	75%	
Faults	30 ... 85%	
Time to market	20 ... 90%	
Failure rate	60%	
Lifetime (operation)	100%	
The cost of obtaining a quality suitable failure rate of 1%	60%	
Overall product quality		100...600%
Productivity running		20 ... 110%
Increased annual sales		5 ... 50%
Rates of return		20 ... 120%

5. ENGINEERING IMPACT OF CONVERGENCE ON VARIOUS COMPANY DEPARTMENTS

Research & Development	- creating reusable / recyclable values; - use acquired experience across all departments;
Product design	- to reduce total product development time; - improving product and process design quality; - reducing products lifecycle costs;
Engineering	- reducing overall product development time; - improving the product design and production process quality ; - creating reusable / recyclable values;
Production	- improving production process quality; - reducing manufacturing product costs ; - reducing the assigned time for the product manufacturing cycle
Distribution	- reducing distribution costs
Sales	- revenue growth
Service	- tight control over warranty costs; - increase the manufacturer's reputation

5.1 BENEFITS EXPECTED BY APPLYING CONCURRENT ENGINEERING IN THE FIRM (Table 2)

6. IMPACT OF ENGINEERING CONVERGED ON THE LEVEL OF COMPANY MANAGEMENT

- Complete remodeling of company's technical activities
- Openness to competitive market demands
- The need to adapt staff structure
- The need of accurate understanding of computer-aided system and facilities offered by it.

7. CONCLUSIONS

Concurrent engineering objectives are: reducing time cycle and production costs diminishing, production reliability continuous improvement and the customer satisfaction level.

Time reduction goal is to: provide a larger variety of products, increase sales volume (so more revenue, the most of this profit comes earlier in the market cycle), increase the market growth velocity resulting in additional income.

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CONSIDERATIONS REGARDING THE RELIABILITY ANALYSIS OF BRAZE-WELDING PROCESSES FOR ZINC STATE STEEL STRUCTURES

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Abstract: *The paper approaches theoretical and practical aspects related to the qualitative and quantitative analysis of products and process reliability, with direct practicability for the braze-welding of galvanized carbon steel plates. Structural analysis is also performed by using the "prediction tree" method for specific flaws, defects which can occur within applying the braze-welding technologies; a calculus of the operational safety coefficients is also being presented, a calculus which represents an essential objective of designing quality. It is being demonstrated that, based on the experimental results, by precisely choosing the test values and the environment type to which the structure is exposed, a deterministic way of calculating can be replaced with an arbitrary safety coefficient can be replaced by an operational calculating method, for which a certain braze-welding assembled system reliability has been imposed.*

Keywords: *braze-welding, reliability analysis, safety coefficient*

INTRODUCTION

In today's industrial activity, the product and services quality is considered a main economical indicator. Due to the fact that reliability is, along with other indicators, a component which defines quality, it must be under focus from all those who design new production processes or new technologies. Reliability is ensured within fabrication by the correct choosing of processes and technical equipment, by complying with fabrication regimes and conditions, by rigorous phase, raw and fabricated material control.

Reliability is maintained by process, using proper putting in function and operating methods. The theoretical basis and the product reliability knowhow are based on an economical substrate. The consumer, defined as the user, will always be interested by the higher reliability products. There is an optimal accepted reliability level for the producer and, usually, another level for the user, the latter being more strict for industrial product lines. The dedicated literature from the past years supports the idea that the reliability and brazed and/or welded mechanical assembly reliability engineering concepts must include wide scale applicable notions. Therefore, in these cases, reliability represents the possibility for the parts, components, products or systems to perform the functions for which they have been designed for subsequent brazing or welding, without failing as a result of the application of the technological process. Under the specified conditions, the above-mentioned parts, components, products or systems will function safely along their entire lifespan, a time period defined by a level of reliability guaranteed by providing the usage warranty.

Reliability engineering for brazed or welded assembled systems offers theoretical methods and practical techniques as means for specifying the probability and capacity of braze-welded components, equipments, products and systems probability to achieve the functions for which they have been designed and constructed. The brazing and welding activities must be undertaken under precise conditions and known levels of reliability regarding the usage time. The applied technologies have to be specific and they also have to be designed, tested and demonstrated under the conditions that they function in, subsequent

monitoring also being necessary. Therefore, from the modern point of view [3,4], reliability is generally based on an ensemble of study activities and on the analysis of technical solutions, materials, technologies and costs, all necessary for the deployment of a technological application. This ensemble can contain activities regarding the methodology and calculus procedures elaboration - for the dimensional and functional pre-estimation of the adopted solution, regarding documentation preparing and experimental results and prototype testing interpretation.

In conformity with the international standards, reliability is defined as a product or service properties and characteristics ensemble, an ensemble which offers the aptitude if being a reliable product or service. Thus the notion of reliability results from the proportion between the characteristics ensemble and the beneficiary necessities. Therefore, quality can be explicitly expressed by means of special characteristics such as: reliability, maintenance capability, availability and security, which can all be rigorously defined mathematically. Quality depends on several factors and on numerous interdependent activities, which, if grouped regarding the main domains of design, fabrication and usage, form the conceptual model denominated as the "quality loop" (**Fig. 1**). Based on the quality loop concept, the components are: design quality, fabrication quality and usage quality, which also contains maintenance elements [5].

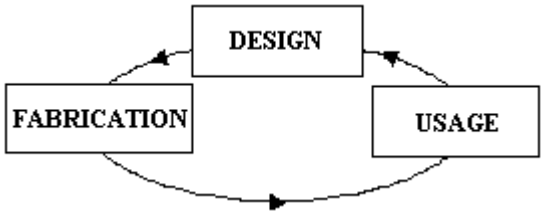

Fig. 1. The quality loop, within the general concept of reliability.

A products' level of quality is decided in the conception phase (design/development). The subsequent fabrication and usage steps only achieve the calculated quality or spoil it by means of technological deviations, derogations from the prescribed material, inadequate control, or usage and maintenance with exceptions from the specified instructions.

Quality and reliability have constantly evolved [6], passing from empiric design, specification and certification, to the quality assurance stage. For this matter, there is a new quality concept in power: "excellence". Quality characteristics like reliability, maintenance capability and sometimes security, must be regarded and treated in a similar manner to other classical technical characteristics and must be considered of an equal rank in designing, fabrication and usage.

A series if quality indicators have become "classical", because all are defined as mathematical expressions and practical values. Therefore the designers have to be acquainted with a collection of general quality related indicators such as: F – failure rate; MTTF – mean time to (first) failure; MTBF – mean time between (two consecutive) failures; MTTR – mean time to repair; MUT – mean up time (after repair); MDT – mean down time.

From the **quality** point of view, reliability can be defines as the capacity (aptitude) of a product, obtained by means of braze-welding or welding techniques, to accomplish the nominal operating requirements (the specified resistance and stability function), in defined environmental conditions and operating demands and within a preordained period of time. Reliability analysis for this last case offers information regarding the functioning of different types of assemblies done by brazing or welding and the diverse reshuffle possibilities for these kinds of assemblies.

The reliability quality analysis consists of the following stages:

- the analysis of the imperfection appearance modalities, of the influence of various types of imperfections and of the possibility of evaluating their consequences upon the functioning of the braze-welded or welded ensemble. Imperfections such as cracks, microcracks, deformations due to internal stresses, material discontinuities etc. are being analyzed;
- the systematizing and graphical representation of the information obtained from the previous analysis, shaped as a logical schema (block diagramme or imperfection tree), which would highlight the most frequent types of interventions which appear when applying the braze-welding technology.

Along with these concepts, two other extra ones can be introduced, concerning the functioning security and the functioning of the brazed or welded assembled systems risk. The security of a system usually has two ways of understanding:

- the intrinsical sense, which concerns only the technical system and which represents this systems' ability to complete its functionality, without the danger of own or adiacent components destruction;
- the relational sense (of technological interconnection) which refers to the systems' external environment as well, including the human factor, and which represents the systems' ability to complete its functionality without endangering human life or having adverse consequences upon the exterior environment.

Security is measured by a probability. Security it linked to reliability by the fact that reliability ensures security, but non-reliability does not implicitly assume non-security or risk. Risk is a notion which attaches to non-reliability or to non-security a measure of their effects, a consequence of a product which cannot have an infinite working period. Therefore risk has two components: a probability to be achieved and an economical consequence, evaluable or not. Risk represents a basis notion in taking decisions.

The objectives of qualitative analysis of reliability factors [7] are:

- identifying weak spots within the design and engineering stage;
- highlighting the potential flaws by ranking and criticality identifying;
- providing statistical data, necessary for the quantitative analysis of reliability.

Regarding that reliability represents the probability that the braze-welded mechanically assembled system completes its functions for which it has been designed and built, with a certain performance indicator and without flaws, in a certain time interval and for given conditions, with a confidence level (operational safety) imposed via specific norms, the **qualitative** approach to reliability targets the quantification, as numeric indicators, of the reliability level for established entities such as:

- the comparison of two or more technical solutions from the obtained performances point of view;
- the demonstration of the reliability indicators values abidance by certain imposed limits, in interfacing areas with other similar technologies (mechanical assemblies with rivets, bolts, electric welding, etc.);
- the identification of weak nodes (nodal points) within the applied or analyzed technology;
- the foreseeing of warranty indicators, which can be included in future offers and contracts for braze-welding technology, material and equipment provision.

Reliability can be defined as a probability function, with time and a certain studied system behavior as variables:

$$R(t) = P[T > t] \text{ for } t \geq 0 \qquad (1)$$

For a binary element, to which a braze-welding process is applied, two states can be identified: assembled element → unassembled or functional → not functional; reliability can now be defined mathematically by:

$$R(t) = P[T_f > t] \qquad (2)$$

where T_f represents the uninterrupted working time for given conditions, which consist of effects determined by the outer environment, which are due to functioning, maintenance, etc. The time interval defined the standardized (designed) life period.

Reliability, as a notion, implicitly assumes a certain level of technology and a strong industrial activity and it refers to a set of demands which must be respected all along the products existence. The designed and desired level of reliability throughout this period of time can be the result of an optimization process based on expenses and/or savings [8].

Quantitatively, reliability can be defined in several ways:

- estimated reliability, resulted from the controlled experimental exploitation and from the laboratory tryouts: endurance (with nominal stress), accelerated to destruction (with increased stress);
- operational reliability represents the result obtained by controlled experimental exploitation (exploitation statistics);
- preliminary reliability, for systems, as a result of calculi based on element and system structure reliability. Also known as system structural reliability;
- extrapolated reliability, obtained via extrapolation calculations for the

accelerated (with increased stress) laboratory obtained results;
- nominal reliability is given by the manufacturer.

Therefore, is can be deduced that reliability is a component of quality – it is quality in time.

Maintenance capability (Mn) represents a concept which reflects, in a general way, the result of maintenance for the readjustable elements and systems (for given usage conditions, Mn represents the ability of the system or element to be maintained or reinstated in a functional condition, when maintenance is completed in given conditions and by prescribed processes and technologies) and can be defined as the probability that a certain element or system, which is out of order at a specified time *t*, would pass into functioning state in the subsequent time interval. For this, terms like total predictive maintenance (TPM), proactive planned maintenance (PPM) or reliability centered maintenance (RCM) can be used.

The objectives of quality engineering, of process reliability and of braze-welding equipment

The study of braze-welded products reliability is being done by structural analysis and by the "braze-welding technologies specific flaw prediction tree" method or, in short, the flaw identification tree. For brazing and welding activities, the series type logical structure is often being encountered. In this case, the major critical flaw/defect (D_{cr}) of a brazed or welded product is related, via serial type influence, to the elementary flaws/defects (D_i) which the product contains (discontinuities, microcraks, inclusions, pores), as follows:

$$D_{cr} = \bigcup_{i=1}^{n} D_i \qquad (3)$$

The "braze-welding technologies specific flaw prediction tree" method allows for the schematization and tracking of these logical links between defects. Such a representation by principle is presented in **Fig. 2**.

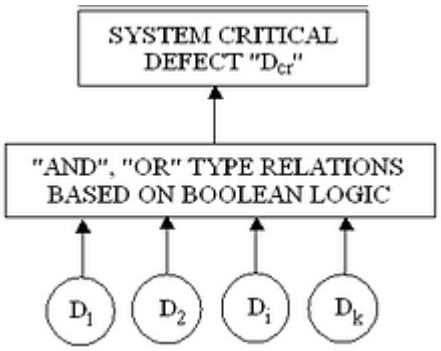

Fig. 2. Flaw identification tree.

Generally, the identified and recorded flaws, during the period of applying a certain technology, are compatible and independent events [9], and the value of the critical event probability, $P(D_{cr})$, is determined by the values of the elementary defects probabilities $P(D_i)$, according to:

$$P(D_{cr}) = 1 - \prod_{i=1}^{n} [1 - P(D_i)] \qquad (4)$$

Next, applying the stochastic analytic modeling to braze-welded systems reliability analysis will be presented. Calculating the "operational safety coefficients" represents an essential objective in designing quality. This coefficient is being calculated based on the flaw probability value, related to the characteristic to which it refers to (imposed, accepted or determined by flaw identification tree probability). Therefore, by taking into account the u and v characteristics, the safety coefficient is:

$$\gamma_s = \left(1 - Z_\alpha \frac{\sqrt{\sigma_u^2 + \sigma_v^2}}{V}\right)^{-1} \qquad (5)$$

where Z_α represents the value which corresponds to the respective flaws/defects probability $P(D_i)$.

Estimating the natural variation intervals for all dimensional or functional material characteristics and the tolerance calculus represent an important objective of modern design. During conception, the aleatory aspects related to the technological processes of fabrication must be taken into account when pre-estimating a characteristic for certain equipment. It is necessary that for every characteristic x_i the medium (nominal) value μ_i and the dispersion σ^2_i are known.

If a relation such as $Z=\varphi(x_1, x_2, s\ldots, x_n)$, linear or non-linear, is being used for designing, representing a systems' characteristic and being

dependent on the x_i (i=1,2,...,n) characteristics of the components or different physical variables, then the Z characteristics' mean is $\mu_Z=\varphi(\mu_1, \mu_2,\ldots, \mu_n)$, and the dispersion will be:

$$\sigma_Z^2 = \sum \left(\frac{\partial \varphi}{\partial x_i} \right)^2 \sigma_i^2 \qquad (6)$$

The σ^2_Z dispersion shows the dependency between the variation of a systems characteristic and the component variations. Further more, this relation determines the spreading of errors or deviations by the x_i to Z parameters calculation formula.

Generally, there is a relation between the prescribed tolerance, T and the standard deviation, σ:

$$T = k\sigma \qquad (7)$$

where k is chosen regarding the particularity of the characteristic and the accepted risk. Thus, in case of a stable and perfectly centered fabrication process, for k=6 the risk is 0.28%. The preliminary reliability analysis and the establishing of the base indicators are being done by taking into consideration, at first, the exponential repartition:

$$R = e^{-\lambda t} \qquad (8)$$

where λ – recorded flaws rate; t – the time, expressed in time units or technological cycle duration (**Fig. 3**).

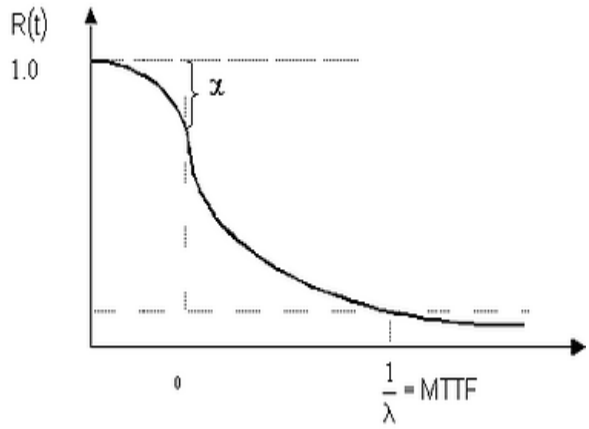

Fig. 3. The reliability curve R(t) depending on the mean time to the first failure.

Between the base indicators **MTTF** – Mean Time to Failure, and **MTBF** – Mean Time Between Failures (consecutive) the following relation exists:

$$MTTF = MTBF = \frac{1}{\lambda} \qquad (9)$$

If for a braze-welding assembled bicomponent system, after a functioning time t_o, the acceptance that the forming probability of a flow is α is proposed, then:

$$\alpha = P(D_{cr}) = 1 - R(t_o) = 1 - e^{-\lambda t_o} \qquad (10)$$

In this way, the values of the flaws/defects rate and of the MTTF or MTBF indicators can be obtained.

By using a defect analysis method (DAM) and the defect tree method, where $P(D_{cr})=\alpha$, the probabilities of the elementary flaws $P(D_i)=\alpha_i$ can be determined, which can occur in the braze-welding assembled system. With these values, one can determine the related operational safety coefficients.

For some different systems, which contain braze-welding assembled galvanized steel components, it is better to consider that a Weibull distribution of flaws is obtained. With this hypothesis, reliability is:

$$R = e^{-\left(\frac{t}{\eta}\right)^{\beta}} \qquad (11)$$

where η and β are the Weibull distribution parameters, estimated from previoud research, and:

$$MTTF = \eta \Gamma \left(1 + \frac{1}{\beta} \right) \qquad (12)$$

where Γ is the gamma function.

In this special case, reliability can refer to a mechanical system obtained by braze-welding or only to a component of this particular system. For the systems with a logical structure, for which the flaw interaction is of the serial type and which are composed of n elements with R_i correspondent reliabilities, the system reliability will be:

$$R = \prod_{i=1}^{n} R_i \qquad (13)$$

the defect occurrence rate in the system being:

$$\lambda_s = \sum \lambda_i \qquad (14)$$

where λ_i is the flaw recording rate for the "i" component.

The maintenance indicators must be specified for the repairable systems. The afferent theory for this domain offers a series of simple relations, based on the exponential repartition:
-asymptotic availability:

$$A = \frac{MUT}{MDT + MUT} = \frac{MUT}{MTBT} \qquad (15)$$

-asymptotic unavailability:

$$U = \frac{MDT}{MDT + MUT} = \frac{MDT}{MTBF} \qquad (16)$$

In traditional design, the safety coefficient c, defined as a proportion between the resistance to stress V and the stress applied to the assembled area U, is arbitrarily adopted, c= V/U, based on the previous fabrication and exploitation experience in braze-welding. By respecting the condition V>U, respectively c>1, even from the project stage, the functionality of the ensemble can be assured, without danger all along the products' life cycle. As V is even greater than U, the safety gets better, but also the material and energy consumption increases.

In the structure of the braze-welding assembled systems, the alloys system, to which the braze-welding technology can be applied, presents a significant importance. The alloy systems, as material contributions used for braze-welding technologies, have therefore been created such as the costs for raw material, alloy material for welding and the costs for energy consumption for applying the technology would all be optimal and the properties obtained after applying the technology would be at the same quality level with the properties of the base material upon which the technology was applied.

The assembled elements are usually subdued to traction or bending stresses, and the dimensional and functional characteristics depend on the types of stresses, on the temperature and the environment's corrosive nature as well. Based on previously completed experiments on a test stand, by the precise choosing of the test values and of the environment type for exposing the structure, a deterministic way of calculating with an arbitrary safety coefficient can be replaced by an operational calculating method, for which a certain braze-welding assembled system reliability has been imposed.

The presented analysis can be completed by an economical quality-cost-benefit-efficacy one, which has only been contoured according to **Fig. 4**. This might generally offer to interested specialists a more precise picture regarding the quality and efficiency of applying the technology as well as its reliability [10].

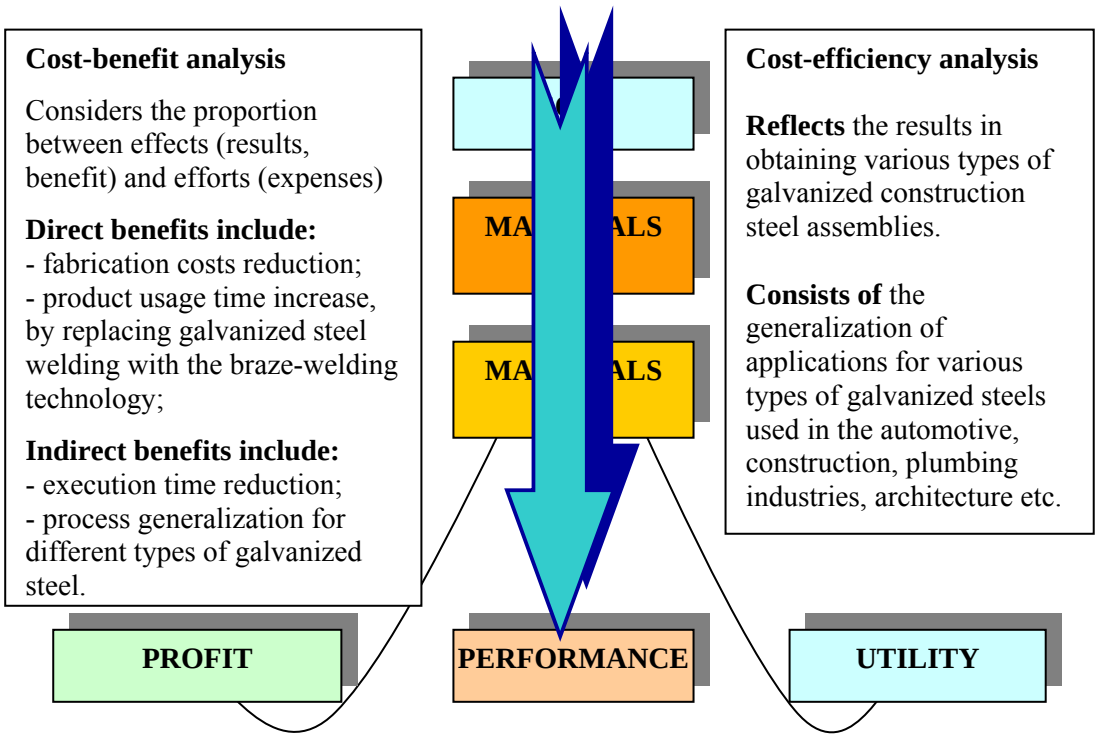

Fig. 4. The schematic presentation of a benefit-utility-performance analysis.

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A HYDROPNEUMATIC STATION'S STRUCTURE ANALYSIS AT EXTERNAL FACTORS ACTION

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Abstract: *A hydro-pneumatic station is used to convert sea wave action into electrical energy. This station traps waves in a partially submerged chamber with a hole in one wall above the water line. The hole leads to an air-driven turbine. As the crest of a wave enters the chamber, the water level is quickly raised, pushing the air above the wave through the hole and spinning the turbine's blades. The turbine is designed to turn the same way no matter which way the air flows, so the machine also runs as the retracting wave sucks the air back into the chamber. The paper presents numerical results from finite element simulation based on the 3D model of the hydro-pneumatic station and dynamic pressure which act on it during the wave's impact on lower structure.*

Keywords: *hydro-pneumatic station, finite element, dynamic analyses, dynamic force, waves' power, wave energy conversion.*

1. INTRODUCTION

To convert wave action into useful energy, a power must provide a way for waves to drive something, such as hydro-pneumatic station. This system traps waves in a partially submerged, artificial chamber with a hole in one wall above the water line. The hole leads to an air-driven turbine. As the crest of a wave enters the chamber, it raises the water level quickly, pushing the air above the wave through the hole and spinning the turbine's blades.

The paper presents numerical results of the simulation in dynamic behavior of the hydro-pneumatic station structure taking into account the acting force of waves on it, and especially of its base. Numerical results are obtained with finite element software. The purpose of the study is to see the dynamic behavior of some important parts of an electrical hydro-pneumatic station powered by wave, and in particularly the study of the hydro-pneumatic station base structure.

2. ANALYSIS

2.1. Analyzed Configuration

The main idea of this paper is to study the dynamic behavior of the hydro-pneumatic station base during the wave's impact on the upper structure. Study the dynamic behavior of the hydro-pneumatic station base when the waves act on the lower structure.

The studied model is presented in figure 1.

For the numerical simulation we make some assumptions for simplification:

- the waves forces are greater then the sea currents due to the waves impact on the upper structure;
- the variation of pressure with depth will be unused, because is considered too small compared with the dynamic force;

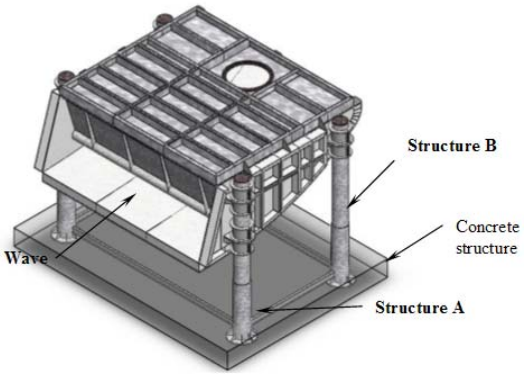

Fig. 1 The 3D model of the hydro-pneumatic station

- we use only the dynamic forces to see the base behavior (the exceptional forces);
- we consider a surface flow for the upper structure about 3 to 6 square meters.

2.2. Setup Case and Mathematical Background

For the maximum waves pressure was made a simulation of water flow on the simplified structure in 2D, using a dynamic mesh. The waves a function was implemented using the total wave energy as a function of T and h.

The total wave energy was calculated as the sum of the kinetic and the potential energy.

The flow field result especially pressure maximum peak is represented in the pressure flow field presented in figures 2 and 3, for successive steps.

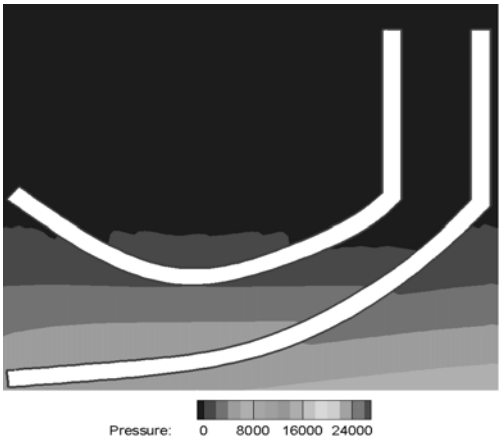

Fig. 2 Total Pressure [Pa] contours obtained using the dynamic mesh simulation at 2,691 time step

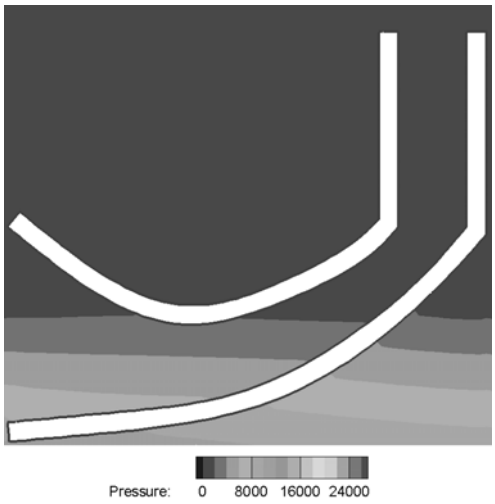

Fig. 3 Total Pressure [Pa] contours obtained using the dynamic mesh simulation at 2,991 time step

Considering that the oscillating pressure in the chamber is a sinusoidal function, with maximal amplitude of 24 kPa, we can study the dynamic behavior of the hydro-pneumatic station's base structure. The study is made using Cosmos and SolidWorks. The model of the base is created in SolidWorks and is imported in Cosmos to study it.

The structure's study was made using a value of the maximum peak for dynamic pressure around 12 kPa.

The model used for simulation is represented in figure 4.

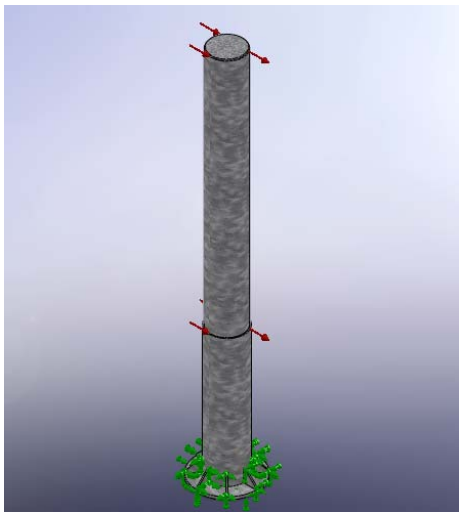

Fig. 4 Studied configuration

3. RESULTS AND CONCLUSIONS

The numerical simulation was made with the assumptions made on the first paragraph,

and considering only the exceptional forces, materialized here in dynamic forces of waves.

Considering pressure a variation in time for pressure, a dynamic study was made for this configuration. The time step for simulation was about 0.314 seconds and the total time of simulation was of 6 seconds. The metal used for the structure was Steel AISI 1020. the simulation was done for this type of steel.

The results are presented in a centralized form in table 1.

Table 1 Stress and displacements results

Time step [sec]	Stress [kgf/cm^2]	Displacement [mm]
0.2691	6.493	1.447
0.2991	3.423	2.409

From the results obtained in table 1 we can say that we have some preliminary results to design this mode of station.

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NUMERICAL AND EXPERIMENTAL STUDY OF THE LAUNCHING DEVICE OSCILLATIONS DURING THE LAUNCH

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Abstract: *An important problem that appears in the study of sloped rocket launch is to determine the launchers oscillations during firing and also the disturbances the rocket gets in the moment of the launch, phenomenon that influence the stability of the launcher and firing precision. The main preoccupation in the rocket launching system design, fabrication, experimentation and maintenance is the rigorous evaluation of the launching system oscillations influence upon the rocket's performances and upon the rocket's flight parameters as well as the study of the rocket compatibility with the launching system. The article presents the calculations by numerical and experimental methods of the launching device oscillations during the launch.*

Key-Words*: launching device, oscillations, intrinsic frequency*

1. INTRODUCTION

The study of the launching device's oscillation during firing is necessary for the design of precise and efficient rocket-launching system, especially in the case of unguided rocket. We consider that the launching device with the moving rocket form an oscillating system, described by an assemble of the rigid bodies (as depicted in fig.1). The system is bound together by elastic elements, consisting of the following main components: the vehicle chassis (supporting the launching device's basis with the revolving support of the mechanisms), the tilting platform (with the rocket's containers) and the rockets (including the moving rocket).

When launching the rocket, the system acts as a complex oscillating system. This system is considered as a set of the rigid bodies bound together by elastic elements. It has a high number of degrees of freedom; hence a complex study of the oscillations is induced. To simplify the computation while still avoiding any limitation in generalization the study, we consider that the motion of the rocket-launching device system during launching can be completely described by 6 status-variables [1]. They are: the rocket linear translation in the container's guiding tube, s, two angles that define the tilting platform's position (pitch and gyration oscillations), φ_y, φ_z, other two angles that define the vehicle chassis pitch and rolling motion, γ_x, γ_y, and the chassis center of masse oscillating vertical displacement, z_S. In this study, all the forces and moments acting on the rocket-launching device system during firing are taken into consideration.

Since the differential equations system [1] that defines the system's oscillating motion is quite complex, it can't be solved in an analytical way; hence we need to use a numerical solving. So, it was necessary to create a programming algorithm and to develop a numerical application (named ILANPRN [2]), consisting of numerical solving rocket-launching device system's movement equations by successive iterations. With each iteration the rocket-launching device system status variables are computed one by one by the means of the container, the guiding tube movement equation, the tilting platform and the chassis

angular oscillation equations, as well as of the chassis vertical translation equation.

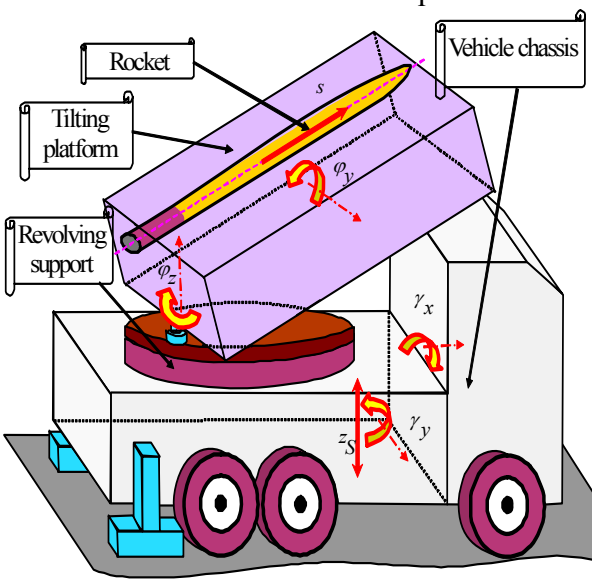

Fig.1. The components of the rocket-launching device system

We use the 122 mm unguided rocket-launching device with a container of 40 rockets. In order to validate the programming algorithm and the numerical application ILANPRN the experimental results were compared to the numerical results concerning the launching device oscillations.

2. THE NUMERICAL DETERMINATION OF THE LAUNCHING DEVICE OSCILLATIONS DURING FIRING

2.1 *Computational diagrams*

In order to solve the differential equations system [1] that describes the launching device oscillations during firing, we use the numerical methods. In this respect the authors developed a programming algorithm and a numerical application named ILANPRN (fig.2). This programming algorithm allows the computation of the launching device oscillations as well as the computation of the rocket flight evolution on the trajectory. The numerical application is structured on 5 main modules: the „*data management*" module, the „*launching device parameters*" module, the „*launching device calculus*" module, the „*results of the launching device calculus*" module and the „*rocket flight evolution on the trajectory*" module.

Solving the equations that describe the rocket-launching device system motion [1] assumes an iterative method. Any iteration separately solves the equations corresponding to each system component levels (the moving rocket, the tilting platform and the vehicle chassis) considering that the status variables of the other known components.

To solve the rocket-launching system equations we need to know the initial firing parameters. Some of them are as follows: the rocket's parameters, the presence of the rockets on the container as well as the initial firing position (the orientation of the tilting platform upon the firing direction).

Because the rockets are in the guiding tube of the container, these will have the same movement like the tilting platform: the rotation γ and the translation $\bar{z}_S$ from the vehicle chassis, and the rotation φ from the tilting platform (fig.3). In relation with the tilting platform, the rocket has a translation motion with the velocity $\dot{\bar{s}}$ and a rotation motion with the angular velocity $\dot{\bar{\beta}}$.

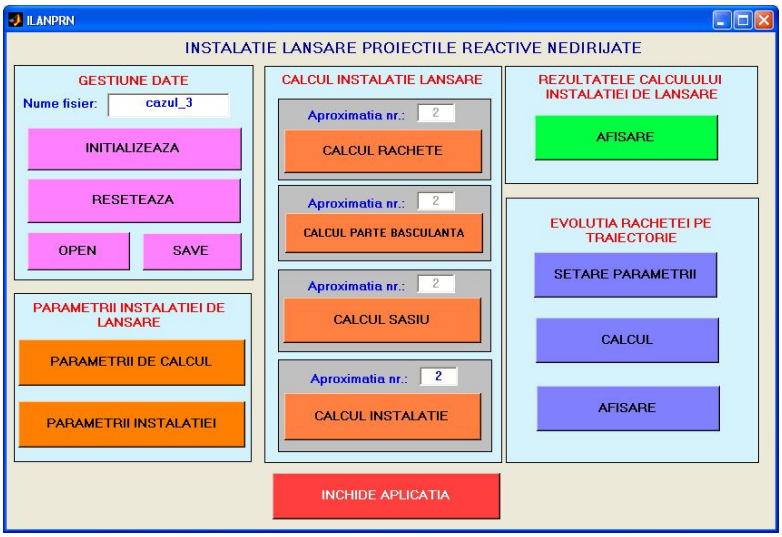

Fig. 2 The numerical application ILANPRN for the launching device calculus

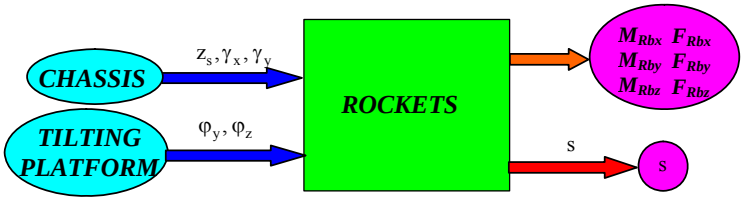

Fig. 3 Rocket's computational diagram

Solving the rocket equations allow getting the values of the link forces and moments between the rocket and the tilting platform, as well as the time history of the rocket's velocity, acceleration and position during the rocket's movement in the guiding tube. Subsequently we compute the tilting platform movement parameters (φ_y, φ_z) and the link forces and moments between the tilting platform and the vehicle chassis (fig. 4).

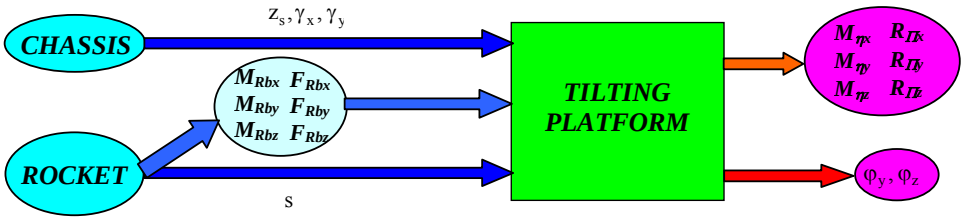

Fig. 4 The tilting platform's computational diagram

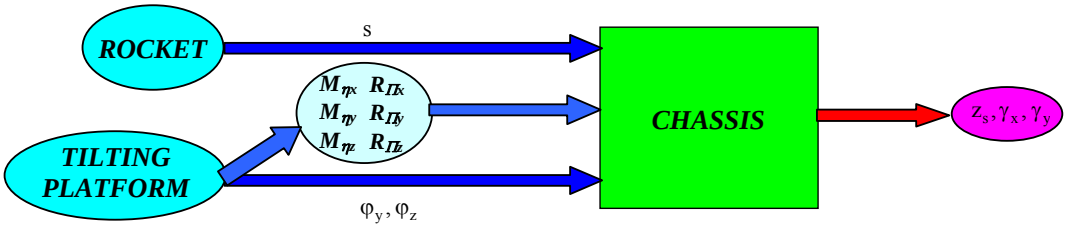

Fig. 5 The vehicle's chassis computational diagram

Eventually, we calculate the chassis movement parameters (fig.5). We obtain the time history of the vehicle's chassis center of masse vertical translation z_S, as well as the rotation of the vehicle's chassis around the center of the masse γ_x, γ_y during firing. So, in this application we determine the motion parameters of the launching system during firing (the rocket's translation s, the tilting platform's rotation φ as well as the chassis' translation z_S and rotation γ). Using these status variables, the numerical application allows the calculations of the motion evolution for any point located on the launching device during firing.

2.2 *Numerical results*

We further present some results obtained by numerical solving of the equation system in according to the previously presented programming, in order to study the rocket-launching device system.

Many simulations are computed in a single rocket firing case with the rocket in central position in the container (position no. 15).

The time history of the status variables that describe the rocket-launching device system $(z_S, \gamma_x, \gamma_y, \varphi_y, \varphi_z, s)$ is presented in fig. 6 - 11.

We notice that the displacement z_S of the chassis center of masse has an oscillatory evolution (fig. 6) having a 0.75 s oscillating period. The oscillating amplitude has the initial value of 1.6 mm, and after the first period it decreases to 1 mm (62.5% from the initial amplitude).

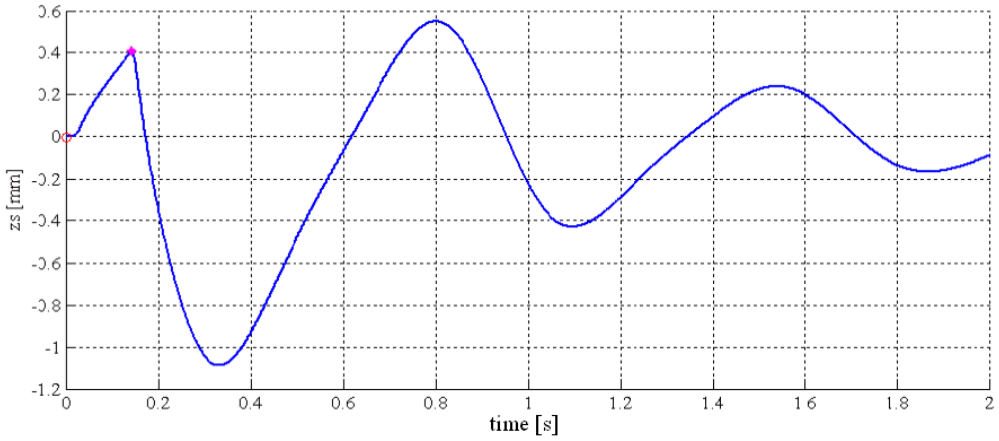

Fig. 6 Time history of the z_S displacement

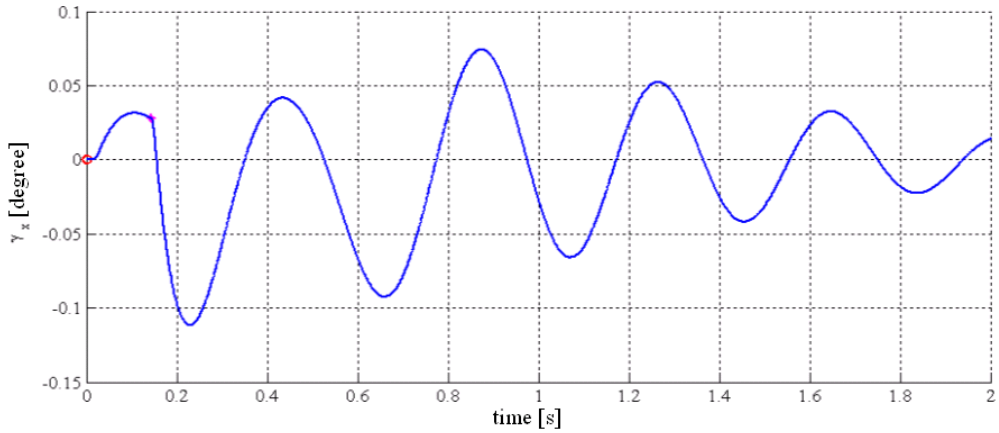

Fig. 7 The time history of the rotation angle γ_x

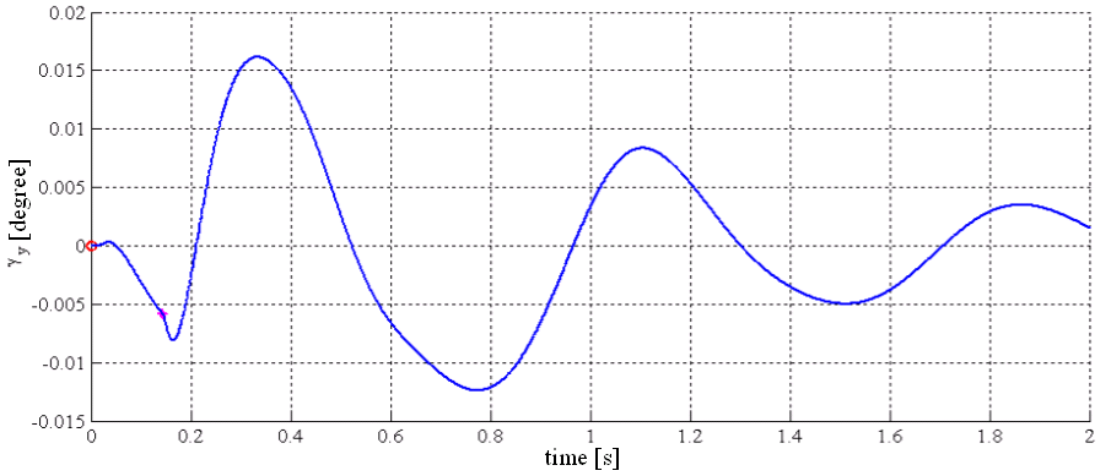

Fig. 8 Time history of the rotation angle γ_y

The chassis angle rotations γ_x and γ_y have also a damped oscillatory evolution (fig. 7 and fig. 8). Moreover, the oscillating period for γ_x (0.4 s) is smaller than the oscillating period for γ_y (0.8 s). The γ_x oscillating amplitude is 0.18 degrees while the γ_y oscillating amplitude is only 0.028 degrees leading to the conclusion that the rolling oscillation is more important than the pitch oscillation.

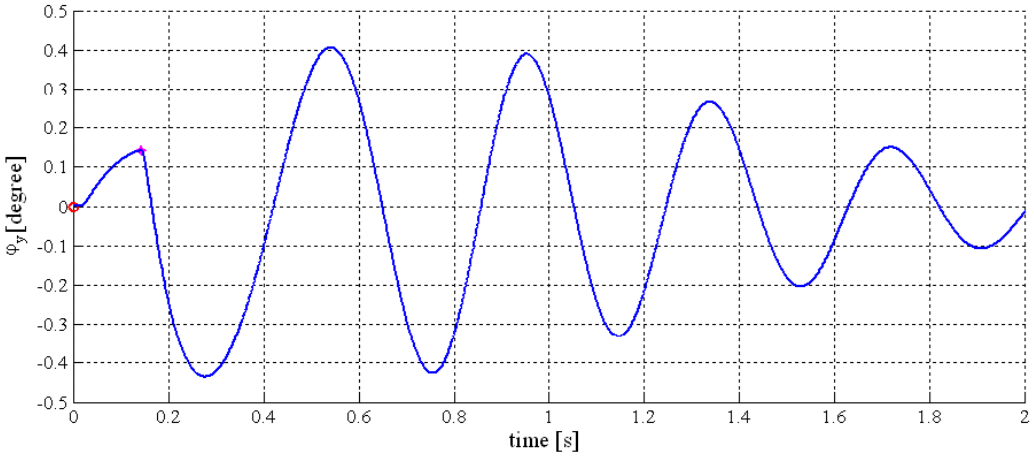

Fig. 9 Time history rotation angle φ_y

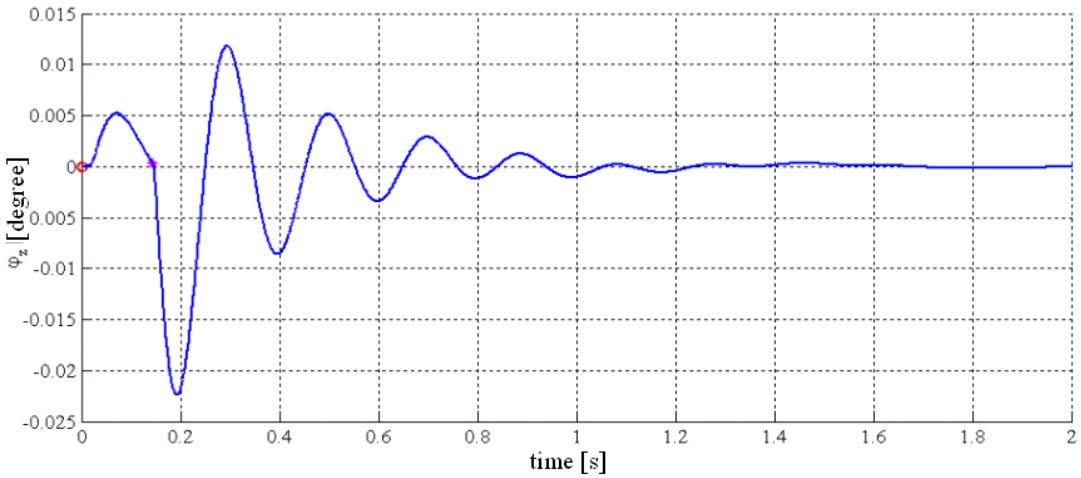

Fig. 10 Time history of the rotation angle φ_Z

As the oscillations of the tilting platform are concerned, the rotation angle φ_y (see fig. 9 and fig. 10) has a larger period (0.5 s) and larger amplitude (0.8 degrees) than φ_z (0.2 s oscillating period and 0.04 degrees oscillating amplitude). So, we can say that, at the tilting platform level, the main oscillation is the pitch oscillation (φ_y).

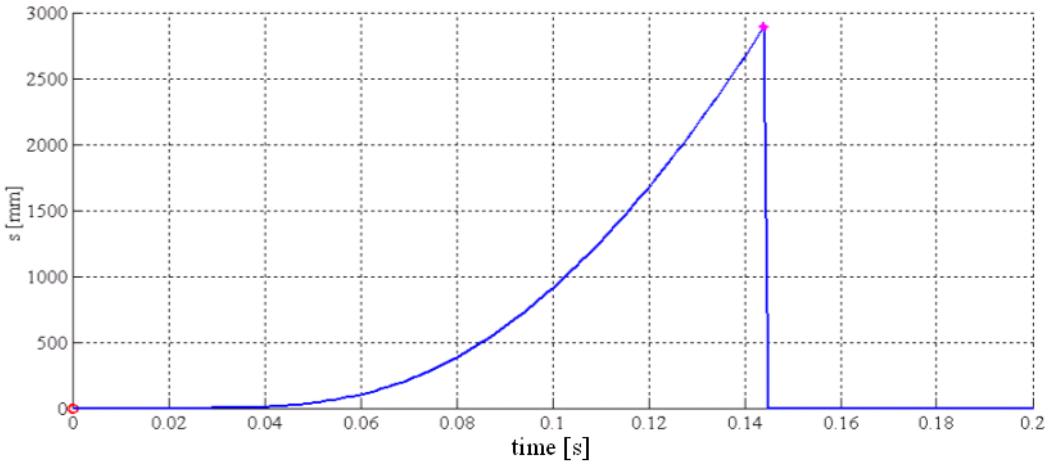

Fig. 11 Time history of the displacement s

Fig. 11 depicts the trajectory of the rocket's center of masse during the launching. The evolution range starts from zero (initial position) to 3 m (the position of the rocket's center of masse when it leaves the launching device).

3. EXPERIMENTAL RESULTS OF THE LAUNCHING DEVICE OSCILLATIONS

3.1 Experimental configurations

The aim of the experimental tests is to evaluate the measured parameters of the oscillations and to compare these values with the ones given by the numerical application ILANPRN, developed using the theoretical model [1].

Considering the hypothesis that was used to develop the theoretical model (concerning the type of the launching device), the experiments were developed upon an unguided rocket sloped launching device (122 mm unguided rocket launching device with 40 guiding tubes in 2 containers – APRA 122).

The experimental configuration used to measure the parameters of the launching device oscillation as time histories is shown in fig. 12.

The experimental development aimed at obtaining the intrinsic frequency, the dumping time response as well as other parameters that describe the free oscillating motion. We use many sets of records corresponding to the 4 configurations based upon the position of the displacement sensor (TD) and upon the two cases possible for the chassis suspension: **fixed** (as in the time of firing) or **free**.

3.2 Experimental results

We present the experimental results for the particular cases when the displacement sensor has its body fixed at the horizontal platform, and the sliding rod attached on the left extremity of the second vehicle axle.

Fig. 13 and 14 depict the time history of the displacement of the point placed on the left extremity of the second vehicle axle.

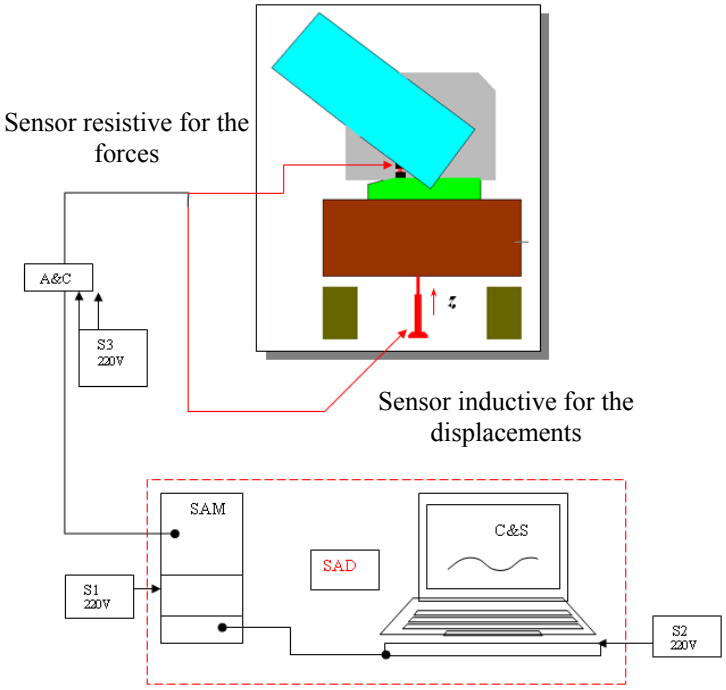

Fig.12 Experimental configuration

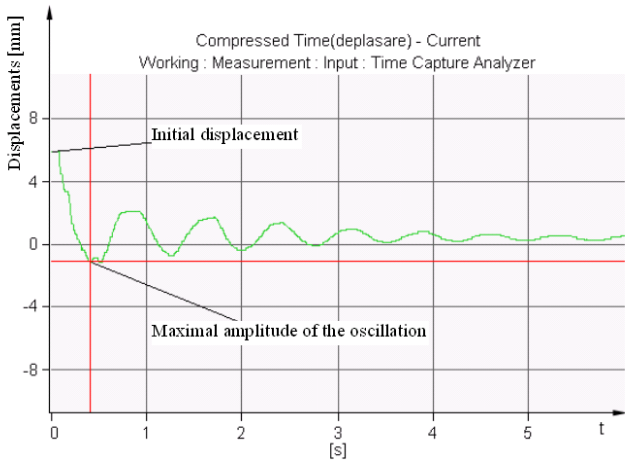

Fig. 13 Time history of the displacement in vertical plan of the point placed on the left extremity of second vehicle axle (fixed suspension case assumed)

We notice that a visible difference occurs between the two cases for the maximal value of the oscillating amplitude: in the case of the fixed suspension the maximal amplitude is 2.33 mm, and in the case of the free suspension the maximal amplitude is 2.69 mm.

Analyzing the previously presented experimental results, we notice that the launching device has an oscillating motion (in fact the vehicle chassis' oscillating motion is transmitted to all other components: the tilting platform and the rockets). The intrinsic frequency measured is about 8.01 rad/s corresponding at 0.78 s the oscillating period. These experimental values are close to the ones that have been obtained by numerical means (8.15 rad/s and 0.77 s). The determination of these parameters (intrinsic frequency and oscillating period) is very important in order to study the optimal time between two successive launches. This study is useful in avoiding the resonance phenomenon that may lead to the amplification of the launching device oscillations (in this case the rocket-launching device system will be unstable).

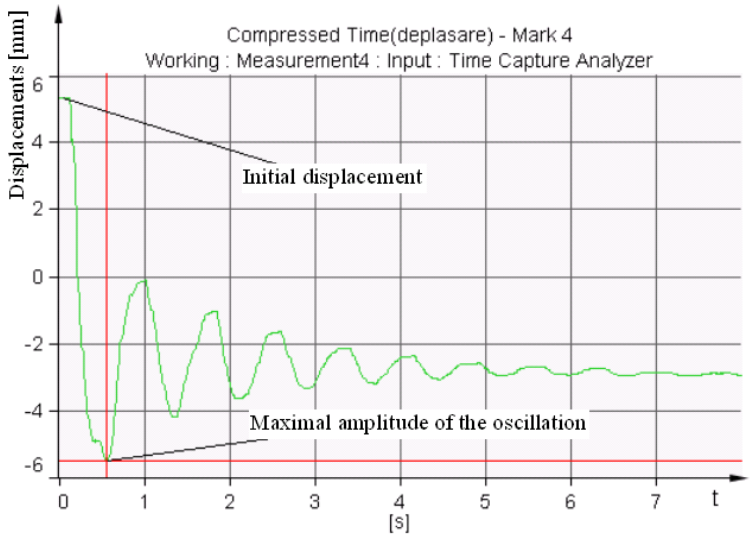

Fig. 14 Time history of the displacement in vertical plan of the point placed on the left extremity of second vehicle axle (free suspension case assumed)

4. CONCLUSION

The evolution calculus of the rocket-launching device system state variables during firing sequences allows the evaluation of dynamic forces that are present at all levels of the launching device system component, and therefore the analysis of the dynamic behavior of the whole assembly system.

Evaluating the oscillation parameters of a rocket-launching device system, their influence upon the system's stability during firing, such as the initial rocket flight condition, leads implicitly to the evaluation of the firing accuracy. This last issue is essential in the design of a precise rocket-launching device system.

In conclusion, a rocket launching phase design needs to take into account the system's oscillations. These oscillations can be computed by numerically solving a theoretical model [1] that has also confirmed by the experimental results, which, at their turn, validate and lead to the improvement of the numerical programming algorithm.

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THE UNSTEADY HEAT TRANSFER THROUGH THE BOUNDARY LAYER OF ARTILERRY SYSTEM'S GUN BARREL

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Abstract*: The heat transfer in the artillery system cannot be evaluated separately from the internal ballistic cycle. The solution of the momentum equation of the unsteady compressible boundary layer has been developed in order to match with to the special features of the gun boundary layers. Including more approximations, the partial derivative equation is transformed in differential one and affords exact solutions. Instead of including the energy equation in the integration procedure, a derivate Reynolds's analogy, the Chilton-Colburn analogy between heat and mass transfer is used to evaluate the heat transfer coefficient. Based on the mathematical model, a computer program has been developed to supply with the data for plotting of the variations of the boundary layer parameters and convective heat transfer coefficients versus the space.*
Key words*: Convective Heat Transfer, Unsteady Compressible Boundary Layer, Shape Factors, Method of Characteristics, Chilton-Colburn Analogy.*

1. INTRODUCTION

During firing cycle with an artilerry system, a signifiant part of propelant gases energy is loosed to heat the barrel, the shell and unburned propellant webs, phenomen called heat transfer. As the temperature gradient at the wall barrel depends on the high values of gas density that exist, and the characteristics of gas motion between breech end and the projectile behind, it is obvious that every heat transfer analyse is validated only in conection to the internal ballistic cycle evaluation.

As the projectile in weapon moves ahead because of the high-pressure gases created by the burning propellant, the propellant gas will be set into motion starting from the rest. The type of motion at a particular cross section at any instant need not be the same as at another instant, the flow in gun barrel could be laminar, transitional, or turbulent in nature.

Since the Reynold's number Re takes high values and the gas viscosity shows small values, for the evaluation of heat transfer al the solid surface level, one can assume the Prandtl's hypothese accordingly which, at any cross section, the gas velocity decreasing from the nominal value at the centreline to zero at the edge section (no slip condition) occurs only at a short thickness, namely boundary layer.

Therefore, the gas flow field should be examined and the overall problem should be splitted in tho parts: transient inviscid, compressible flow through central section of the barrel and unsteady compressible boundary layer flow near the bore surface.

The subject of this paper is primarily concerned with the analytical representation of the transient, compressible turbulent boundary layer wich expected in gun barrels.

The heat transfer coefficient is evalueted here based on the Chilton–Colburn analogy of the energy boundary layer to the momentum bounary layer.

The boundary layer shows some features which affect the method of solving, as follows:

- an unusual characteristic of the velocity boundary layer is that it dissapers as the projectile is approached since all fluid at the base of the projectile must be moving at projectile velocity. Mathematically, this amounts to the requirement of an additional

boundary condition at a downstream location. That implies that the analyses may be carried out from the both ends of the flow to match the solutions in the middle of the flow;

- since the flow has to start from the rest an must also satisfy zero boundary layer thickness at the bullet base because of the scrapping action of bullet, laminar flow always exists in some parts of the gun barrel boundary layers. Flow in a laminar boundary layer eventually becomes unstable as the Reynld's number is incresed. The boundary thickness, skin friction and heat transfer increase more rapidly in turbulent flow than in laminar one. The bounadry layer flow can be turbulent somewhere in the middle of the flow between the breech and the bullet base. A transitional regime should exist between thwe laminar and turbulent regimes. Therefore, the unsteady boundary layer analysis is needed for laminar and turbulent boundary layer.

2. THE MAIN ASUMPTIONS

All the boundary layer solutions wivh will be developed in this article include the following aproximations:

a) The barel of artillery system is considered smooth and cylindrical bore gun;

b) The gun barel itself is assumed to be devoid of accelerations (recoil and other motion influences could be re-evaluated at some later time);

c) The flow immediately outside the boundary layer is isentropic and one dimensional parallel to the wall;

d) The analysis is restricted to an ideal Noble-Able gas;

e) Because of the small thickness of the boundary layer over the caliber of the gun bore, the motion in the boundary layer is considered planar one;

f) Prssure is constant through the boundary layer perpendicular to the wall;

g) Because of limited knowledge about the transitional regimes, the flow will be assumed to chnage suddendly from laminar to turbulent flow at a time and place determined by a well-known laminar-turbulent criteria; instead of the Reynold's number based on the local distance, a Reynold's number calculated on the momentum thickness is chosed; the echivalent criterion for accelerating flow becomes $\mathrm{Re}_\theta = \rho u \theta / \nu$; if $\mathrm{Re}_\theta > 398{,}4$ boyndary layer is of the turbulent type;

h) There is no separation of the boundary layer from the surface;

i) The gas has a constant Prandtl number, a viscosity wich varies as a power of the temperature;

j) The skin-friction coefficientis the same as the constant-pressure constant-wall-temperature flow on the flat plate at the same free-stream condition, wall temperature, and momentum thickness;

k) The boundary layer shape parameters are those for $n = 1/7$ power profiles of velocity $\left(\frac{u}{u_1}\right)^n$;

l) The analysis ends at the bore muzle.

3. THE MATHEMATICAL MODEL

Based on the mai assumptions, the general time dependent planar-two dimensional continuity and bondary layer momentum equation are:

$$\frac{\partial \rho}{\partial T} + \frac{\partial \rho U}{\partial X} + \frac{\partial \rho V}{\partial Y} = 0; \qquad (1a)$$

$$\rho \frac{\partial U}{\partial T} + \rho U \frac{\partial U}{\partial X} + \rho V \frac{\partial U}{\partial Y} = -\frac{dp}{dX} + \frac{\partial}{\partial Y}\left[(\mu + \mu_t)\frac{\partial U}{\partial Y}\right] \qquad (1b)$$

where the turbulent transport term in equation (1.b) is expressed in the Boussinesq form and all parameters are expressed in term of an inertial coordonate system.

It is useful to transform these relations to a moving coodinate system, whose longitudinal velocity of its origin is U_c; system (1) becomes

$$\frac{\partial \rho}{\partial t} + \frac{\partial \rho u}{\partial x} + \frac{\partial \rho v}{\partial y} = 0; \qquad (2a)$$

$$\rho\frac{dU_c}{dt}+\rho\frac{\partial u}{\partial t}+\rho u\frac{\partial u}{\partial x}+\rho v\frac{\partial u}{\partial y}=$$
$$-\frac{dp}{dx}+\frac{\partial}{\partial y}\left[(\mu+\mu_t)\frac{\partial u}{\partial y}\right], \qquad (2b)$$

followed by the transformation equations:

$$X=x+\int U_c dt\,;\,Y=y\,;\,T=t\,;\,U=u+U_c,$$

respectively ,

$$\frac{\partial}{\partial X}=\frac{\partial}{\partial x}\,;\frac{\partial}{\partial Y}=\frac{\partial}{\partial y}\ \text{şi}\ \frac{\partial}{\partial T}=\frac{\partial}{\partial t}-U_c\frac{\partial}{\partial x}.$$

The pressure gradient can be eliminated from equation (2b) at the edge of the boundary layer where the y derivation of u is equal to zero ($\partial u/\partial y=0$), i.e.,

$$-\frac{\partial p}{\partial x}=\rho_1\frac{dU_c}{dt}+\rho_1\frac{du_1}{dt}+\rho_1 u_1\frac{du_1}{dx}. \qquad (3)$$

If in equation (2b) the pressure gradient is replaced by its expression (3) and the product ρv_p is substituted with its expression by integration of (1b), then after overall integration with respect to y out to a value ℓ' greater than momentum boundary layer δ and the thermal boundary layer δ_t, one could achieves

$$\tau_p=\frac{dU_c}{dt}\int_0^y(\rho_1-\rho)dy+\frac{\partial}{\partial t}\int_0^y(\rho_1u_1-\rho u)dy$$
$$+\frac{\partial}{\partial x}\int_0^y\rho u(u_1-u)dy+\frac{\partial u_1}{\partial x}\int_0^y(\rho_1u_1-\rho u)dy$$
$$-u_1\frac{\partial}{\partial t}\int_0^y(\rho_1-\rho)dy-\rho_p v_p u_1. \qquad (4)$$

Equation (4) is divided by $\rho_1(u_1-u_p)^2$ and, after regrouping, one could achieves the final form of momentum equation, i.e.:

$$\frac{\partial\theta}{\partial x}+\theta\left(\frac{2}{u_1-u_p}+\frac{u_p}{u_1-u_p}\right)\frac{\partial\ln(u_1-u_p)}{\partial x}+$$
$$+\theta\left(1+\frac{Gu_p}{u_1-u_p}\right)\frac{\partial\ln\rho_1}{\partial x}+\frac{1}{u_1-u_p}\left[\frac{\partial G\theta}{\partial t}+\right.$$
$$\left.+u_p\frac{\partial G\theta}{\partial x}+H\theta\frac{\partial\ln(u_1-u_p)}{\partial t}+G\theta\frac{\partial\ln\rho_1}{\partial t}\right]-$$
$$-\frac{(G-H)\theta}{(u_1-u_p)^2}\left(\frac{dU_c}{dt}+\frac{du_p}{dt}\right)=B+\frac{C_f}{2} \qquad (5)$$

where:

$$B=\frac{\rho_p v_p}{\rho_1(u_1-u_p)};$$

$$\frac{C_f}{2}=\frac{\tau_p}{\kappa\rho_1(u_1-u_p)};$$

$$\kappa=\frac{|u_1-u_p|}{u_1-u_p};$$

$$G=\frac{\delta^*-\delta^*_\rho}{\theta};$$

$$H=\frac{\delta^*}{\theta};$$

$\delta^*=\int_0^{\ell'}(1-\tilde\rho\tilde u)dy$ - Steady boundary layer thickness;

$\delta^*_\rho=\int_0^{\ell'}(1-\tilde\rho)dy$ - Un-steady boundary layer thickness;

$\theta=\int_0^{\ell'}\tilde\rho\tilde u(1-\tilde u)dy$ - momentum thickness;

$$\tilde\rho=\frac{\rho}{\rho_1};$$

$$\tilde u=\frac{u-u_p}{u_1-u_p};$$

and subscripts 1, ***p*** referring to properties of flow from central section and, respectively, flow near the wall.

For an isothermal boundary layer, it means that $\delta^*_\rho=0$, then $G=H$ the last term of (5) dissapears:

$$\frac{\partial\theta}{\partial t}+A_1\frac{\partial\theta}{\partial x}+(A_2+A_3)\theta-A_4=0, \qquad (6)$$

where:

$$A_1 = \frac{u_1}{G};$$

$$A_2 = A_1 \frac{\partial \ln \rho_1}{\partial x} + \frac{2+H}{G}\frac{\partial u_1}{\partial x};$$

$$A_3 = \frac{\partial \ln G}{\partial t} + \frac{H}{G}\frac{\partial \ln u_1}{\partial t} + \frac{\partial \ln \rho_1}{\partial t};$$

$$A_4 = \frac{u_1}{G}\left(\frac{C_f}{2} + \frac{\rho_p v_p}{\rho_1 u_1}\right).$$

The quantities A_1 to A_4 are functions of both distance and time which reveal that equation (6) is a differential equations, the unknown is θ.

At the breech end of the barrel and at the projectile end of the barrel, momentum equation has particular forms, equations of first order , unknown t or x, i.e.:

- at the breech end of barrel, where the gas velocity is zero, the coefficient A_2 is zero, equation (6) becomes

$$\frac{d\theta}{dt} + (A_2 + A_3)\theta - A_4 = 0; \qquad (7)$$

- at the projectile end of flow, the bounary layer thickness dissapears, that implies so momentum bounary layers thicness and, also its derivates so equation (6) has a simpler form

$$A_1 \frac{d\theta}{dx} + (A_2 + A_3)\theta - A_4 = 0. \qquad (8)$$

In the general case, equation of momentum (6) can be solved by the method of characteristics.

4. THE BOUNDARY LAYER FRICTION COEFFICIENT AND SHAPE FACTORS

There arc two aproaches for evaluation of the friction coefficient C_f. First of them, one could determines a liasson between C_f and θ if the internal structure of the boundary layer is aproximated at two sub-layers and a velocity profile is established. In the other way, the experimental information are corelated with specifial condition at the gun barrel level. Because the first method is possible only with the gun system description itself and the scope of these article is to include as many as possible the all system, the second method is preffered for C_f evaluating.

Therefore, accordingly h) şi j) hypothesis and Re values, for evaluation of C_f one can chose the following [1]:

$$\frac{C_f}{2} = \frac{a}{\mathrm{Re}_x^m}, \qquad (9)$$

where:

- the constants a şi m depend of the flow regime (laminar or turbulent);
- Re_x is Reynolds based on local distance x.

If the equation (8) is integrated with respect to x employing the equation (9) for Re_x lead to the result

$$\frac{C_f}{2} = \frac{a^{\frac{1}{1-m}}}{\left[(1-m)\mathrm{Re}_\theta\right]^{\frac{m}{1-m}}}, \qquad (10)$$

where:

$$\mathrm{Re}_\theta = \frac{\kappa(u_1 - u_p)\theta}{\upsilon_1}.$$

The last equation is introduced in the curent analysis for the reasons:

- is validated for the Reynold's number from $\left[10^2 - 10^5\right]$ interval, the probable REYNOLS number extremes of interest for turbulent bounary layer in gun ;
- the form of equation (10) enables a transformation of equation (6) and, therefore, an exact solution.

Based on the k) hypothese, the bounary layer profiles on the form $\frac{y}{\delta}$ are often employed in the integral analyses :

$$\frac{u}{u_1} = \left(\frac{y}{\delta}\right)^{\frac{1}{n}}. \qquad (11)$$

The experimental information and hypothese a), if one neglects the gas density

gradient, the boundary layer shapes H and G are :

$$G = H_{incompr} = \frac{\int_0^{\delta}\left(1-\frac{u}{u_1}\right)dy}{\int_0^{\delta}\frac{u}{u_1}\left(1-\frac{u}{u_1}\right)dy}, \qquad (12)$$

which, in conection with (11) becomes

$$H_{incompr} = \frac{n+2}{n}. \qquad (13)$$

To evaluate accurately the shape factors under compressible conditions, the boundary layer temperature profiles is estimated, i.e.:

$$\frac{T}{T_1} = \frac{T_p}{T_1} + \left(1-\frac{T_p}{T_1}\right)\frac{u}{u_1}, \qquad (14)$$

which is true if:
- the is similar with flat plane flow (without pressure gradient);
- Prandtl number is constant and equal to $\Pr = 1$(which implies equivalence of thermal and momentum bounary layer thicknesses);
- the Mach number small $M = \frac{u_1}{c_\infty}$ $(M \to 0)$

where c_∞represents the central flow sound speed at the curent section and the curent instant .

Based on the equation (14) and the d) hypothese, the boundary layer shapes depend entirely on $\frac{T_p}{T_1}$ ratio and the specific values of ρ_1:

$$H = \frac{\frac{c}{n} - I_2}{I_1}; \qquad (15)$$

$$G = \frac{I_3 - I_2}{I_1}, \qquad (16)$$

where:

$$I_1 = \int_0^1 \frac{\bar{u}^n\left(1-\bar{u}\right)}{1+\beta\bar{u}}d\bar{u};$$

$$I_2 = \int_0^1 \frac{\bar{u}^n}{1+\beta\bar{u}^n}d\bar{u};$$

$$I_3 = \int_0^1 \frac{\bar{u}^{n-1}}{1+\beta\bar{u}}d\bar{u};$$

$$\bar{u} = \frac{u}{u_1};$$

$$c = \frac{T_p}{T_1} + \rho_1\alpha\left(1-\frac{T_p}{T_1}\right);$$

$$\beta = \frac{1-c}{c};$$

α covolume for propellant gases.

5. SOLUTIONS OF THE MOMENTUM EQUATION

All boundary layer solutions which will be developed in this section include the following aproximations:

a. the bounary layer shape factors are evauated from Crocco's relation for the case of $M_1 \approx 0$;

b. zero transpiration;

c. the friction coefficient is evaluated from exponential shear law, equation(10);

d. refernce properties evaluated at the instantaneous local average of gas and wall temperatures;

e. longitudinal gradient of gas and wall temperatures are assumed equal to zero; the viscosity is assumed to be a function of temperatures only;

f. longitudinal gradient of gas density assumed equal to zero; along with a. and d. above, this implies the longitudinal gradients of the boundary layer shape parameters are zero;

g. the neglect in f. above of longitudinal density gradients is a sufficinet (although no necesary) condition to obtain, via continuity equation (2a) a linear gas velocity variation along a cylindrical barrel–the Lagrange approximation ;

h. the Chilton-Colburn analogy is invoked here; plus, the Prandtl's number is asumed constant.

5.1. SOLUTIONAT THE BREECH END OF THE BARREL

Employing equation (9) for evaluating of A_4 term in equation (7), the inertial coordinate system $(u_p = 0)$ and taking the mass flux at the wall $(B = 0)$, one can achieve

$$\frac{d\theta}{dt} + (A_2 + A_3)\theta = A_5\theta^{-\frac{m}{1-m}}. \quad (17)$$

where:

$$A_5 = \frac{\rho'}{\rho_e}\frac{(\kappa u_1)^{\frac{1-2m}{1-m}}}{G}\left(\frac{a^{\frac{1}{m}}\upsilon'}{1-m}\right)^{\frac{m}{1-m}}.$$

The general solution of equation (17) is

$$\theta = e^{-\frac{1}{1-m}\int(A_2+A_3)dt}\left[C - \frac{1}{1-m}\int(-A_5)f_4 dt\right] \quad (18)$$

The integrating factor, $f_4(t) = e^{-\frac{1}{1-m}\int(A_2+A_3)dt}$, for this equation becomes for $(u_p = 0)$ and approximations taken

$$f_4(t) = f_3(t)^{\frac{1}{1-m}} e^{\frac{2}{1-m}f_2(t)}, \quad (19)$$

where:

$$f_3(t) = \rho_e G u_p^{\frac{H}{G}};$$

$$f_2(t) = \int_0^t \frac{1}{G} f_1(t)dt;$$

$$f_1(t) = \frac{u_p}{L}.$$

The general solution of equation (17) becomes

$$\theta = \frac{ax^{1-2m}}{(1-m)f_4^{1-m}}\left(\int_0^t f_1^{\frac{1-2m}{1-m}} f_4 f_5 v_1^{\frac{m}{1-m}} dt + C\right)^{1-m} \quad (20)$$

where:

$$f_5(t) = \frac{\rho'}{\rho_1}\left(\frac{\upsilon}{\upsilon_1}\right)^{\frac{m}{1-m}}.$$

Along the characteristic's equation, x is a function only on t, that dependency is used in (20) to achieve the general solution of the momentum equation.

At the breech end of the barrel solution, x is entirely independent of t and, therefore, can be taken outside of the integral (20). The boundary condition is chosen for this solution is

$$\theta(x,0) = 0, \quad (21)$$

although an additional boundary layer condition will be considered later.

Equation (21) dictates that the integration constant in equation (20) to be zero.

The approximate solution for the equation is

$$\theta(x,t) = \frac{ax^{1-2m}}{1-m}\frac{1}{f_4^{1-m}}\left[\int_0^t \frac{f_1^{\frac{1-2m}{1-m}} f_4 f_5 \upsilon_1^{\frac{m}{1-m}}}{G} dt\right]^{1-m} \quad (22)$$

Equation (22) can be evaluated by quadrate method.

The complete form of the Chilton-Colburn analogy is

$$\frac{h}{\rho u c_p}\mathrm{Pr}^{\frac{2}{3}} = \frac{k_{cx}}{u}Sc^{\frac{2}{3}} = 0{,}332\,\mathrm{Re}^{-\frac{1}{2}} = \frac{C_f}{2}, \quad (23)$$

where:

h - the convective transfer coefficient;

c_p - the specific heat assumed constant;

Pr - the Prandtl number;

k_{cx} - mass transfer coefficient, equivalent with h;

Sc - Schmidt number;

Re - Reynolds number;

C_f - the local skin friction.

From equation (23) results the expression for the convective heat transfer coefficient

$$h_c = \frac{\rho' u_1 c_p}{\Pr^{\frac{2}{3}}} \frac{C_f}{2} = \rho' u_1 c_p St\,, \qquad (24)$$

where:

St - the Stanton number.

5.2 SOLUTION AT THE PROJECTILE END OF BARREL

From equation (8), using (9) for A_4 term, a mobile coordinate system $(u_w = u_p)$ and no mass flux at the wall $(B = 0)$, the results is

$$\frac{d\theta}{dx} + \frac{A_2 + A_3}{A_1}\theta - A_6\theta^{-\frac{m}{1-m}} = 0\,,$$

(25)

where:

$$A_6 = \frac{\rho'}{\rho_e}\frac{\left[\kappa(u_1 - u_p)\right]^{\frac{1-2m}{1-m}}}{u_1 - u_p + Gu_p}\left(\frac{a^{\frac{1}{m}}\upsilon'}{1-m}\right)^{\frac{m}{1-m}}.$$

The integrating factor of the equation (25) is

$$e^{\frac{1}{1-m}\int \frac{\left[2+H\left(1+\frac{u_p}{u_1-u_p}\right)\right]\frac{\partial(u_1-u_p)}{\partial x}+f_{p0}}{u_1-u_p+Gu_p}}.$$

where:

$$f_{p_0}(t) = \frac{dG}{dt} + H\frac{\partial[\ln(u_e - u_w)]}{\partial t} + G\frac{d[\rho_e]}{dt}.$$

The solution of equation (25) is true only for an isothermal boundary layer $(G = H)$ and for the values of $f_{p_0}(t)$ equal to zero. In this case, solution of equation (8) will be (27) where

$$\hat{\theta} = \mathrm{Re}_L^m\,\tilde{\theta}\,;$$

$$\mathrm{Re}_L^m = \frac{u_p L}{\upsilon_e}\,;$$

$$\tilde{\theta} = \frac{\theta}{L}\,;$$

$$\xi = \frac{x}{L}\,.$$

Beside the solution itself, the curent analysis has suggested various grouping of parameters which are convenient for data presentation and for corelation of gun convective heating data under condition where the Lagrange approximation applies. These groupings are following:

$$\tilde{\mathrm{Re}}_\theta = \xi\hat{\theta}\,; \qquad (28)$$

$$\frac{\tilde{C}_f}{2} = \frac{a^{\frac{1}{1-m}}}{\left[(1-m)\tilde{\mathrm{Re}}_\theta\right]^{\frac{m}{1-m}}}\,; \qquad (29)$$

$$\tilde{N}u = \xi\frac{\tilde{C}_f}{2}\,,$$

(30)

where:

$$\tilde{\mathrm{Re}}_\theta = \frac{\mathrm{Re}_\theta}{\mathrm{Re}_L^{1-m}}\,; \qquad (4.66)$$

$$\frac{\tilde{C}_f}{2} = \frac{C_f}{2}\mathrm{Re}_L^m\,; \qquad (4.67)$$

$$\tilde{N}u = \frac{Nu}{\mathrm{Re}_L^{1-m}\,\Pr^{\frac{1}{3}}}\,; \qquad (4.68)$$

$$Nu = \frac{h_c L}{k}\,; \qquad (4.69)$$

k - conductive coefficient;

L - distance between the breech and projectile base.

6. THE RESULTS AND THE CONCLUSION

From the mathematical model of the boundary layer flow near the wall of the gun barrel, there has been developed an computer program in order to supply the variation of various parameters function of the space between the breech and the base projectile.

The thickness of the boundary layer versus the relative space are plotted in fig. 5.1.

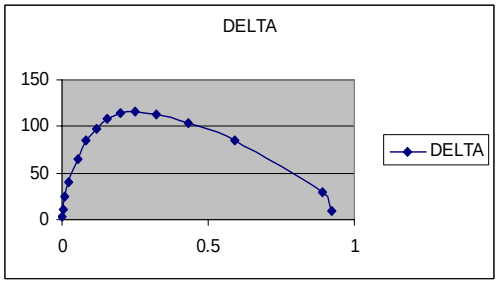

Fig. 5.1 the boundary layer thickness versus relative space

$$\hat{\theta}=\frac{a}{1-m}\left\{e^{-\frac{1}{1-m}\int\frac{2\xi-2+H\xi}{u_p(\xi-1+H)(\xi-1)^2}d\xi}\left[\frac{1}{1-m}\int\left(\frac{\upsilon'}{\upsilon_e}L\right)^{\frac{m}{1-m}}\frac{\rho'}{\rho_e}\frac{(\xi-1)^{\frac{1-2m}{1-m}}}{\xi-1+H}e^{\frac{1}{1-m}\int\frac{2\xi-2+H\xi}{u_p(\xi-1+H)(\xi-1)^2}d\xi}d\xi+C\right]\right\}^{1-m}$$

(27)

The momentum boundary layer thickness versus the relative space are plotted in fig. 5.2.

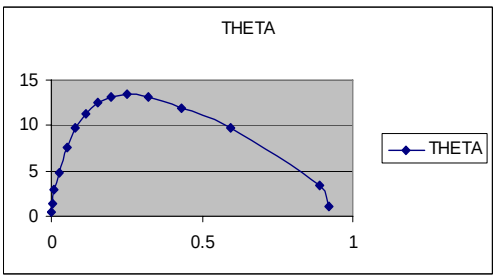

Fig. 5.2. the momentum boundary layer thickness versus the relative space

The convective heat transfer coefficient versus the relative space are plotted fig.5.3.

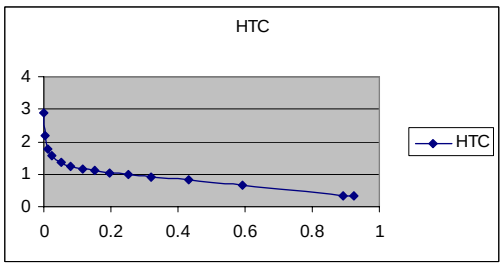

Fig. 5.3. the convective heat transfer coefficient versus relative space

With the values of the convective heat transfer and the temperature gradient at a current section and at an instant of time, one could apply to evaluate the amount of the heat/heat flux loaded by the barrel. Once the heat loading at the wall level is established, the procedures of the temperature inside the barrel distribution is initiated.

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DRAG COEFICIENT DETERMINATION FOR A 30 MM CALIBER AMMUNITION USING EXPERIMENTAL TESTING AND NUMERICAL SIMULATION

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Abstract: *The paper covers some aspects concerning the numerical and experimental determination of the drag coefficient for a 30 mm calibre projectile. As we know the movement of the projectile in the air is a movement with six degree of freedom. To define the bullet's body position on the trajectory to a specific step time we need to know six parameters: three coordinates for the centre of mass position and the three angles which define the bullet's body orientation considering 3D coordinates system before defined. To determine the parameters reminded before we need to know drag, lift and momentum coefficient for the aero-dynamical configuration.*

Keywords: *Aerodynamics, finite volume, drag coefficient, external ballistics.*

1. INTRODUCTION

Experimental velocity of the projectile represents an important element used to solve many problems like: 2D trajectories shape, 3D trajectories shape, drag coefficient etc.

Using experimental methods the projectile's velocity can be easily measured and with a sufficient precision nearby the gun muzzle.

Also to reduce the costs of testing the authors try to develop and test a mathematical and numerical model which can help in research and design of projectiles of this type.

By the ideas exposed before we will compare the drag coefficient obtained by experimental measurements with the theoretical one, to see the differences. Also to a further work we have in mind to develop a mathematical model to obtain the 2D and 3D trajectories shape for a projectile of 30 mm caliber, in the design phase with the purpose to see if the ammunition meets the tactical requirements for trajectory's parameters. The mathematical model for 2D trajectories will use the drag coefficient determined by experimental shootings or numerical.

For this paper we will compare the drag coefficient for a 30 mm projectile obtained using experimental determination with the one obtained by numerical model.

2. ANALYSIS

2.1. Analyzed Configuration

The length of the considered system is 147.62 mm and the maximum diameter is 30 mm. This configuration is presented in figure 1.

2.2. Experimental model

The experimental model consists in: drag coefficient C_x determination, making special shootings with ballistic velocity

barrels. The measurement scheme is presented in figure 2.

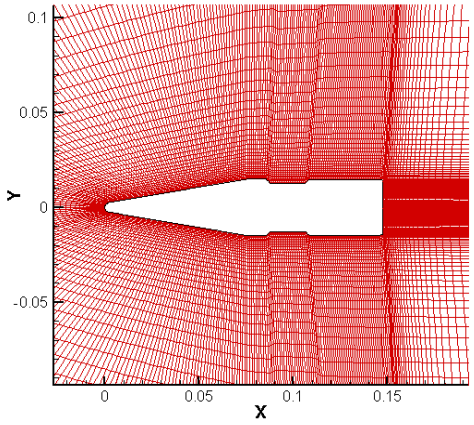

Fig. 1 System's configuration

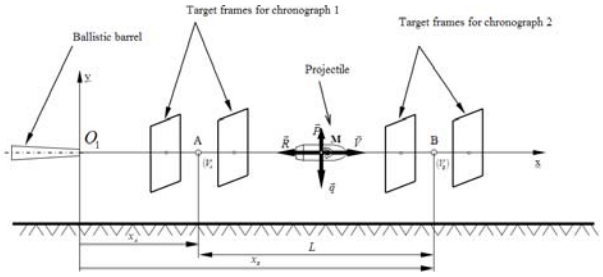

Fig. 2 Measurement of the drag coefficient using two chronographs

The experimental shootings are made with an angle of zero degree (horizontal shootings), as we can consider the projectile's trajectory horizontal.

Using the chronograph we can measure the velocity in points A and B (see fig. 1). If the shooting angle is zero the projectile's trajectory is practical a horizontal segment formed by A and B points. Velocities V_A and V_B are measured using the chronograph. Also we know the distance L between points A and B.

The acting forces on projectile are (see figure 2):

- $\vec{R}$ - drag force;
- $\vec{P}$ - lift force which is considered to be zero;
- $\vec{q}$ - gravitational force;
- g - gravity.

Considering the hypothesis exposed before we can determine the drag force, considered constant, and using the following equations:

$$\frac{1}{2}\cdot\frac{q}{g}\cdot\left(V_A^2 - V_B^2\right) = R\cdot L \qquad (01)$$

$$R = \frac{q\cdot(V_A - V_B)\cdot(V_A + V_B)}{2\cdot g\cdot L} \qquad (02)$$

Considering for the drag force the following equation:

$$R = \frac{\rho}{2}\cdot\frac{(V_A + V_B)}{2}\cdot S\cdot C_x \qquad (03)$$

From equations (02) and (03) we can obtain the equation for drag projectile's drag coefficient by experimental method.

2.3. Numerical Models for Drag Coefficient Determination

Numerical integration was made using a 2D finite volume code. The integration method used for the supersonic stationary flow was Cranck-Nicholson method.

The velocity for the free stream current was around 890 m/s, and has an angle of 0 degree.

The mesh domain consist in 25.000 volumes elements. The mesh used can be observed in figure 3.

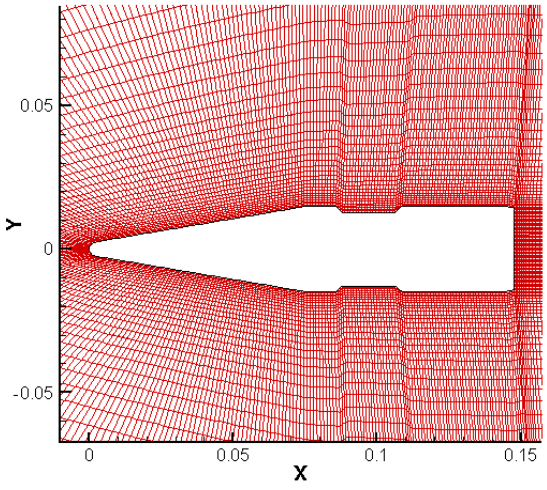

Fig. 3 Mesh domain and projectile's shape

3. RESULTS AND CONCLUSIONS

The results obtained from experimental and numerical simulation for drag coefficient are centralized in Table 1.

Table 1 Drag force coefficient numerical and experimental values

No.	Test	Initial speed [m/s]	Drag Coefficient
1	Experiment	890	0.01792
2	Numerical	890	0.01754

Also in figures 4 and 5 we can some qualitative representations for pressure and velocities fields obtained by numerical simulation.

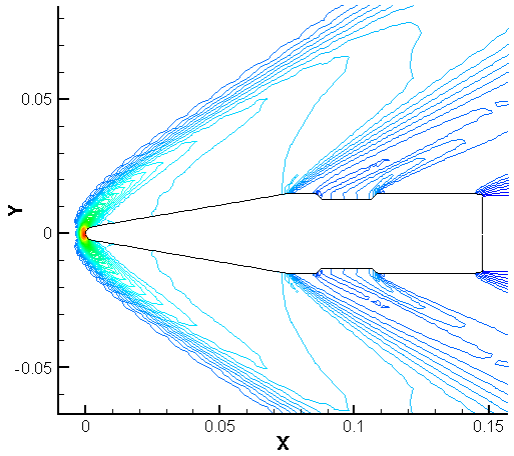

Fig. 4 Pressure field qualitative representation

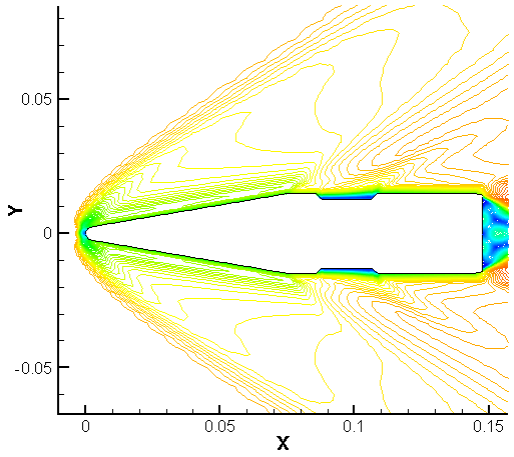

Fig. 5 Velocity field qualitative representation

From the results obtained in table 1 we can say that we have a difference around 2.21% between experimental and numerical. Comparing the values for drag coefficient, obtained numerical and experimental we can tell that we can use the numerical method in primary phase for projectile design and research purposes. Also, we can continue our work to develop the model for 2D projectile trajectory using the drag coefficient data obtained by numerical simulation.

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CONCEPTUAL DESIGN OF THE UNMANNED AERIAL VEHICLE SYSTEMS FOR THE FIREFIGHTER APPLICATIONS

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Abstract: *Unmanned aerial vehicles (UAV) are widely applied for many purposes like military, or non-military applications. At Zrínyi Miklós National Defense University we developed a scientific survey to evaluate technical requirement of the customers how they think about application of the newest technologies. This paper deals with Firefighter-applications of the UAVs, and gives complex set of the customers' requirements.*

Keywords: *UAV applications, flying and handling qualities of UAVs.*

I. INTRODUCTION

Unmanned aerial vehicles (UAV) are effective tools for gathering information both in military, and in non-military applications. It is well-known that they can be used in D3 (Dull-Dirty-Dangerous) circumstances having no pilot on the board. There are many new challenges for firefighters to have prompt information about mission circumstances. Fast information delivered to the firefighters might result in the most effective deployment of the brigades, and losses can be minimized in such way.

At our university there was performed a scientific survey upon possible applications of the UAV systems. Main motivation was to derive technical requirements put by the Firefighter to UAV systems. The paper gives main information about the results of the survey. Final result of the paper will be a complex set of the flying and handling criterions, technical requirements of the small UAV systems used in firefighter applications.

II. REFERENCE REVIEW

The preliminary initiative for our advanced scientific research program is established in 2007, and outlined in [4], which defines motivation for this, and gives short description of the future work. First papers dealing with the preliminary statistical evaluation of the experimental review were published in 2007 year [1,2,3,5]. These papers define weather clearances, and other technical requirements defined by customers. Besides civilian application there are many military applications of the UAVs. Military experts were involved into the scientific survey, and in [5] one can find technical requirements defined by them.

III. TECHNICAL REQUIREMENTS OF THE UAV SYSTEMS APPLIED FOR FIREFIGHTER PURPOSES

3.1. Preliminary statistical evaluation of the Firefighter-team activity

The FIREFIGHTER-team has 36 experts representing firefighter-leaders. Some data of the preliminary statistical evaluation of the team being investigated are summarized in Table 1.

Table 1. The Firefighter Team Statistical Data

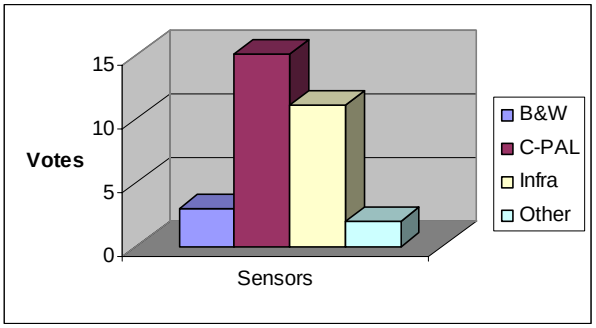
Number of Sent Questionnaire	Number of Delivered Questionnaire	Number of Undelivered Questionnaire	Number of Answered Questionnaire	Number of Completed Questionnaire
36 (100 %)	36 (100 %)	0 (0 %)	21 (≈58 %)	20 (≈95 %)

Regarding statistical data given in Table 1 it can be derived that experts of the Firefighter-team showed positive attitude to the review, and played active role in definition of the technical requirements of the UAVs (21 experts reflected to the review), i.e. we can use this information for conceptual design of the UAV systems for firefighter applications (20 experts of reflecting persons gave answers to the questionnaire).

3.2. Conceptual design of the UAV systems for Firefighter applications

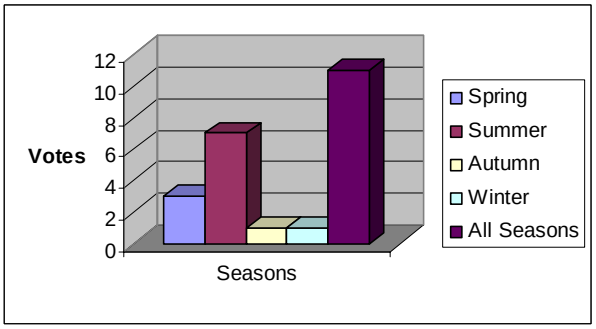
The most important and insensitive questions about requirements put by experts for UAV firefighter applications, and also answers are summarized below:

1. What kind of the information do you plan to use in your tasks?



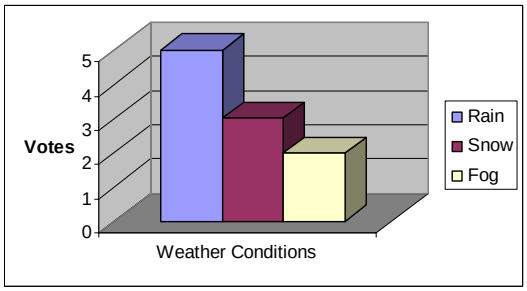
Most of the experts voted for color images and for the infra-red signals to have during firefighter actions. There are few requests for GPS, or radar signals.

2. When do you plan to fly UAV in your tasks?!



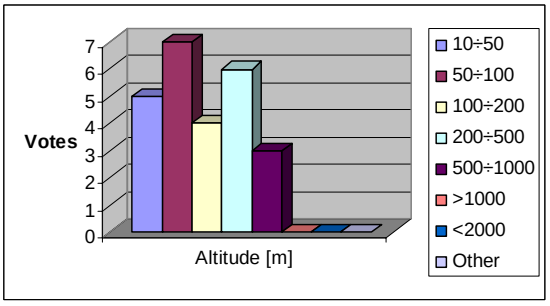
No doubt about all-seasonality of the UAV firefighter application – unmanned aerial systems must be ready to carry out missions in all seasons.

3. Define weather conditions for UAV flights!

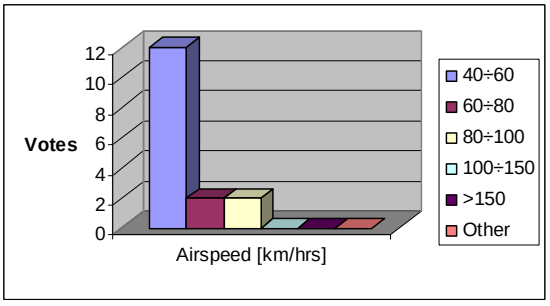


Firefighter experts defined weather conditions for UAV flights, which must be carried out in bad weather conditions, in rainy, snowy, and foggy time.

4. Define flight envelope for the UAV flights in your duty!



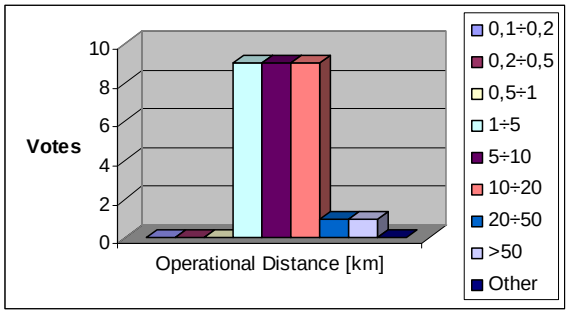
Regarding firefighter experts' opinions the UAV flight envelope must cover altitudes mostly in the range of $H = (10 \div 500)\, m$. There are some votes came to the higher altitude of the UAV. Let take for maximum altitude $H_{\max} = 500\, m$.



Regarding firefighter experts' opinions the UAV flight envelope must cover airspeeds

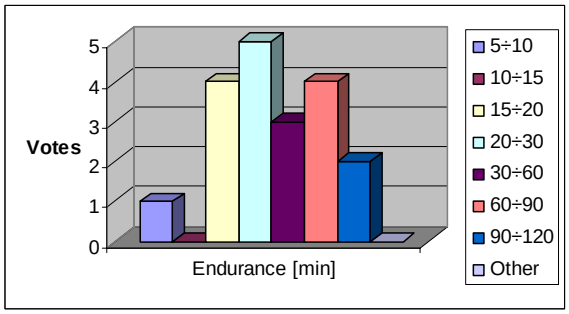
mostly in the range of $v = (40 \div 60)\,km/h$. There are two votes for larger airspeeds. Let take for the maximum airspeed $v_{max} = 80\,km/h$.

5. Define operational distance for the UAV flights in your duty!



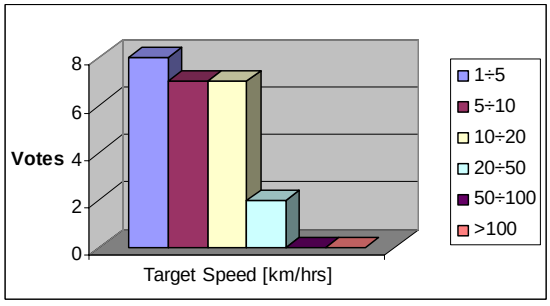
Most of the firefighter experts voted for the UAV range of $L = (1 \div 20)\,km$, i.e. UAV systems shall support firefighter missions beyond visual range.

6. Define flight endurance for the UAV flights in your duty!



The most preferable endurance of the flight is in the domain of $t_{endur} = (5 \div 120)$ minutes.

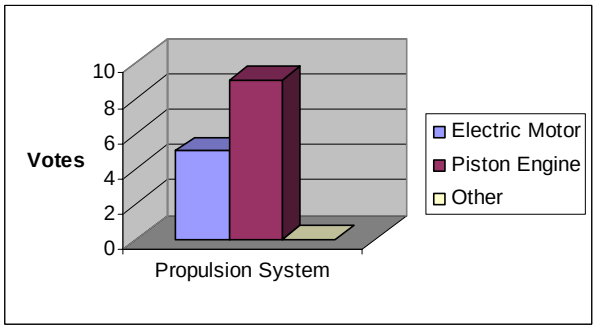
7. Define target/moving object speed to be monitored!



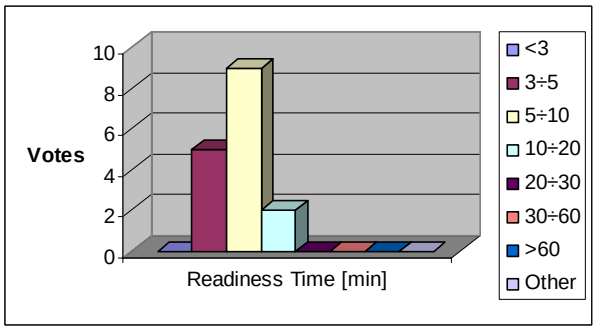
The speed of the targets being observed is in the average domain of $v = (1 \div 20)\,km/h$. There are also votes for observation of the targets moving at higher speed. Thus, a special UAV type must be chosen for these actions, i.e. a quadrotor, or a helicopter type UAV must be applied for the reconnaissance purposes.

8. What kind of the propulsion system do you suggest to apply?

Regarding propulsion system of the UAV systems most of the experts are for application of the piston engine propulsion systems, however, there are many votes for electrical motors application. There was a unique vote for combined propulsion systems applications.

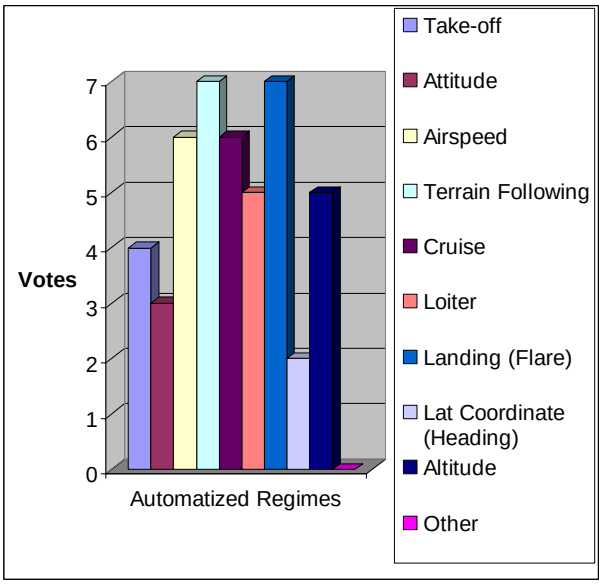


9. Define readiness time for the UAV flights in your duty?



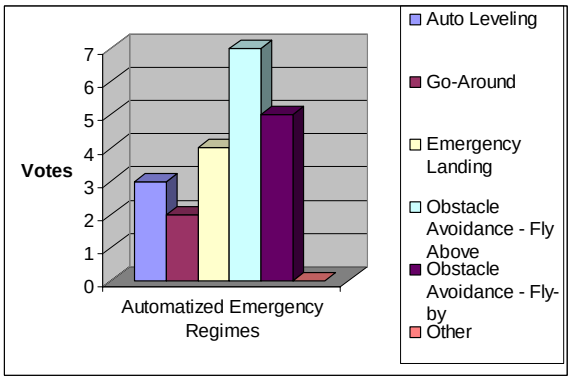
The average readiness time lies in the time domain of $t_{ready} = (3 \div 10)$ minutes. This means the firefighter units must have UAVs at the moving brigades.

10. Define UAV flight regimes must be automatized?!



The firefighter experts voted for many flight phases to be automatized. Most preferable flight parameters to be automatized are cruise parameters, terrain following, and flight path parameters.

11. Define emergency regimes of the UAV flight must be automatized!



Regarding votes of the firefighter experts, most important emergency regimes to be automatized are auto-leveling, and obstacle (collision) avoidance.

V. CONCLUSIONS

The paper gives information about requirements of the UAV system designed for firefighter applications. Present scientific survey and its results limited only to that of the technical requirements of the UAV systems, i. e. there is no weights derived for the finalization of the complex set of the technical requirements of the UAV systems. Very important requirements can be derived from other survey dealing with technology of the UAV, with weights, sizes, and other physical parameters. Future developments are targeted to finalization of the complex set of the technical requirements of the UAV systems, including new requirements defined above.

VI. REFERENCES

[1] DR. HABIL. SZABOLCSI Róbert: Pilóta nélküli repülőgépek polgári alkalmazási lehetőségeinek vizsgálata. Elektronikus Műszaki Füzetek IV, MTA Debreceni Területi Bizottság, Debreceni Akadémiai Bizottság, Műszaki Szakbizottsága, pp (59–65), Debrecen, 2007.

[2] DR. HABIL. SZABOLCSI Róbert – MÉSZÁROS György: Pilóta nélküli repülőgépek polgári alkalmazási lehetőségeinek vizsgálata. Elektronikus Műszaki Füzetek IV, MTA Debreceni Területi Bizottság, Debreceni Akadémiai Bizottság, Műszaki Szakbizottsága, pp (59–65), Debrecen, 2008.

[3] DR. HABIL. SZABOLCSI Róbert – MÉSZÁROS György: Pilóta nélküli repülőgépek polgári alkalmazási lehetőségeinek vizsgálata. „70 éves a légierő” tudományos konferencia CD-ROM kiadványa, Repüléstudományi Közlemények, Különszám, 2008. április 11.

[4] DR. HABIL. SZABOLCSI Róbert – MÉSZÁROS György: A new initiative – a new scientific research program „Computer aided design and analysis of the vehicle systems”, CD-ROM Proceedings of the Vth International Symposium on Defense Technology, HU ISSN 1416-1443, 21-22 April 2008, Budapest, Hungary.

[5] Dr. habil. Szabolcsi Róbert: Egy felmérés margójára – néhány gondolat a pilóta nélküli repülőgépek polgári és katonai alkalmazásáról, Szolnoki Tudományos Közlemények, HU ISSN 2060-3002, 2008, Szolnok, Hungary.

CONCEPTUAL DESIGN OF THE UNMANNED AERIAL VEHICLE SYSTEMS FOR THE POLICE APPLICATIONS

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Abstract: *Unmanned aerial vehicles (UAV) are widely applied for many purposes like military, or non-military applications. At Zrínyi Miklós National Defense University we developed a scientific survey to evaluate technical requirement of the customers, and to support penetration of this technology in the fields must to have it in the modern world. This paper deals with Police-applications of the UAVs.*

Keywords: *UAV applications, flying and handling qualities of UAVs.*

I. INTRODUCTION

Unmanned aerial vehicles (UAV) are effective tools for gathering information both in military, and in non-military applications. It is well-known that they can be used in D3 (Dull-Dirty-Dangerous) circumstances having no pilot on the board. At our university there was performed a scientific survey upon possible applications of the UAV systems. Main motivation was to derive technical requirements put by the Police to UAV systems. The paper gives main information about the results of the survey. Final result of the paper will be a complex set of the flying and handling criterions, technical requirements of the small UAV systems used in police applications.

II. PRELIMINARIES & LITERATURE REVIEW

The preliminary initiative for our advanced scientific research program is established in 2007, and outlined in [4], which defines motivation for this, and gives short description of the future work. First papers dealing with the preliminary statistical evaluation of the experimental review were published in 2007 year. These papers give information about penetration of the topic in several branches of the civilian (non-military) organizations [1,2,3,5]. These papers define weather clearances, and other technical requirements defined by customers. Besides civilian application there are many military applications of the UAVs. Military experts were involved into the scientific survey, and in [5] one can find technical requirements defined by them.

III. TECHNICAL REQUIREMENTS OF THE UAV SYSTEMS APPLIED FOR POLICE PURPOSES

3.1. Preliminary statistical evaluation of the Police-team activity

The POLICE-team has 11 experts representing police-leaders. Some data of the preliminary statistical evaluation of the team being investigated are summarized in Table 1.

Table 1. The „POLICE" Team Statistical Data

Number of Sent Questionnaire	Number of Delivered Questionnaire	Number of Undelivered Questionnaire	Number of Answered Questionnaire	Number of Completed Questionnaire
11 (100 %)	11 (100 %)	0 (0 %)	8 (≈73 %)	5 (≈63 %)

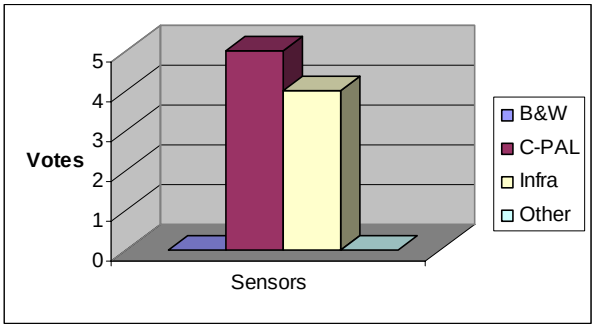
Regarding statistical data given in Table 1 it can be derived that experts of the Police-team showed positive attitude to the review, and played active role in definition of the technical

requirements of the UAVs (8 experts reflected to the review), i.e. we can use this information for conceptual design of the UAV systems for military applications (5 experts of reflecting persons gave answers to the questionnaire).

3.2. Conceptual design of the UAV systems for Police applications

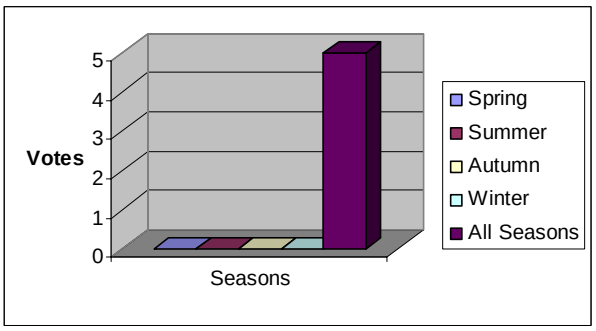
The most important and insensitive questions about requirements put by experts for UAV police applications, and also answers are summarized below:

1. What kind of the information do you plan to use in your tasks?



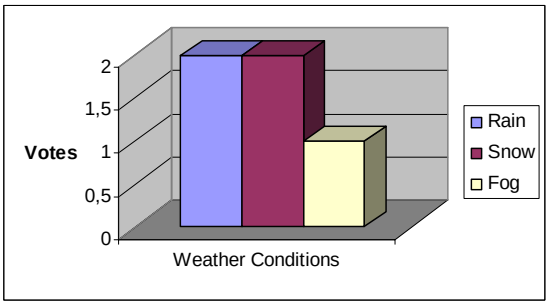
Most of the experts voted for color images and for the infra-red signals to have during police actions. The important consequence of the review that there is no need for black & white, or other signals.

2. When do you plan to fly UAV in your tasks?!



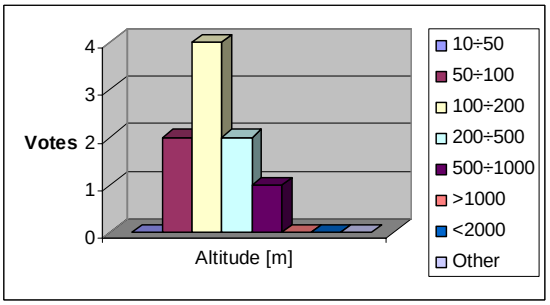
There is no doubt about all-seasonality of the UAV police application – unmanned aerial systems must be ready to carry out missions in all seasons.

3. Define weather conditions for UAV flights!

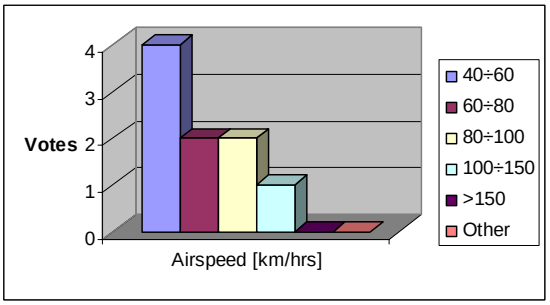


Police experts derived weather conditions for UAV flights, which must be carried out in bad weather conditions, in rainy, snowy, and foggy time.

4. Define flight envelope for the UAV flights in your duty!

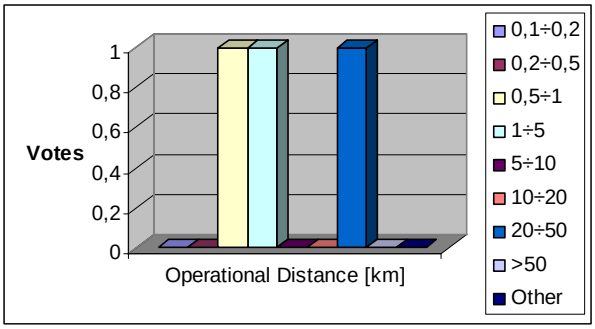


Regarding police experts' opinions the UAV flight envelope must cover altitudes mostly in the range of $H = (50 \div 500)\, m$. A single vote came to the higher altitude of the UAV. Let take for maximum altitude $H_{\max} = 500\, m$.



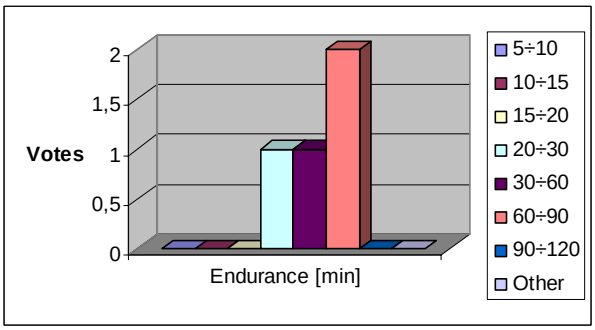
Regarding police experts' opinions the UAV flight envelope must cover airspeeds mostly in the range of $v = (40 \div 100)\, km/h$. There is a vote for larger airspeeds. Let take for the maximum airspeed $v_{\max} = 100\, km/h$.

5. Define operational distance for the UAV flights in your duty!



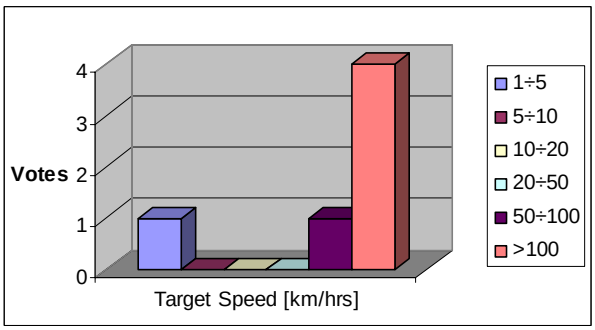
Most of the police experts voted for the UAV range of $L = (0{,}5 \div 5)\,km$, i.e. UAV systems shall support police missions beyond visual range. There is a vote for larger operational distances. Let take for the maximum operational distance of $L_{\max} \geq 5\,km$.

6. Define flight endurance for the UAV flights in your duty!



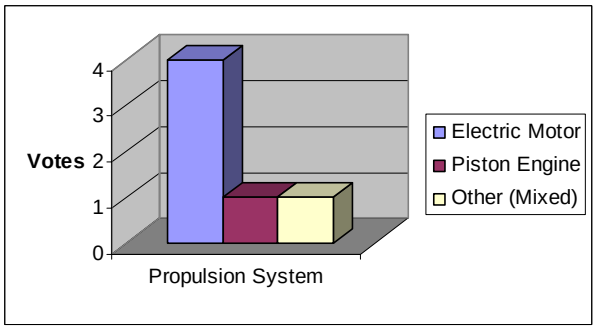
The most preferable endurance of the flight is in the domain of $t_{endur} = (20 \div 90)$ minutes.

7. Define target/moving object speed to be monitored!



The speed of the targets being observed is in the average domain of $v = (5 \div 100)\,km/h$. There is also a vote for observation of the targets moving at very slow speed. Thus, a special UAV must to be chosen for these actions, i.e. a quadrotor, or a helicopter type UAV must be applied for the reconnaissance purposes.

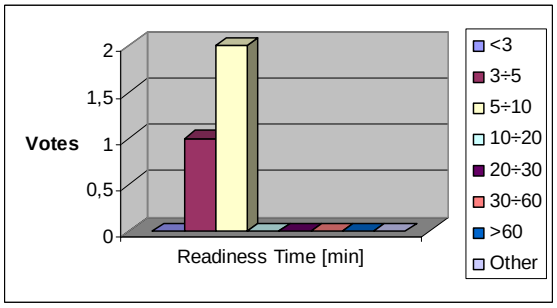
8. What kind of the propulsion system do you suggest to apply?



Regarding propulsion system of the UAV systems most of the experts are for application of the electric motors, having very few noise emission.

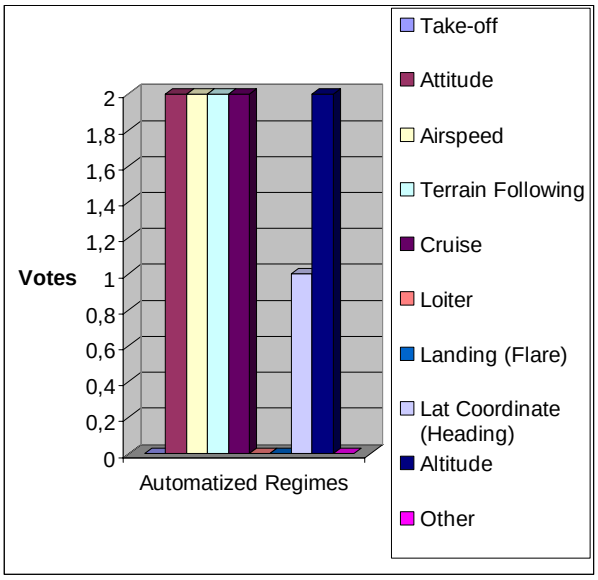
It is evident ability to have such small noise emission makes UAV system ready for the secret applications. However, there is a vote for piston-engine UAV systems, also a vote for the combined (electric, and piston engine) propulsion system.

9. Define readiness time for the UAV flights in your duty?



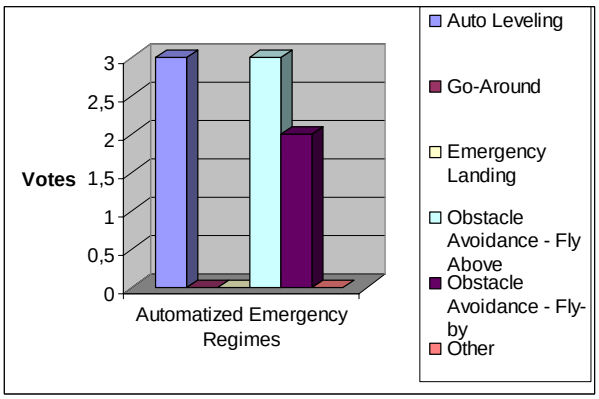
The average readiness time lies in the time domain of $t_{ready} = (3 \div 10)$ minutes. This means the police units must have UAVs as part of theirs gear.

10. Define UAV flight regimes must be automatized?!



The police experts voted for many flight phases to be automatized. Most preferable flight parameters are cruise parameters.

11. Define emergency regimes of the UAV flight must be automatized!



Regarding votes of the police experts, most important emergency regimes to be automatized are auto-leveling, and obstacle (collision) avoidance.

V. CONCLUSIONS

The paper gives information about requirements of the UAV system designed for police applications. Present scientific survey and its results limited only to that of the technical requirements of the UAV systems, i. e. there is no weights derived for the finalization of the complex set of the technical requirements of the UAV systems. Very important requirements can be derived from other survey dealing with technology of the UAV, with weights, sizes, and other physical parameters. Future developments are targeted to finalization of the complex set of the technical requirements of the UAV systems, including new requirements defined above.

VI. OPUS CITATUM

[1] DR. HABIL. SZABOLCSI Róbert: Pilóta nélküli repülőgépek polgári alkalmazási lehetőségeinek vizsgálata. Elektronikus Műszaki Füzetek IV, MTA Debreceni Területi Bizottság, Debreceni Akadémiai Bizottság, Műszaki Szakbizottsága, pp (59–65), Debrecen, 2007.

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[3] DR. HABIL. SZABOLCSI Róbert – MÉSZÁROS György: Pilóta nélküli repülőgépek polgári alkalmazási lehetőségeinek vizsgálata. „70 éves a légierő” tudományos konferencia CD-ROM kiadványa, Repüléstudományi Közlemények, Különszám, 2008. április 11.

[4] DR. HABIL. SZABOLCSI Róbert – MÉSZÁROS György: A new initiative – a new scientific research program „Computer aided design and analysis of the vehicle systems”, CD-ROM Proceedings of the Vth International Symposium on Defense Technology, HU ISSN 1416-1443, 21-22 April 2008, Budapest, Hungary.

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RESEARCH ON THERMO-MECHANICAL FATIGUE OF SHAPE MEMORY ALLOYS CuZnAl

Dragos Cristian ACHITEI*, Dan Gelu GALUSCA*, Petrica VIZUREANU*, Roxana Gabriela STEFANICA*

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Abstract: *New applications of shape memory alloys CuZnAl require establishing the duration of use in optimal conditions. For more precise determination of the number of heating-cooling cycles under load on the resist parts made of such materials can be used for testing prototype installation thermomechanical fatigue. This paper presents experimental research carried out on specimens of CuZnAl, tested on the prototype installation.*

Keywords : *shape memory alloys, fatigue, prototype installation*

1. INTRODUCTION

Memory shape alloys from some installations are submitted to mechanical stresses and to thermal stresses so that their integration within a fatigue calculus system supposes taking into consideration their function.

Fig. 1. Actuators

Memory shape alloys have a series of properties alike the other ordinary metallic materials. Between those, an important characteristic is their capacity of changing the geometric shape from a low temperature to a high one.

Under certain circumstances, shape changing can be reversible so that the materials can memorize two geometric shapes such as the high temperature shape and low temperature shape.

These transformations accomplish because of an effect named memory shape effect. By memory shape effect, one can understand that the material can make labor work when passing from the cold shape to the warm one.

The pieces subjected to variable (cyclic) stresses destroy to stresses, which are inferior to static fracture resistance. The maximum cyclic stress when a material does not brake calls fatigue resistance of the material.

In order to dimension the constructive shape of an element with memory shape from a mechanic device, a series of numeric values are necessary, among these values being also fatigue resistance, labeled by the minimum value of the deformation recovered after a certain number of use cycles.

In addition, besides the phenomena met in classic crystalline materials, memory shape alloys present supplementary connection mechanisms at phase change, which are characteristic only for memory shape alloys.

Taking into consideration a device where memory element makes a double sense memory shape effect, within work system (resort coupling uses for recovery), fatigue resistance limit defines by the number of cycles until recovery tension lowers to a minimum value (approximately 70% from the initial one).

According to the cycling type, a memory shape alloy can present irreversible

deterioration phenomena of the microstructure defined by specific categories of fatigue.

If cycling though double effort, fatigue is thermal and by cycling through simple effort of memory shape thermo-mechanical fatigue appears.

The fatigue of metals is the phenomenon that produces the breakage of different pieces, under temperature variation conditions and other work parameters, too.

Mechanical fatigue implies breakage production in the following stages: defects accumulation, cracks formation and conduction, in stationary regime at first and non stationary at final breakage.

The breakages that appear when applying some variable loads are called fatigue breakages probably because it noticed generally they appear only after a considerable period.

A fatigue breakage is very dangerous because it appears as a preliminary warning.

A fatigue breakage can be easily recognized based on the aspect of the fracture surface, which presents a smooth area and a rough area.

Many times, the way breakage advanced is indicated by a series of concentric circles, which advance from the initial point of the breakage towards the interior of the section.

The stresses producing fatigue breakage at high temperature cannot appear due to some mechanic causes. Fatigue fracture can be produced by variable stresses due to temperature, under conditions where stresses due to mechanic causes do not produce.

Thermal stresses produce when the variation of a piece dimension is stopped in a certain way.

If the breakage appears due to a single appliance of thermal stresses, the stress calls thermal shock.

The proper fatigue breakage is fragile, without important global deformations. At macroscopic scale, breakage surface is usually perpendicular on the direction of the main normal stress.

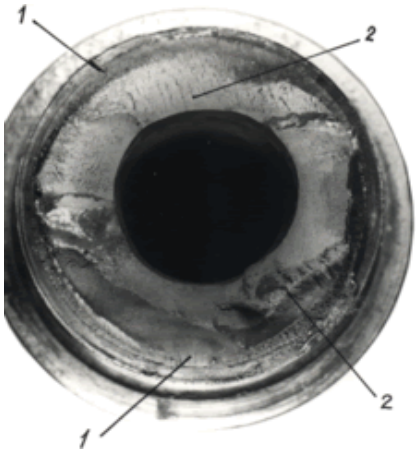


Fig. 2. Fatigue cracks appeared in the areas marked with 1, they conducted in the interior of the piece and the final breakage produced quickly in the areas marked with 2.

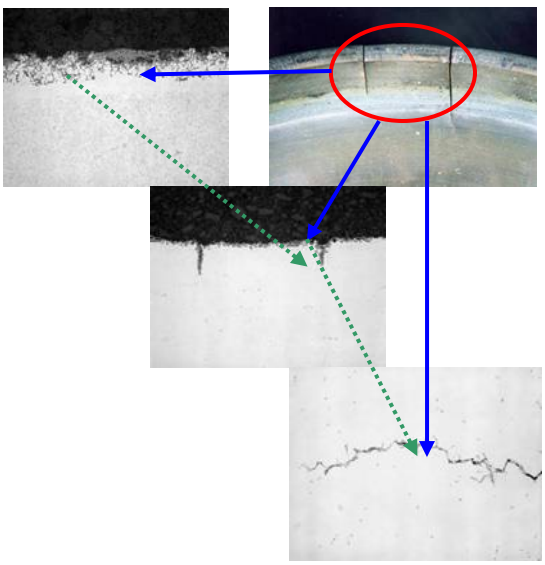
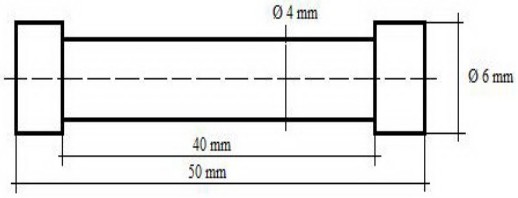


Fig.3. Cracks appeared due to thermal fatigue.

If the breakage appears after many appliances of some thermal stresses of low values, the solicitation calls thermal fatigue. In the equipments working at high temperatures, there are usually created the premises for breakages due to thermal fatigue.

2. EXPERIMENTAL INSTALLATION

In order to study thermo-mechanical phenomenon of memory shape alloys it designed and realized a prototype with a complex configuration.



Samples with memory shape alloys were tested with the chemical composition presented in table 1.

Table 1

Cu	Zn	Fe	Ni	Si	Al
75,4	18,6	0,021	0,005	0,027	5,85

The scheme of the prototype installation presents in figure 5.

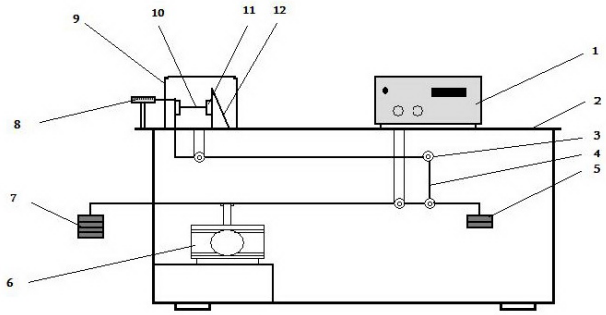


Fig.5. Prototype installation for thermo-mechanical fatigue testing: 1 – command panel; 2 – rigid metallic frame; 3, 4 – system of bearings and levers for load multiplication on the sample; 5 – counter weight; 6 – engine assembly, reducer and arm for weight lifting; 7 – weights; 8 – comparator; 9 – shell of the heating chamber; 10 – sample made of memory shape alloy; 11 – jigs; 12 – fixed die.

Fig.4. Standard samples, from memory shape alloys type CuZnAl, for thermal fatigue test.

The number of cycles necessary for a loading is 10^4 – 10^5 cycles and functioning time for the achievement of these cycles is of the order of tens hours.

Standard sample made of memory shape alloy will be subjected to traction, being caught into the dies, loading realizes by a system of levers, and at their ends, some weights are attached.

The dies used for traction are positions in a metallic chamber, foreseen with a transparent visiting cover. The sample will be cyclic heating and cooled in the range of temperatures 40–100°C, by means of an installation that blows warm and cold air.

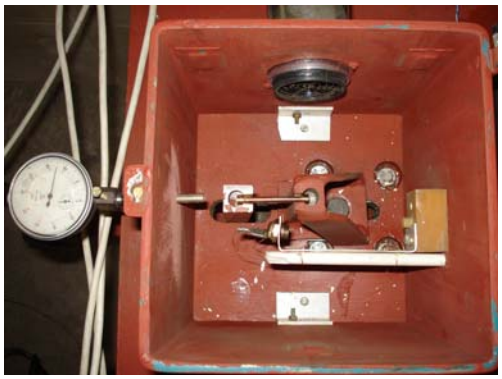


Fig.6. Metallic chamber where the jigs are positioned, measurement system of temperature of sample

According to the weights attached to levers system, the sample will be stressed with a load whose size is directly proportional with the used weight. This proportionality achieved by means of the levers system. For a weight of 5 kg, traction force on the sample ends will be of 500 kgf.

During experiments, the sample made of memory shape alloy will suffer an

elongation, which will be determined with a comparator.

The parameters followed on command panel and a computer using the software named XMEM can control the entire experimental process. As well, the number of heating-cooling cycles will be recorded by XMEM software.

Fig.7. Detail of XMEM software in function.

A very important problem of this installation is the synchronization of the thermal cycle with mechanical cycles. Importance that consists in the fact that memory shape alloys need to determine thermo-mechanical fatigue during material education. Material education realizes in double-effect memory shape materials.

The samples were also analyzed by means of a dilatometer to observe modifications on the characteristic points and implicitly if 'amnesia' phenomenon appears – if the alloy losses its memory shape effect.

CONCLUSIONS

The applications of memory shape alloys impose the determination of functioning period for pieces that work under the conditions of under load cyclic heating.

The determination of the characteristics for a memory shape alloy allows components producers to assure a certain guarantee on these products.

The achievement of the prototype installations, as well the creation of a standard of thermo-mechanical fatigue for a series of analyzed alloys would be a solution for the producers of memory shape components.

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PREPARATION AND CHARACTERIZATION OF ZIRCONIA CERAMICS OBTAINED FROM ULTRAFINE POWDERS

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Abstract: *The superior properties of the stabilized zirconium materials enhance their usage as a grinding media and engineering ceramics. The aim of the present paper was to prepare and characterize total stabilized zirconia ceramics with yttrium (8 mol%), calcium (20 mol%) or magnesia (20 mol%) doping, from powders obtained through co-precipitation method starting from the corresponding chlorides.*

Key words: *nanomaterials, zirconium ceramics*

1. INTRODUCTION

A nanomaterial is composed of nano-objects (whose size ranges from 1 to 100 nm) presenting specific properties at nanometric scale. Nano-objects are used either as they are or to elaborate new materials. These materials can be grouped in three families of products:

- reinforced materials at nanometric scale;
- surface nanostructured materials;
- volume nanostructured materials.

The manufacturing procedures used at present for the elaboration of nano-objects are classified in three large categories:

- elaboration by physical methods;
- elaboration by chemical methods;
- elaboration by mechanical methods.

The nanostructured bulky materials are defined as massive solids with nanometric or partial nanometric structure.

At the end of the XX-th century, when the „microstructures" have been visualized for the first time by light microscopy, it was seen that some microstructures, such as the very small grains showed attractive properties as well as an increased mechanical resistance or a higher toughness.

The very low size (<100 nm) of materials can have as result substantially improved properties or different properties in comparison with the polycrystalline or monocristallin materials with conventional granulometry (>μm) having the same chemical composition. The improved mechanical properties were seen for the first time in materials obtained by the method of condensation from gaseous stage. Among them are mentioned:

- an elasticity module smaller than that of materials with conventional granulometry - percentages ranging from 30 to 50%;
- very high toughness and mechanical resistance – the values of the toughness of pure nanocristallin metals (granules size ~10 nm) are 2 up to 7 times higher than of those metals with higher granulometry (>1μm);
- ductility – and probably a superplastic behavior too – at lower temperatures in fragile ceramic or intermetallic materials with grains of nanometric sizes, phenomenon that occurred because of the diffused deformation mechanisms.

2. COMPARATIVE STUDY

The aim of the study is the achievement of some zirconium nanoceramics with mechanical propensity by unconventional

methods of co-precipitation of zirconium hydroxides and of stabilizing oxides cations.

As stabilizing oxides for zirconium oxide were considered: yttrium oxide, calcium oxide, lanthanum oxide and magnesium oxide. The zirconium oxide was obtained from zirconium chloride ($ZrCl_4$) of 100% purity and the stabilizing oxides have been obtained from the corresponding chlorides.

The synthesized ceramic compositions correspond to a completely stabilized zirconium oxide (cubic polymorph shape). For this purpose, mixtures of raw materials have been prepared to correspond at the end to such compositions (presented in molar percentage):

ZY mixture – 92% ZrO_2 + 8% Y_2O_3
ZC mixture – 80% ZrO_2 + 20% CaO
ZM mixture – 80% ZrO_2 + 20% MgO

The experiments carried out in this study were based on the following experimental flow:

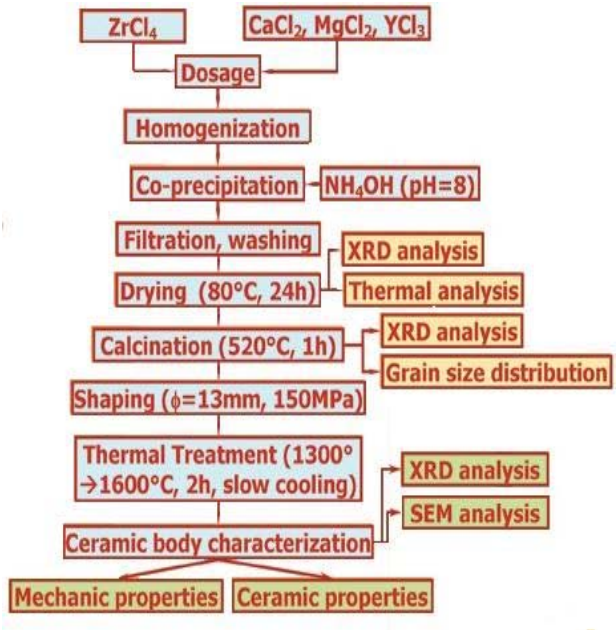

Fig. 1 Experimental flow.

After the co-precipitation of the raw materials mixture and the drying of the precipitate, the obtained powders have been characterized by specific methods, such as: differential thermal analysis, difractometric analysis and granulometric analysis.

Differential thermal analysis

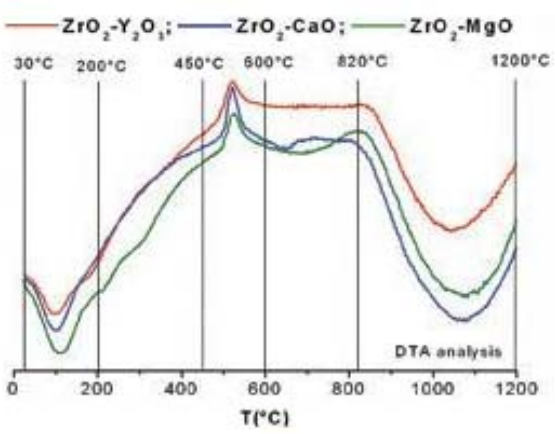

Fig. 2 DTA curves for dry powders.

After differential thermal analyses it can be easily seen three temperature domains:

- 30°-200°C – the temperature domain in which the physical water existing in prepared and dried powders is eliminated;
- 450°-600°C – temperature domain afferent to the exothermal decomposition of $Zr(OH)_4$ at temperatures of 510°-515°C, formed after co-precipitation;
- 820°-1200°C – temperature domain in which the restructuring processes of the solid crystallographic structures begin.

After these analyses it was considered that 520°C is the most indicated calcinations temperature, the calcinations time being established try outs (Fig. 2).

Difractometric analysis

The dried powders were subjected to X-ray diffraction, and besides the halo caused by small angles – characteristic to the nanometric or heavily disordered systems, effects of diffraction characteristic to zirconium hydroxide were seen (Fig. 3). In powders with a supplement corresponding MgO stabilizers added was also seen an increased ability of $Zr(OH)_4$ crystallization.

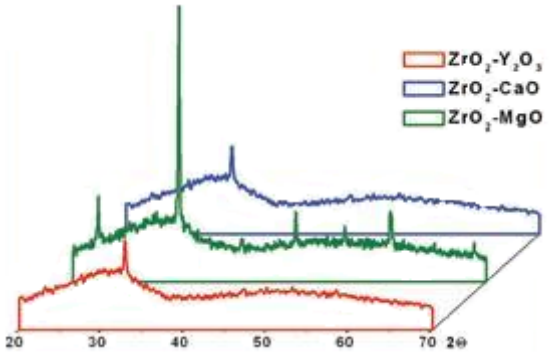

Fig. 3 Difractograms of powders after drying.

All the analyzed powders shown large effects of diffraction afferent to ZrO_2 under monoclinic form, meaning that the monoclinic structure begins to form and arrange itself. The low intensity of peaks of zirconium solid solution supposes small and very reactive crystals, needed in the further processing of these powders.

Granulometric analysis

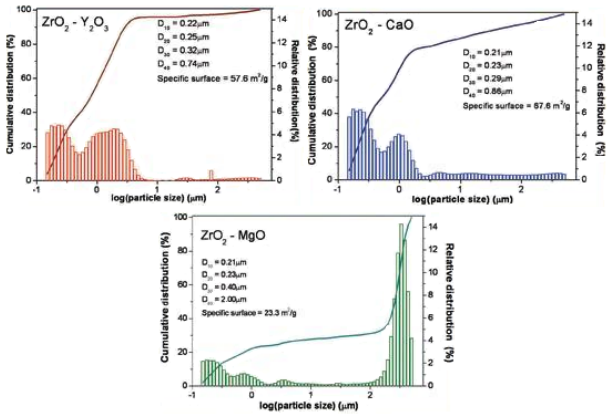

Fig. 4 Granulometric analyses
a. ZY powder; b. ZC powder ; c. ZM powder

The calcinated powders were granulometrically analyzed. From this analysis is evident the following information:

- all the analyzed powders present non-Gaussian granulometric distributions (bimodal distributions);
- ZY şi ZC powders show a finer granulometric spectrum as well as larger specific surfaces (>11m^2/cm^3);
- ZM powder emphasizes a trend of enhanced agglomeration, probably due to the increased hygroscopicity.

All studied powders present bimodal grain size distribution.

By uniaxial pressing (150MPa), the powders became refined in cylinders of 1.3 cm diameter and different heights, which were subjected to thermal treatments at temperatures ranging from 1300°C to 1600°C with a step of 100 degrees. The heating speed was established at 10°C/min and the duration of maintenance at the maximum treatment temperature was of 2 hours. Sintered density higher than 80% of the theoretical density was achieved for all conditions of thermal treatment. The samples were cooled slowly.

After the sintering process, the samples were subjected to the following assays:

a) difractometric analysis – for finding out their mineralogical composition;
b) determination of the ceramic properties – contraction, absorption, open porosity, respectively relative density;
c) determination of the mechanical properties in compression (the compressive strength, Young's modulus and yield strength);
d) scanning electronic microscopy associated with EDAX probe to follow the morphology of the sinterized samples.

a) X-ray Diffraction

The spectra obtained for the samples sinterized at different temperatures are presented in the following figures.

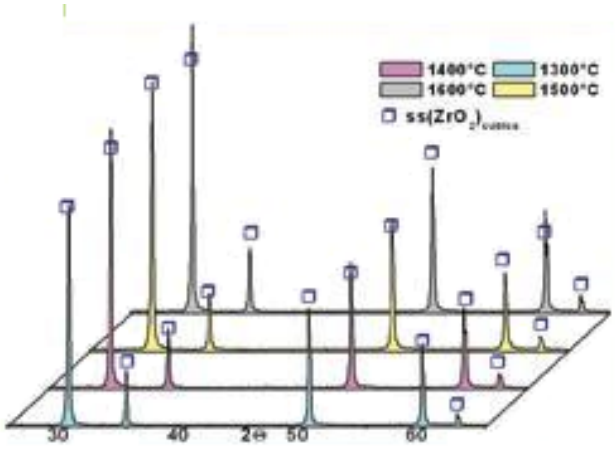

Fig. 5 Spectra of X-rays diffraction for ZY samples.

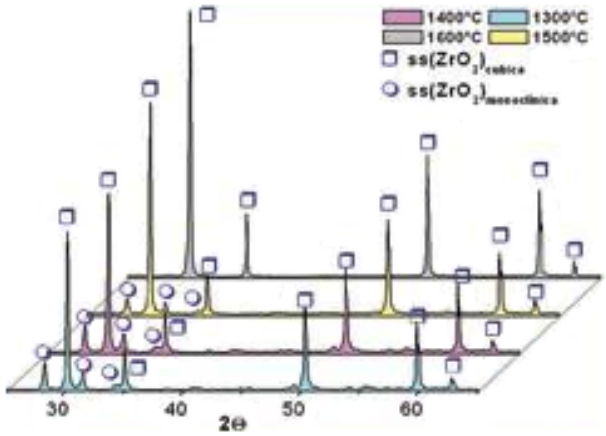

Fig. 6 Spectra of X-rays diffraction for ZC samples.

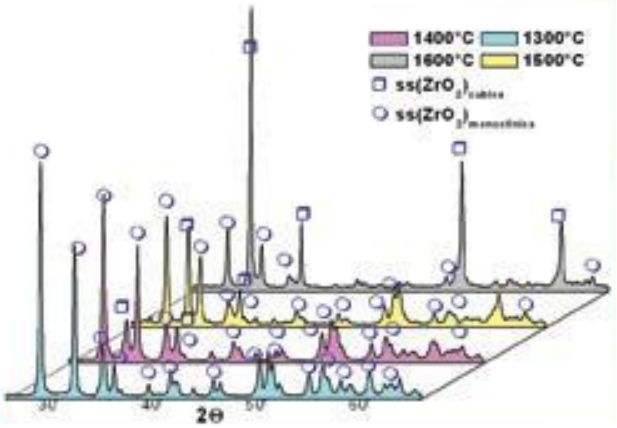

Fig. 7 Spectra of X-rays diffraction for ZM samples.

By studying the difractograms, besides the fact that all the samples at all sintering temperatures are well crystallized, with well-defined peaks, it can conclude that:

- the ceramic samples with Y_2O_3 at any temperature only cubic zirconia solid solutions, very well crystallized;
- the ceramic samples with CaO, although well crystallized up to 1600ºC, also contains traces of zirconia solid solutions of, next to the desired cubic zirconia solid solutions. The ratio of monoclinic zirconia solid solutions decreases with the increase of temperature of thermal treatment;
- the ceramics with MgO, at temperatures lower than 1600ºC, is made up practically almost only from monoclinic zirconia solid solutions.

Although the diffraction effects of the cubic zirconia solid solutions occur at temperatures starting from 1400ºC, they become important only at 1600°C.

b) Determination of the ceramic properties

The four compositions, thermically treated at temperatures ranging from 1300ºC to 1600ºC had the ceramic characteristics presented in the following figures:

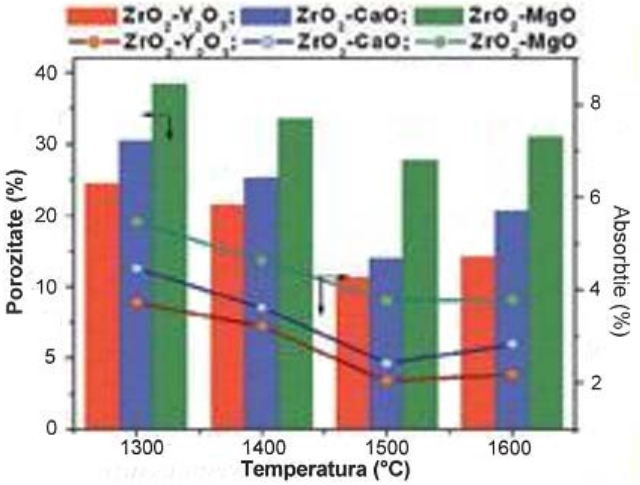

Fig. 8 Evolution of the open porosity and of absorption of the studied samples depending on temperature.

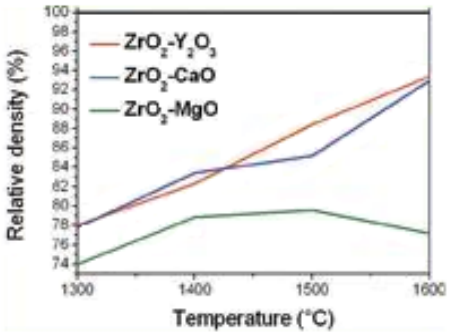

Fig. 9 Evolution of the relative density of the studied samples depending on temperature.

Thus:

- the increase of the thermal treatment temperature brings a more emphasized densification of the studied samples (the relative density increases, the porosity and the absorption decrease). At the maximum treatment temperature, for the samples stabilized

with Y_2O_3 and CaO it can be achieved relative density over 90%;

- the zirconium samples stabilized with Y_2O_3 and CaO have the best ceramic properties, leading to the conclusion of the superiority of the stabilization process of zircon under cubic form with yttrium oxides, respectively calcium oxides.

c) Determination of the mechanical properties in compression

For the determination of mechanical resistances it is used a machine for mechanical trials, whose software allows the calculation of many mechanical properties. The samples subjected to this analysis were cylinders whose diameter was equal with the height.

The values corresponding to the mechanical resistance in compression and to the elasticity module were graphically processed in fig. 10.

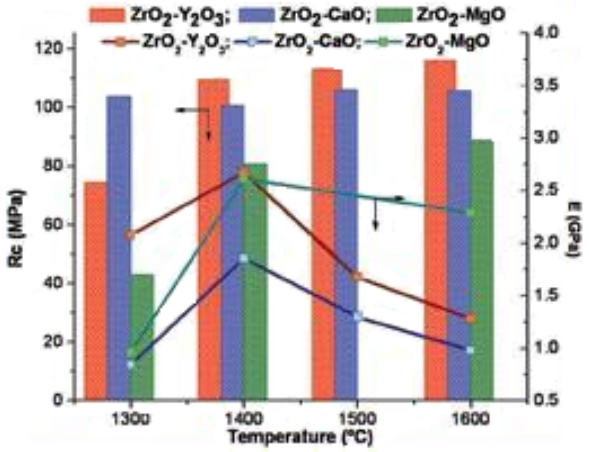

Fig. 10 Evolution of compression resistance and of the elasticity module depending on temperature

It can be seen an increase of the mechanical resistance with the increase of the temperature. It is noticed again the superiority of the samples that were stabilized with yttrium oxide, respectively calcium oxide, although for the last ones, the increase of mechanical resistance with the increase of treatment temperature is very small.

d) Microstructural determinations

The sections of sinterized samples were examined by scanning microscopy (on the surfaces obtained after mechanical testing). The images can be seen in the following figure:

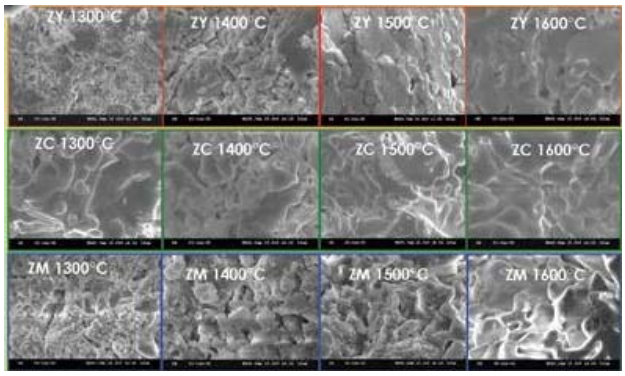

Fig. 11 Microscopic images of samples that were thermically treated at temperatures ranging from 1300ºC to 1600ºC

Analyzing the microscopic images for each lot of samples one can assert the following:

- the ZY mixture – presents irregular crystals at lower temperatures, the appearance becoming uniform by the increase of the temperature; at higher temperatures (over 1400ºC) the sample begins to sinterize, with the development of intergranular bridges; the samples porosity is also reduced, the number and size of pores decreasing with the increase of temperature. At the mechanical testing it is seen that the breaking is inter-granular.
- the ZC mixture – is sintered even at 1300ºC, the diffusion processes are intense and porosity is very low and the breaking mechanism is inter-granular.
- the ZM mixture – up to the maximum thermal treatment temperature presents an un-sintered aspect; the grains of the ceramic increases with temperature, being obvious the monoclinic crystals of zircon from which are gradually formed those of cubic zirconia solid solutions. At the mechanical testing it is also seen that the breaking mechanism is inter-granular.

From EDAX images it is seen the advanced composition homogeneity of all the samples, the distribution of zirconium and of the stabilizer having no local agglomerations.

Depending on the temperature of thermical treatment all the samples also emphasize smaller or bigger intergranular pores.

3. CONCLUSIONS

The superior properties of the stabilized zirconium materials enhance their usage as a grinding media and engineering ceramics.

The impetuous development of the solid physics and chemistry in the last decades enriched the arsenal of investigation means of the modern science with new methods of characterization, through a high degree of reproducibility and increased accuracy.

By its own object of study, the chemistry of oxide compounds and of silicates is one of the greatest beneficiaries of these achievements.

The extreme diversity and the superior characteristics of the materials requested by the technical-scientific revolution need a permanent and profound study of the knowledge concerning the dependence of the properties of the structures, the intimate processes in the manufacturing technology as well as the factors that condition them.

The microstructure and phase composition of the dense sintered ceramics were evaluated through scanning electron microscopy and X-ray diffraction. The compressive strength, Young's modulus, and yield strength of sintered ceramics were, also, measured.

The results have indicated that the nature of the doping oxide and the sintering temperature are the key factors in controlling the mechanical behavior of studied ceramics

From the achieved researches the following conclusions can be drawn:

- the best doping oxide was yttrium oxide, followed by calcium oxide;
- magnesium oxide does not assure the needed stabilization processes for zirconia solid solutions;
- by the selected unconventional way high mechanical resistances can be obtained.

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DETECTION AND EVALUATION OF THE FATIGUE PROPERTIES OF MATERIALS USING IN THE MILITARY TECHNIC

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SUMMARY: *The paper deals with the influence of the load ramp magnitude on the high frequency fatigue characteristics of carbon steel C 15 E fatigue life measured under high frequency cyclic loading frequency f ≈ 20 kHz, alternating symmetric push-pull loading, coefficient of asymmetry R = -1, temperature t = 20 ± 5°C, in the field of high number of cycles from N =10^8 cycles.*

Keywords: *dynamic modulus of elasticity, high frequency fatigue, Wöhler, Coffin- Manson fatigue life curve, load ramp, the cyclic deformation fatigue life curve.*

1. INTRODUCTION

The fatigue process is very sensitive to a great amount of both external and internal factors that, each of them on its own, but especially when acting simultaneously, can very effectively affect the fatigue resistance of materials, parts and constructions.

The fatigue tests can be performed in various experimental conditions at different loading frequencies. Many important characteristics of material can be obtained using high frequency cyclic loading at frequencies of about f ≈ 20 kHz.

Only small attention has been paid so far to initial phases of high frequency tests. It holds true also about non-conventional tests when the amplitude of tension is continually increased in regime of controlled amplitude of tension. When the increase is finished, the amplitude is maintained at a constant value.

The aim of this work was to determine the influence of thermal processing and load ramp on mechanical characteristics and values of dynamic modulus of elasticity and also on fatigue characteristics of experimental material at loading frequency of about f = 20.2 kHz and temperature of t = 20° ± 5 ^{0} C.

1.1 EXPERIMENTAL FATIGUE TESTING EQUIPMENT

Experimental determining of the complete Wöhler's curves, dependence $\sigma_a = f(N_f)$ including fatigue limit σ_c is realized on a test equipment CAFR (complete acoustic fatigue resistance), HFCL(high frequency cyclic loading). Its simplified scheme is presented in Fig. 1.

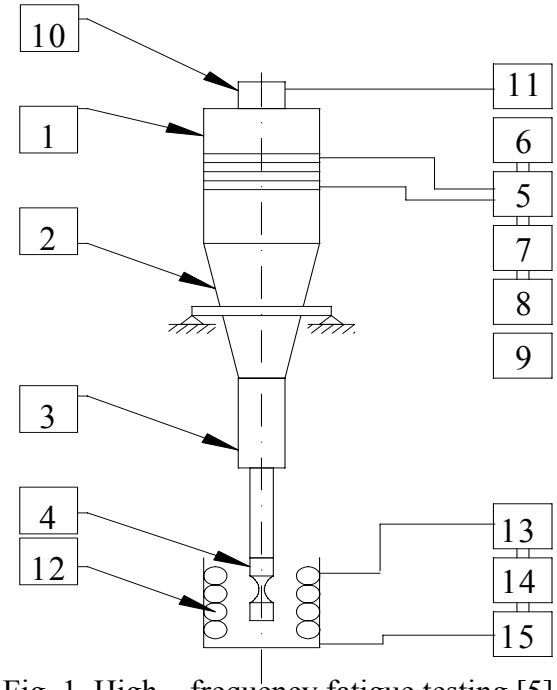

Fig. 1 High – frequency fatigue testing [5]

The main components are:
1–piezoelectric transformer, 2–conical transformer, 3–stepped transformer, 4–specimen, 5–ultrasonic generator, 6–automatic frequency compensator, 7–digital frequency meter, 8–printer, 9–digital stop watch, 10– deviation amplitude sensor, 11–BM 494 milivoltmeter, 12–waterjet, 13–thermostat, 14–waterpump, 15–reservoir.

1.2 EXPERIMENTAL METHODS, MATERIALS, SPECIMENS, METHODOLOGY OF TESTS AND RESULTS

The test specimens used in experiments are designed in accordance with recommendations of Salama and Lamerand [4] so, that they accomplish the resonant conditions. The shape and dimension of test specimens are shown in Fig. 2.

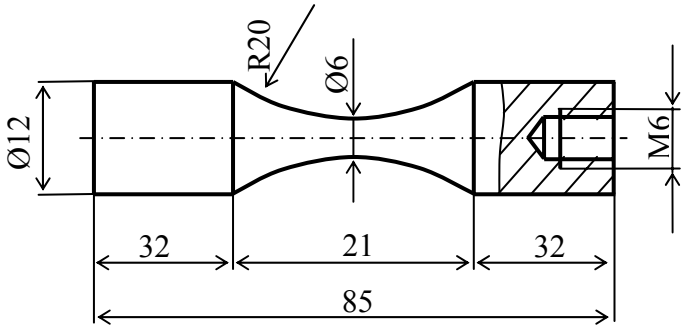

Fig. 2 Shape and dimensions of specimens HFCL

The specimens in the middle-working part are cut with the aim of the highest possible elimination of surface influence on resulting fatigue characteristic. In determining the Wöhler curve including the fatigue limit σ_c, the Coffin-Manson fatigue life curve, the cyclic deformation fatigue life curve, and the dynamic modulus of elasticity E_d. Relative amount of cycles for the fatigue limit determination by HFCL is chosen in accordance with the conclusions of international conference in Ohio in 1985, it means $N_f = 10^8$ cycles. The frequency of cyclic loading with sinusoidal character is $f \approx 20$ kHz, coefficient of asymmetry R= -1 and temperature $t = 20 \pm 5^0$ C.

The carbon steel C 15 E (0,14 wt. % C, 0,68 wt. % Mn, 0,36 % Si, 0,34 Cu, 0,04 Cr, 0,013 S, 0,014 Mn) was normalizing annealed at the temperature of 900 ° C during 1 hour and then cooled in air. Tests specimens with a diameter of 4 mm were manufactured using the method described in [3]. Afterwards stress-relief annealing followed at the temperature of 500° C during 30 minutes and air cooling to the furnace.

Three samples were manufactured from every experimental material to determine its static mechanical characteristics by static tension test and an acoustic wave duct was manufactured from every investigated material with approximate dimensions for loading frequencies of about f = 20,2 kHz [4].

The static mechanical characteristics were obtained using ZDM machine after valid calibration with minimum measuring error. Fatigue tests and measuring of dynamic modulus of elasticity were performed by CAFR machine [5] that is able to control and maintain both the constant value of the amplitude of the free end of a specimen and the actual loading frequency. The samples were loaded by symmetrical stretching and compression (R = -1) at loading frequency of about 20.2 kHz and simultaneously intensely cooled by flowing water having temperature of $t = 20° \pm 5^0$ C.

Fatigue test were performed with 15 samples from experimental material. Different magnitudes of load ramp had been used prior the amplitude of tension reached the demanded value and cycles of loading until the fracture event started to be counted.

Load ramp magnitudes of 10 MPa.s^{-1}, 20 MPa.s^{-1} and 80 MPa.s^{-1} were used by examining the carbon steel C 15 E. The highest load ramp magnitude 80 MPa.s^{-1}, used at different types of investigated material are common by performing fatigue tests with loading frequency of about 20.2 kHz.

Static mechanical characteristics and values of dynamic modulus of elasticity of experimental materials are shown in Table 1. Evaluated numerical values of fatigue life

curve factors and coefficients are shown in Table 2 [6, 7, 8].

Table 1 Static mechanical characteristics and values of dynamic modulus of elasticity of experimental material carbon steel STN 41 2020

Material	R_m (MPa)	R_p (MPa)	A_s (%)	Z (%)	E_{do} (MPa)
C15 E	390	225	28	57	206 640

Table 2 Numerical factors of fatigue characteristics of experimental material carbon steel C 15 E at the frequency of about 20 kHz with various load ramp applied

Material	Parameter	Load ramp ($MPas^{-1}$)		
		10	20	80
C 15 E STN 41 2020	σ_f' (MPa)	598	726	1046
	b	-0,0475	-0,0648	-0,0876
	σ_c (MPa)	249	219	208
	ε_f'	$5{,}77\cdot10^{-5}$	$8{,}48\cdot10^{-5}$	$1{,}43\cdot10^{-4}$
	c	-0,125	-0,184	-0,297
	ε_{ap}	$5{,}75\cdot10^{-6}$	$3{,}86\cdot10^{-6}$	$2{,}94\cdot10^{-6}$
	K (MPa)	23820	19240	13320
	n'	0,38	0,35	0,29

The fatigue tests results were evaluated both graphically and by the method of regressive analysis. The fatigue life curve can be described according to Wöhler by equation

$$\sigma_a = \sigma_f' \cdot N_f^{\,b} \qquad (1)$$

where σ_a is the amplitude of tension, σ_f' is the fatigue firmness factor, N_f is the number of loading cycles and b is the fatigue life coefficient. The Wöhlers fatigue life curves of carbon steel C 15 E are shown in Fig. 3

The fatigue life curve can be described according to Coffin- Manson by equation

$$\varepsilon_{ap} = \varepsilon_f' \cdot N_f^{\,c} \qquad (2)$$

where ε_{ap} is the amplitude plastic deformation, ε_f' is the fatigue ductility factor, N_f is the number of loading cycles and c is fatigue life coefficient. The Coffin-Manson fatigue life curves of carbon steel C 15 E are shown in Fig. 4.

The cyclic deformation curve can be described according to by equation

$$\sigma_a = K \cdot \varepsilon_{ap}^{\,n'} \qquad (3)$$

where σ_a is the amplitude of tension, K is cyclic resistance factor, ε_{ap} is the amplitude plastic deformation and n' is the cyclic deformation hardness coefficient.

The cyclic deformation curves of carbon steel C 15 E are shown in Fig. 5

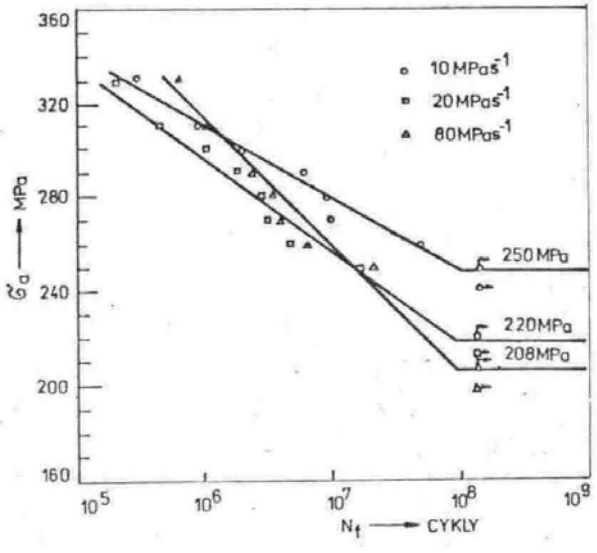

Fig. 3 The Wöhlers fatigue life curves carbon steel C 15 E with various load ramp applied

As can be seen from Table 2 some of our experimental results are sensitive to the rate of increase of amplitude of tension, e. i. the load

ramp magnitude. When the load ramp magnitude is increased the fatigue limit of carbon steel C 15 E decreases that means that the material is softening.

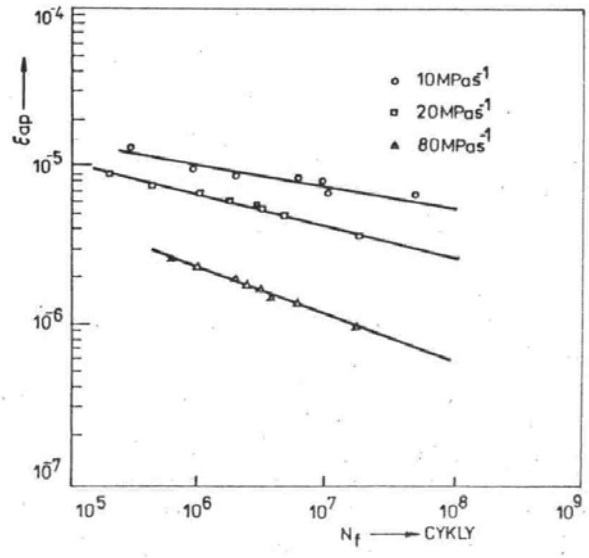

Fig. 4 The Coffin-Manson fatigue life curves carbon steel C 15 E with various load ramp applied

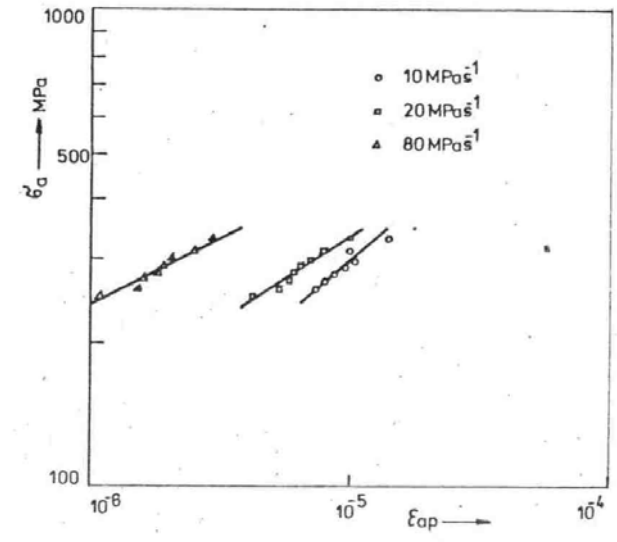

Fig. 5 The cyclic deformation curves of carbon steel C 15 E with various load ramp applied

Conclusion

Requirements on increasing of a suitable properties of machines and machineries in view of their lifetime and safety cause an increase of interest in research experimental studies in areas with cycles amounting to $N_f = 10^9$ [6]. In fatigue degrading processes in gigacycling modes of loading are also studied [6, 7]. Continuous obtained experimental results in constructional materials by high-frequency cycle loading with working frequencies about 20 kHz show possibility of verification of fatigue characteristics beyond limit $N_c = 10^7$ cycles
[8, 9, 12].

Moreover the perspective appears that fatigue degrading processes can be studied up to the required number of cycles $N_f = 10^9$ and even more. Up to the present, studies all over the world have been without any coordination or system [6, 7]. Mutual comparison of results obtained at HFCL and LFCL due to different conditions in experiments serves only for orientation. An important requirement for the expected representative results is the creation mandatory regulations i. e. an international standard for performing experiments at HFCL.

It was proved that being stretched and compressed with loading frequency of about 20.2 kHz at the temperature of 20° ± 5 ^{0} C both carbon steel C 15 E increases.

The method described in [8, 9, 10, 11, 12] is fully applicable for high-frequency test and provides reproducible characteristics. Measured values make it possible to analyse the Wöhler fatigue life curve, the Coffin-Manson fatigue life curve, and the cyclic deformation fatigue life curve, both graphically and analytically even when obtained at high-frequency loading.

From mutual comparison of fracture surfaces of investigated experimental material, damaged by fatigue tests with different load ramp magnitudes, it follows that their values have no significant influence on character and morphology of fracture surfaces [8].

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STUDY ON SOLID WAVES THAT APPEARS TO LASER WELDS SURFACES

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Abstract: *Laser welding is a non contact process of melting material. It presents an experimental study on laser welding of carbon steel. Laser welds surfaces show the aspects of melt motion presents in welding bath. After solidification solid waves are presented on the piece surface. The study compared the contour length of solid wave and weld width. Showed a similar behavior of the two sizes for variations with laser power and welding speed.*

Key words*: laser welding, steel, weld surface, solid waves, melt movement*

1. INTRODUCTION

Laser welds surface analysis shows interest in terms of physical phenomena occurring in the welding bath. At the welds surfaces appear where solid waves having a great regular in shape and sizes (height, width and curvature).Their appearance is explained by the melt movement welding bath. Waves on the surface of the welding bath are trapped in the solidification [1]. As remoteness from the formation point the wave period increase and becomes comparable to the solidification time. Production of solid waves is simultaneous with the over lifting of the weld. Accurate assessment of solid waves formation and their regularity is difficult. For weld solid waves are studied the two consequences of their presence. They are weld over lifting and weld surface roughness [2,3].

The purpose of the paper is to present the characteristics of solid waves produced at weld surface. They come from catching molten material current in the solidification proces. Solid wave contour (wave length) characterizing the weld surface. It simultaneously shows the welding bath width and melt movement in welding bath. This paper studies compared solid wave contour length (wave length) and weld width.

2. EXPERIMENTAL PROCEDURE

The experiment consisted of fusion lines (welds) with the line length of 110mm on steel Dillimax500 plates with thickness 10 mm. An industrial laser machine Nd: YAG Trumph Haas 3006D was used. It emits radiation with wavelength $\lambda = 1.06$ μm and has a maximum power of 3kW. Irradiation was performed in continuous regime. Laser beam was transmitted through a fiber with 0.6 mm diameter. The focusing system assures the spot in focal point with 0.6 mm diameter.

The focal distance of lens was 200 mm. As protective gas was argon with a flow rate of 20 l/min. On the 6 sheets of material with $100\times130\times10$ mm dimensions was made between 5 and 8 welds on each plate, total 37 welds.

The material used was steel Dillimax500 EN 10137. This is a fine grain steel with high elasticity limit elasticity. Chemical composition with the upper limit expressed as a percentage is given as follows:$C\leq0.16, Si\leq0.5,$ $Mn\leq0.1.6,$

$P \le 0.02$, $S \le 0.01$, $Cr \le 0.7$, $Ni \le 1$, $Mo \le 0.6$, $V+Nb \le 0.08$.

Steel was made by tempering in water and return. Dillimax500 has a low carbon content and relatively low carbon equivalent index.
Also it shows a low hardness in heat affected zone and therefore a low risk fracture at cold because inclusion of hydrogen and good tenacity. Experience shows that good characteristics are obtained in welded area if the parameters are chosen so that cooling times $t_{8/5}$ have value between 10 to 30 seconds.

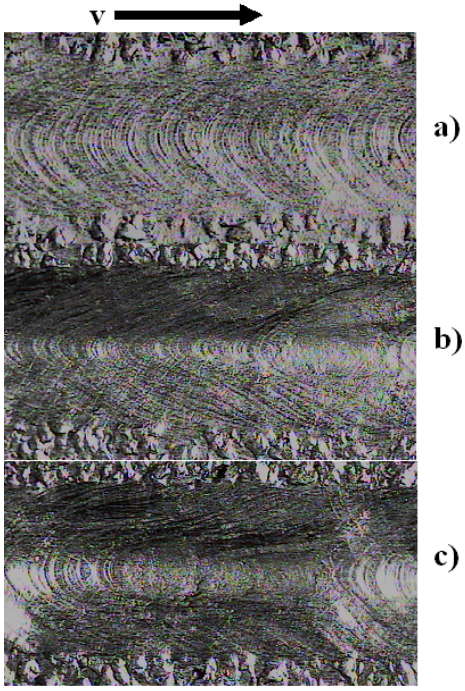

Fig. 1 Weld surface for welds made at laser power of) 1.5kW, b) 2.5kW, c) 3kW

Experiments were conducted as classical experimental series were varied laser power P [kW], welding speed v[m/min]. The experiments were identical for three values of defocusing.Defocusing is the distance between the piece surface and the focal plane of the lens. Focus of the laser beam on the piece surface is designated as $\delta = 0$. Defocusings $\delta = -2\,mm$ and $\delta = -4\,mm$ means focusing inside piece (shown by negative sign).Focus inside the piece ensure the convergent propagation of laser beam in the interaction zone between laser radiation and material. Figure 1 shows the welds surfaces for increasing values of laser power. In Figure 2 are presented the vary parameters in experiments.

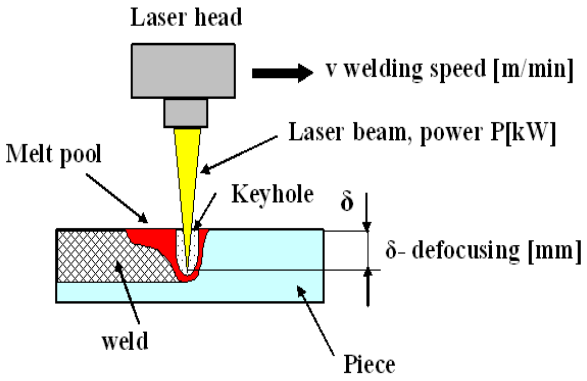

Fig.2 Parameters varied in experimental tests

Interpretation of experimental results required that changes direct parameter values with the calculated values used depending on the varied parameters. By this method there is an increase for number of the experimental results for one experimental series.

Linear energy E_l [j/cm] is a size that characterizing material irradiation in terms of relative movement between the material and laser head, and in terms of ability to irradiate the laser material. In welding linear energy is a standard size that characterizes the heat source. Linear energy shows that energy is sent to the material per unit length traveled by the laser beam. Linear energy is calculated by the ratio of power and welding speed.

$$E_l = \frac{P}{v} \quad [\text{j/cm}] \qquad (01)$$

Linear energy presents a dual vary parameters depending on the power and welding speed.

The interaction energy E_v is defined as the ratio of intensity to the piece surface and welding speed. Interaction energy has not a direct physical significance as energy brought in a certain volume. Higher values for interaction energy of interaction are justified by the small size of focal spot.

Interaction energy presents the ability of laser induced thermal phenomena in the material. The heat of the laser on the material is proportional to the laser intensity I [W/cm^2] to the piece surface and with time of interaction between laser radiation and material. The interaction time is inversely proportional to the welding speed. Interaction energy ensures a complete definition of the conditions for laser –material interaction.

$$E_v = \frac{I}{v} \quad [\frac{j}{cm^3}] \qquad (02)$$

Laser beam intensity on the piece surface of was calculated as the ratio of laser power and spot area on the piece surface. Spot was considered circular. The link between spot diameter and defocusing values were determined by an empirical relationship. We have:

$$I = \frac{4}{\pi}\frac{P}{D^2} = \frac{4}{\pi}\frac{P}{(0.12|\delta| + 0.6)^2} \ [\text{W/cm}^2] \qquad (03)$$

The two previous relations shows that the interaction energy E_v depends on all three parameters varied in the experiment, power, welding speed and defocusing.

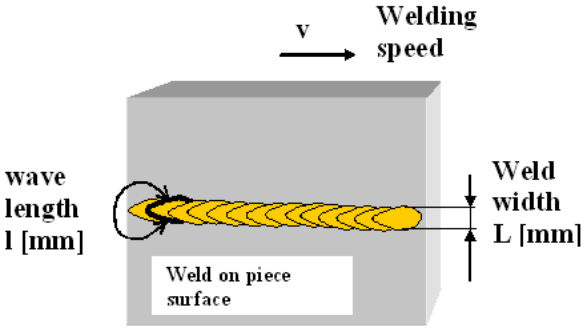

Fig. 3 Sizes measured on the piece surface, weld width and wave length

In this paper the two sizes were analyzed characterizing the weld area. Its characterize transverse the weld. Weld width L [mm] directly characterize the weld width. Wave length l [mm] presents the length of solidification front. Wave length added to the weld width deflection deformation produced by melt flow. It was considered that the wave is characterized by this size, wave length; better than the distance between waves that is difficult to measure. Figure 3 shows the two sizes measured on the piece surface of the play.

To measure the weld width of and wave length were made three replicas for each measurement. To measure the wave length were used photographs of the weld surface with a magnification of 15X. Analysis of experimental results will be made below.

3 EXPERIMENTAL RESULTS

The varied parameters laser power, welding speeds and defocusing have the following effects on molten zone dimensions:

- Laser power. Increasing the laser power produce increase the intensity on piece surface therefore melted material amount increases. From a certain value, intensity not too high melting material amount, favours material vaporization.
- Welding speed. Increasing welding speed decrease the interaction (time) between laser radiation and material. If the interaction time is less then the molten zone dimensions are smaller.
- Defocusing. Defocusing by lowering the focal plane within piece produce lower intensity at piece surface by increasing laser spot area at piece surface and from same issue will increase interaction time between laser and material.

Focus within piece associated with the presence of keyhole welding bath will increase the spread of radiation in keyhole and coupling of laser radiation and material. Defocusing may thus have different effects on melting material. You can not predetermine a clear trend of increasing or decreasing the molten zone. Defocusing effects will be analyzed based on experimental results.

In the following will be analyzing variations to the wave length and weld width.

Variation depending on laser power

Figure 4 shows a linear increase for wave length depending on the laser power. This

increase rate is similar for all three defocusing values studied. Values are close to the three cases. It is noted that at low power focus to piece surface area produces higher values for wave length while at the great power values are lowered. It looks so low powers favors melt movement in welding bath.

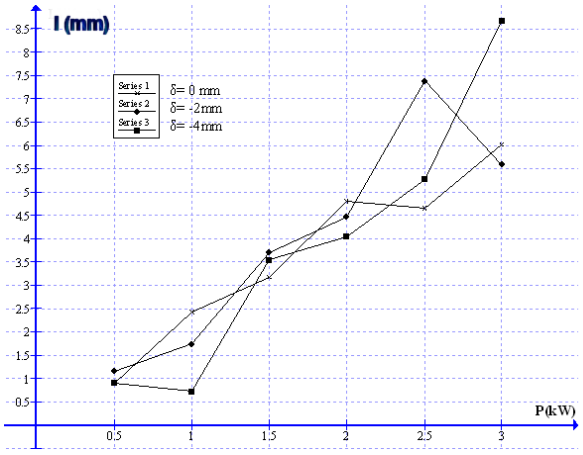

Fig. 4 Wave length depending on the laser power at welding speed of 0.6 m / min.

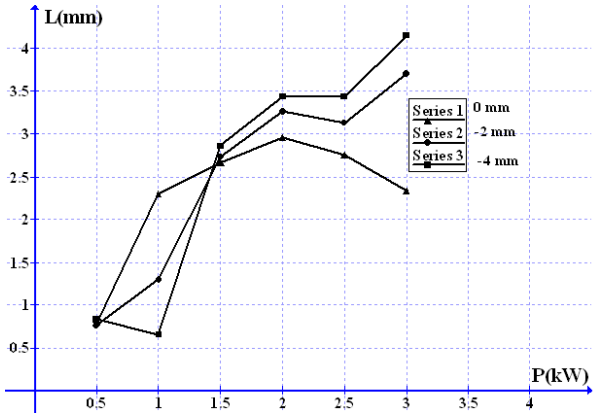

Fig. 5 Weld width depending on laser power at welding speed of 0.6 m / min

Figure 5 shows the change in weld width with laser power. It shows an increase trend of weld width with laser power. This tends approach to a logarithmically variation which finish asymptotic constant values. From this is achieved a limiting of the weld width increase with laser power. This limitation could be followed even lower given the increased contribution of vaporisation. Experimental series with focus on piece surface $\delta = 0$ where the laser intensity is highest show general trend of variation. It is noted that the high power focus within the play will give higher values of weld width.

Figures 4 and 5 shows the close type to the power varies for wave length and weld width. Wave length is less sensitive to power changes than the weld width on the experimental field studied.

Variation depending on the welding speed

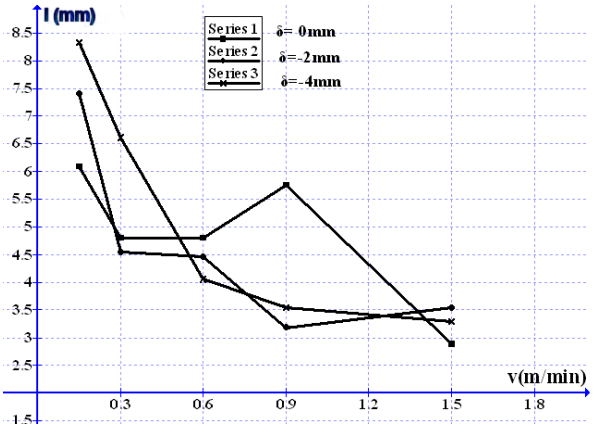

Fig. 6 Wave length depending on welding speed at laser power of 2kW

Figure 6 shows a decrease for wave length depending on the welding speed. For focus within piece produce smaller wave lengths. For this defocusing tendency of decreasing with welding speed of welding is clear without the relative perturbations. It can be interpreted as a decrease of logarithmic type. At low welding speeds of the wave length is greater for great spot on piece surface (defocusing in piece) Focusing on the piece surface, where the intensity is greater than the wave length produces are higher on range of the experimental field.

Figure 7 shows the change in weld width with laser power. There is a strong decrease in weld width with laser power. This occurs similarly for the three defocusing values It is noted that the focus within the piece give

higher values for the weld width than focusing on the piece surface.

From figures 6 and 7 are observed similar behavior for the wave length and weld width depending on the welding speed.

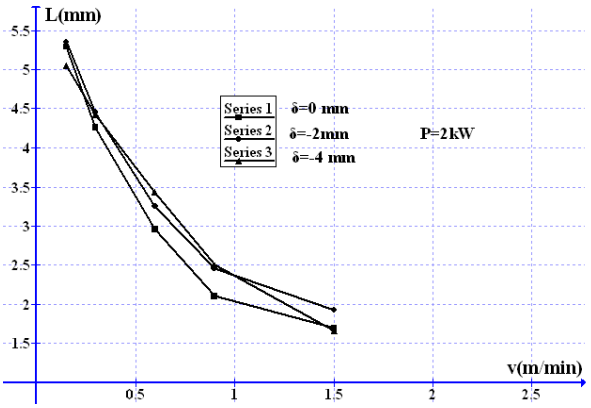

Fig. 7 Weld width depending on welding speed at laser power of 2kW

Variation depending on the linear energy

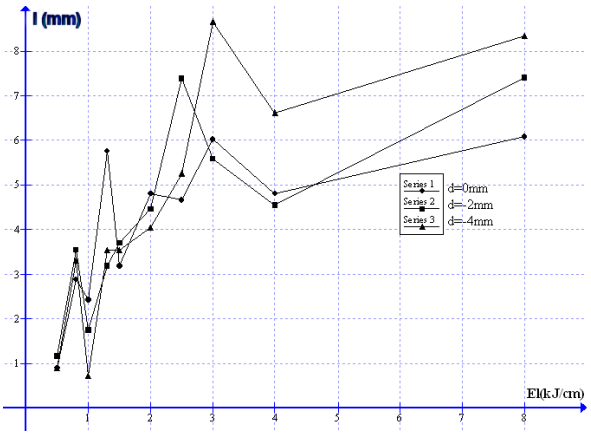

Fig. 8 Variation of the wave length with linear energy

Figure 8 presents the change for wave length with linear energy. There is a logarithmic-type growth. There is a general trend of increasing wave length with more instability for low linear energy.

Figure 9 shows an logarithmic type increase for weld width with linear energy. There is a tendency to increase weld width depending on linear energy. For low linear energy the great variations are observed. The range of these variations is greater focus on the piece surface. For all three defocusing values there is a maximum around 2 kJ / cm, it is followed by a relative minimum.

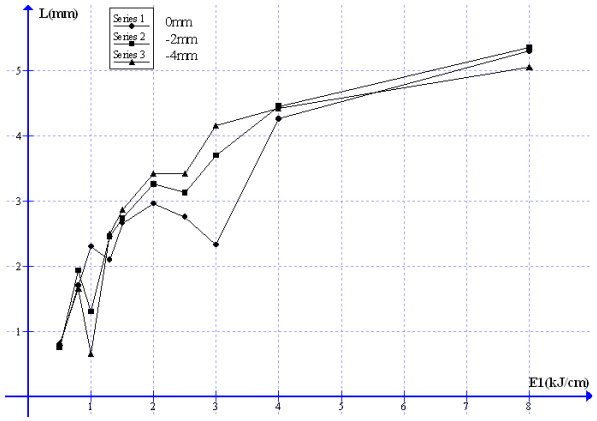

Fig. 9 Variation of the weld width with linear energy

The two previous figures 8 and 9 indicates the same type of variation , logarithmic increase type according to the linear energy. There is a greater scattering of values for the wave length than the weld width. At linear energy 3 kJ / cm is observed an opposite trend behavior of the two sizes. Such weld width decrease is accompanied by increased wave length.

Variation depending on the interaction energy

In Figure 10 there is presented a logarithmic increase for the wave length with interaction energy. There is a large scattering for data at lower values for interaction energy

In Figure 11 there is presented a logarithmic increase for weld width with interaction energy. Strong variations are observed at beginning of experimental field related to a weak correlation.

Figure 10 and figure11 shows the same type of variation for wave length and weld width. This is given by logarithmic growth type. It is noted that is a better correlation for weld width than wave length, for functions of

regression. This means that the individual effect of process parameters on the wave length is greater than the weld width.

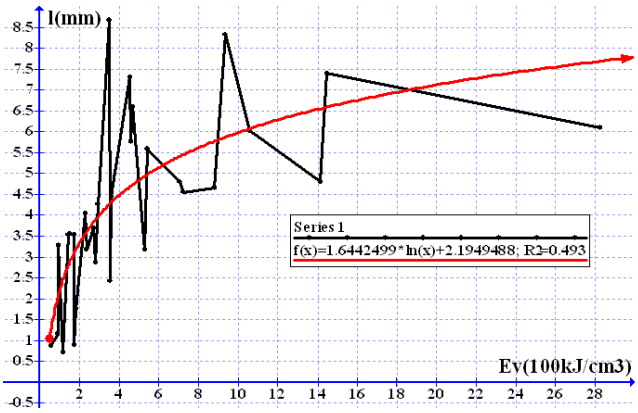

Fig. 10 Variation of the wave length with interaction energy

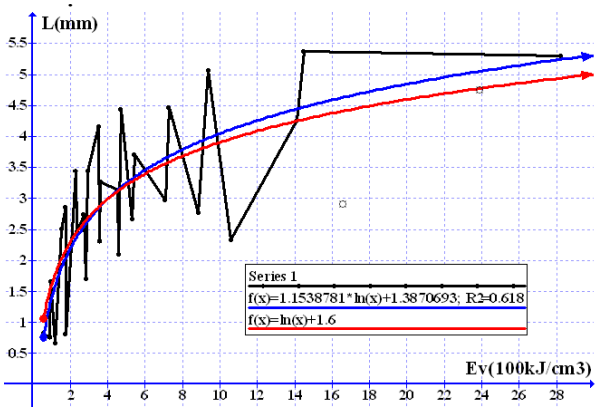

Fig. 11 Variation of the weld width with interaction energy

4. CONCLUSIONS

In previous studies presented by the comparison between the weld width and wave contour length expressed quantitatively welding bath melt movement. Were shown following for melt motion in the welding bath relative to wave length:

- Increasing the laser power increases the melt movement in welding bath.
- Increase welding speed reduced melt movement in welding bath. High intensity at piece surface (defocusing $\delta = 0$) reduce decreasing of melt mouvement.
- Increase energy linear increase melt movement in welding bath.
- Increasing interaction energy increases melt movement in welding bath.

The mathematical model for weld width and l wave engthvariations was a logritmic type. Values for wave length varied similar to the weld width , ranged as a higher level of weld width values. Under the same energy conditions (on the linear energy, that energy of interaction) there are cases in which the wave length increase is accompanied by weld width decreased . In this cases the three defocusing values used in experiments defocalizării produce similar changes.

High values for the wave length are associated with high intensity to focus on the piece surface $\delta = 0$ and with high focal spot diameter for defocusing $\delta = -4\,mm$.

The method proposed in the paper to measure the melt motion in the welding bath by solid wave contour length is an alternative method to measurements of surface roughness or monitoring welding bath surface during welding process.

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MAIN ASPECTS OF THE LASER WELDING PROCESS

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Abstract: *The process laser welding process for carbon steel plates is analyzed. An experimental factorial plan is applied. On the welds made on plates were analyzed effects of laser power, welding speed and defocusing to the weld width and depth. The hierarchy of effects and interactions between them was made by full factorial design method. The efficiency for obtaining a melt in the welding is analyzed for laser power and welding speed variations.*

Key words*: laser welding, steel, full factorial deign, pareto chart, melting efficiency.*

1. INTRODUCTION

Monitoring and analysis of the welding process is done by controlled changes of parameters and analysis of important characteristics of welds. Thus the parameters variations were considered laser power, welding speed and defocusing in study [1]. Particular interest to variations due by defocusing on the weld characteristics were reported in the paper [2]. As they use the laser focus within the piece. Laser focus over the piece was used in the work [3]. The linear energy was used as a parameter to characterize the welds in the work of [4]. The principal weld characteristics weld width and weld depth are showing as measured sizes. They varied from classic experimental series are presented in the work [5]. Molten zone area was measured on weld section in the paper [6]. Studies using the type-factorial experimental plans were presented in the paper [4]. The efficiency of obtaining fusion in welding process has been analyzed in works [6,7,8].

This paper presents a study for laser beam welding of carbon steel plates. It seeks the ability to produce laser beam melt the piece. Experimental conditions used allowed the free development of melt in the piece. It examines the effects of power, welding speed and defocusing on the weld width and depth and melt production efficiency in the welding process.

2. EXPERIMENTAL PROCEDURE

The experiment consisted of fusion lines (welds) with the line length of 110mm on steel Dillimax500 plates with thickness 10 mm. An industrial laser machine Nd: YAG Trumph Haas 3006D was used. It emits radiation with wavelength $\lambda = 1.06$ μm and has a maximum power of 3kW. Irradiation was performed in continuous regime. Laser beam was transmitted through a fiber with 0.6 mm diameter. The focusing system assures the spot in focal point with 0.6 mm diameter.

The focal distance of lens was 200 mm. As protective gas was argon with a flow rate of 20 l / min. On the 6 sheets of material with $100 \times 130 \times 10$ mm dimensions was made between 5 and 8 welds on each plate, total 37 welds.

The material used was steel Dillimax500 EN 10137. This is a fine grain steel with high elasticity limit elasticity. Chemical composition with upper limit expressed as a percentage is given as follows: $C \leq 0.16$, $Si \leq 0.5$, $Mn \leq 0.1.6$, $P \leq 0.02$, $S \leq 0.01$, $Cr \leq 0.7$, $Ni \leq 1$, $Mo \leq 0.6$, $V+Nb \leq 0.08$

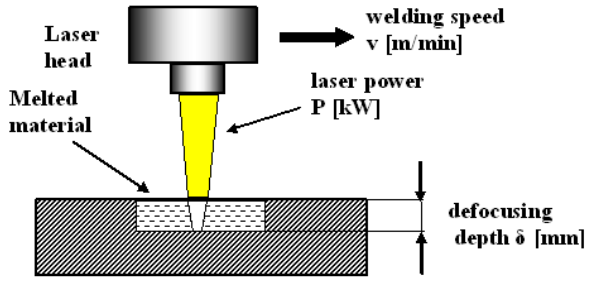

Fig. 1 The parameters varied in the experiment

Steel plates were made by tempering in water and return .Dillimax500 has a low carbon content and relatively low carbon equivalent index.

The radiation was controlled by variation of three parameters: laser power P[kW], welding speed v [m/min] and defocusing δ [mm] (distance between the focal point and the piece surface) figure 1.

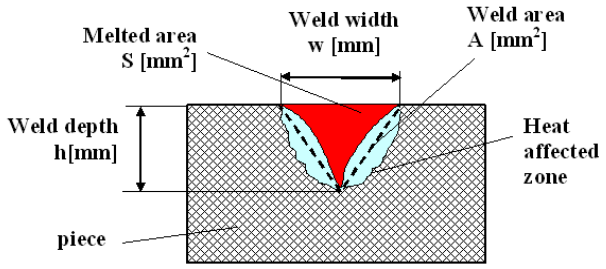

Fig. 2 Sizes measured on the weld section

Experiments were conducted after complete factorial plan or full factorial design type 2^3. It contains three variables with two levels to each one. Scheme using a combination of factors levels “one with each others” For statistical analysis is added a number experiments with values at mid-range level named as replies in the center point of the experiment.

For the varied parameters values are expressed as dimensionless variables. Such for presented experiments varied parameters (or influence factors) are named laser power A [-], welding speed B[-] and defocusing C [-]. Their levels are designated by values +1 for the upper level and -1 for the lower level. Table 1 shows actual and coded values for made welds.

Table 1 Actual values and dimensionless values for vary parameters in experiment

weld	**Power**		**Speed**		**defocusing**	
	P [kW]	A [-]	v [m/min]	B [-]	δ [mm]	C [-]
1	1	-1	0.6	-1	0	-1
2	3	+1	0.6	-1	0	-1
3	1	-1	1.5	+1	0	-1
4	3	+1	1.5	+1	0	-1
5	1	-1	0.6	-1	-2	+1
6	3	+1	0.6	-1	-2	+1
7	1	-1	1.5	+1	-2	+1
8	3	+1	1.5	+1	-2	+1
9	2	0	1	0	-1	0
10	2	0	1	0	-1	0

Welds were sectioned in the stable part of welding. The weld cross-section was metallographic processed. On section through the weld were measured the weld width at piece surface w [mm] and weld depth h [mm]. These were measured with a light microscope with precision of 0.01 mm.

The measured area of the weld molten zone S [mm^2] was achieved by measuring the footprint of melted area with raster in millimeter with a approximated precision of 0.25 mm^2.

Scheme of sizes measured weld cross-section is shown in Figure 2.

To analyze welds were introduced following calculated sizes:

- F-ratio, ratio of width and depth of weld:

$$F = \frac{w}{h} \text{ [-]} \qquad (01)$$

-Weld area (on the assumption of a triangular weld section)

$$WA = \frac{w \cdot h}{2} \ [\text{mm}^2] \qquad (02)$$

Factorial experiment type allows more experimental data analysis. The paper presents analysis of hierarchy influence factors (parameters) and interactions between them, named as effects. It has some references to statistical significance of effects for weld characteristics.

To study the efficiency of melting in the welding process were performed classic experiments for which were varied the laser power at the welding speed of 0.6 m/min and welding speed at power of 2kW. The experimental series have been reproduced similarly for three defocusing values $\delta = 0$, $\delta = -2\,mm$ respectively $\delta = -4\,mm$.

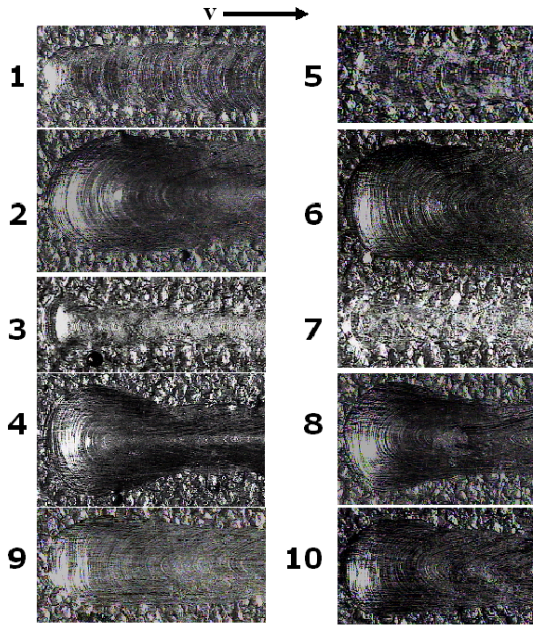

Fig. 3 Images of the welds surfaces for factorial experimental plan weld 1-4 with $\delta = 0$, welds 5-8 with $\delta = -2\,mm$, welds 9-10, reply $\delta = -1\,mm$

3. EFFECTS ANALYSIS

Laser welding has two regimes, conduction welding regime and keyhole welding regime. Keyhole welding regime is associated with keyhole phenomenon in welding bath. Keyhole is a cavity filled with vapors. For keyhole welding regime are obtained deep welds.

The two welding regimes differ by the form of weld cross-section. In the experiments were made both type of welds. Welds in the conduction regime have low penetration and low over height of their surface. These were obtained for the lower level of power. Images of welds surfaces associated with full factorial design experiment, table 1 are shown in figure 3. The following analysis will show the link between the effects of influence factors and keyhole welding regime.

Method of analysis of the effects is based on mathematical modeling that considers measured sizes (response functions) as the sum of the effects (influence factors and their interactions represented by product of two or all three factors of influence). Each interaction is considered an effect in part. Modules of coefficients involved in the mathematical model will show contribution of effects at response function. The contributions of various effects are represented in the Pareto charts. Mathematic model is accompanied by a statistical analysis. Effects over the dotted line of Pareto diagrams are given with a confidence given by a probability density of less than 0.05 from the average. These effects will be called statistically significant effects. The statistical confidence is specific achievements of technological processes. The sign associated with effect value will show a increasing positive sign or a decreasing for negative sign of the response function. In the following will be presented analyze of Pareto charts for physical quantities measured and calculated. It will discuss the type response changes (increase or decrease) with the assumption that examined effect increase. Defocusing is considered increasing for increase his module or ignoring the negative sign.

Pareto diagram for weld width, figure 4, shows as statistical significant factors power, welding speed and interaction between power and defocusing. Power increases weld width

and a welding speed decreases it. Interaction between power and defocusing increase the weld this shows that increasing spot diameter on piece surface increasing weld width. Interaction between power and welding speed decreases the weld width also the interaction between speed and defocusing and interaction of three factors.

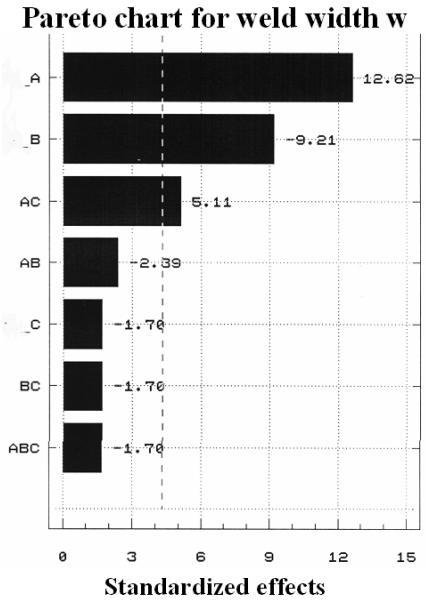

Fig. 4 Pareto chart for weld width

Although decrease given speed is lower than the increase given by power, decrease on weld width is associated with all interactions involving speed. Defocusing decreases the weld width. It is understood that a transfer of energy within the piece at defocusing increase and with keyhole phenomenon in welding bath. Defocusing effect on weld width is mainly given by the interaction between his and power. Note that effects due to influence factors and second order interactions between them is greater than the interaction of three factors that show the effect of background.

Pareto chart from figure 5 shows that most high effect on the weld depth has power. Weld depth increases with power. The power effect is one order of magnitude greater than the speed effect. Power effect is only statistically significant. Speed, defocusing and their interactions decrease the weld depth. This decrease is explained by the decrease of interaction time due speed or/and decrease intensity at piece surface due defocusing.

Observe that the effects for speed and defocusing are close. Interaction of three factors has a role close to the interaction between speed and power and is higher than those between power and defocusing respectively speed and defocusing. Note that only power effect increase weld depth.

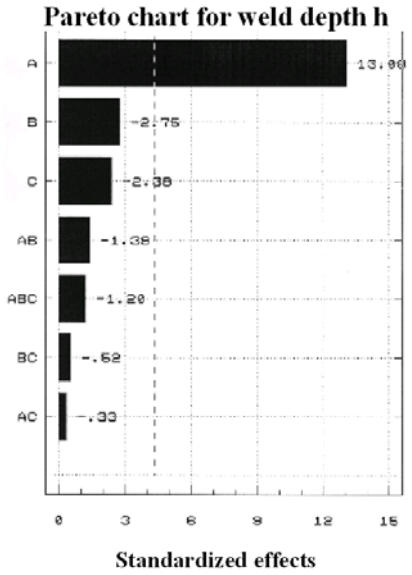

Fig. 5 Pareto chart for weld depth

The effect of three factors separately is higher than effect of their interactions. Second-order interaction effect of defocusing is lower than that effect between the three factors.

This shows that power and speed and defocusing have a direct influence on weld depth. Laser intensity on the surface has the dominant role in determining the weld depth.

From figure 6 is observed that the ratio F drops sharply with power. F ratio decreases with power. Power is the only statistically significant effect. The second effect is the interaction between three factors. This means that the other effects of factors and interactions are covered by it. Interaction between power, speed and defocusing increases F-ratio. This increase for F ratio is based on increased that separately produced with speed and defocusing. Note that power second order interactions are weak effects in but acts as the power to

decrease F ratio. F ratio is increased by speed and defocusing, but the interaction between them has the opposite effect more powerful. Increased power and thus decreases the ratio F leads to keyhole welding regime. In principle, increasing speed and lowering the focal point within the produce an increase for ratio F.

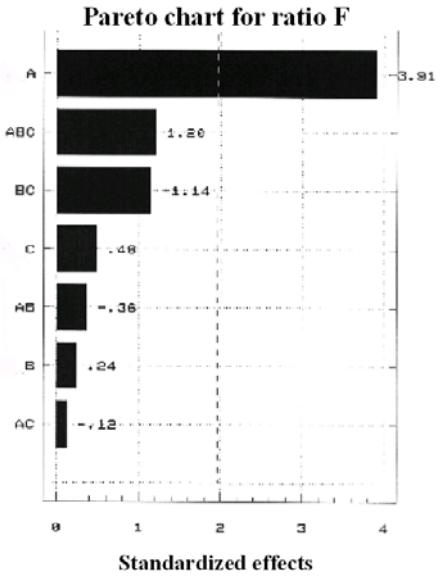

Fig. 6 Pareto chart for ratio F

From this keyhole regime tends towards low. This variation is due to lower intensity piece surface and lower laser interaction time .

That interaction between power and speed has the opposite effect enough important than separately show a specific phenomenon for keyhole in welding bath. Increase speed to produces tilt for front wall of the keyhole.

Inclined front keyhole wall and large welding bath because great spot diameter produce laser radiation propagation keyhole incease absorption in pice leading to increase weld depth and decrase ratio F.

Pareto diagram in figure7 shows the effects on the weld area. It is noted that the weld area strong increases with power as the main effect. Weld area decreases with welding speed and the interaction between power and welding speed. The cumulative decreasing effect of the speed and his interaction with power approaches that the power increasing effect. Interaction between power, welding speed and defocusing has effect of decreasing to the weld area. This interaction is stronger than defocusing effect its second order interactions effects. This shows that power and welding speed are main factors controlling the weld area. The first four effects are predicted by model with statistical significance. Defocusing contribution is presented as background effect. The overall increase effect due to interactions involving power and it is higher than the decrease due to other effects.

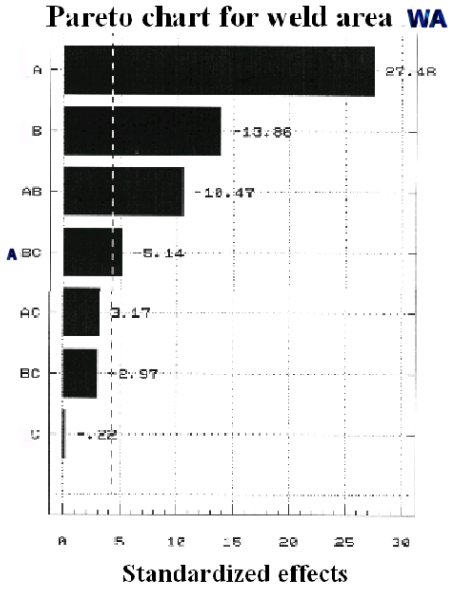

Fig. 7 Pareto chart for weld area

4. MELTING EFFICIENCY ANALYZE

The melting efficiency is defined as the ratio of energy introduced in material and energy used to melt the material.

$$K = \frac{\rho L_0 S}{E_l} [-] \qquad (03)$$

S- cross-section area of the weld molten zone [cm^2]

L_0-heat content [j/g]

E_l - linear energy (ratio between power and welding speed) [j/cm]

ρ – -material density [g/cm^3]

Figures 8,9,10 show that efficiency K increases sharply with power. This corresponds

to the transition from conduction welding regime to keyhole welding regime. This increase ends with a maximum , followed by a fall. Note that K efficiency values are high for focus inside piece. This shows that focus inside piece increase the energy coupling between laser radiation and material. Maximum ending K increase with power show limitation of increase and that even keyhole regime has a limitation of energy coupling for melting material. This shows that increasing the energy coupling between laser and material involves increased both power and depth of focus.

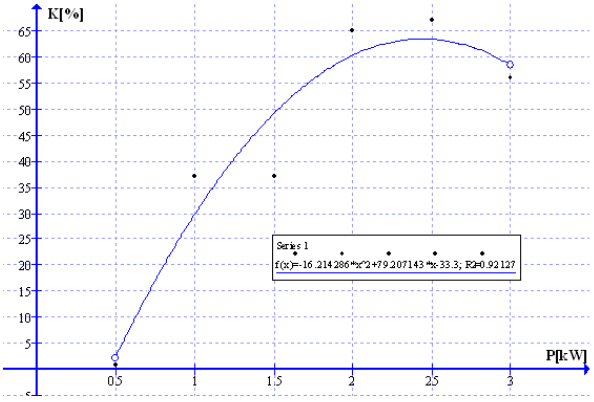

Fig. 8 Melting efficiency depending on laser power at welding speed 0.6 m/min for defocusing $\delta = 0$

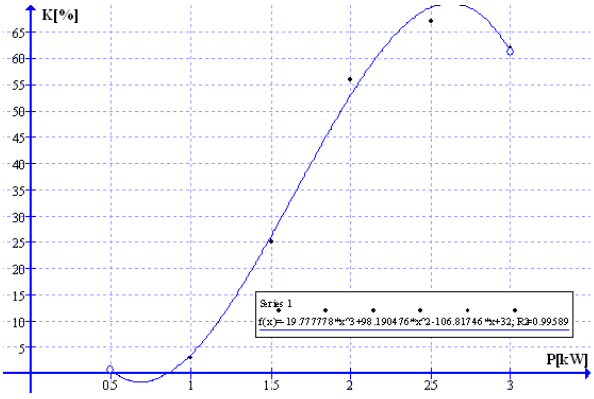

Fig. 9 Melting efficiency depending on laser power at welding speed 0.6m/min for defocusing $\delta = -2\,mm$

Study of K efficiency changes with speed K is shown in figures 11,12,13. Its show that all values that are typical for keyhole welding regime. To focus at piece surface $\delta = 0$ is achieve a increase, a maximum, a slight decrease followed by a steady landing. Thus there is a maximum for the speed of 0.6 m / min.

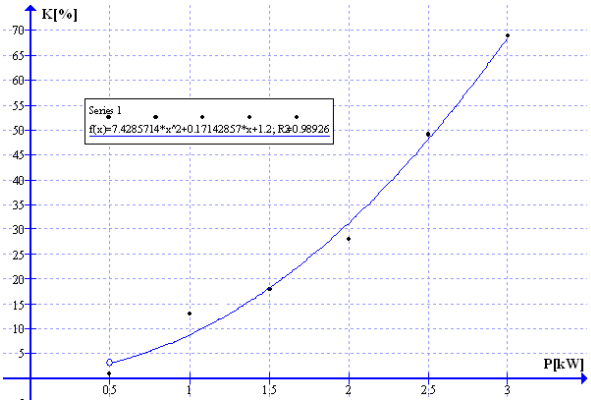

Fig. 10 Melting efficiency depending on laser power at welding speed 0.6 m/min for defocusing $\delta = -4\,mm$.

Focus within piece $\delta = -2$ mm shows a high maximum near the value 0.5 m/min followed by a sudden drop to a minimum at speed of 1.1 m / min, followed by an increase. For defocusing $\delta = -4$ mm is obtained an exponential downward trend to a steady landing. So for this defocusing giving the highest values of K have decreased exponentially constant type. The explanation for this phenomenon is that the inclination is the front keyhole wall of creates a strong modified absorption regime. There is a minimum landing for efficiency K which decreases with focus inside piece. It is dependent on the intensity at the piece surface. Thus minimum landing is set to 40% for $\delta = 0$ to 38% for $\delta = -2$ and to $\delta = -4$ mm drops to 22%.It can be assumed that these values characterize the laser beam intensity on the piece surface. Increase of speed favors the heating and melting the material in front of laser beam so that the front part of beam melting material while rear part vaporize it. This explains the rapid increase of K was made for a narrow range of speed increase. Keyhole opening at low speeds successive laser spot area without deep. With speed increase

increasing relative amont of molten material. Vaporization of the molten material thus becomes more efficient. Decrease after maximum is due to the inclination of the keyhole front wall , little inclination to piece surface that starts to promote reflection of radiation outside the keyhole, and thus losing them.

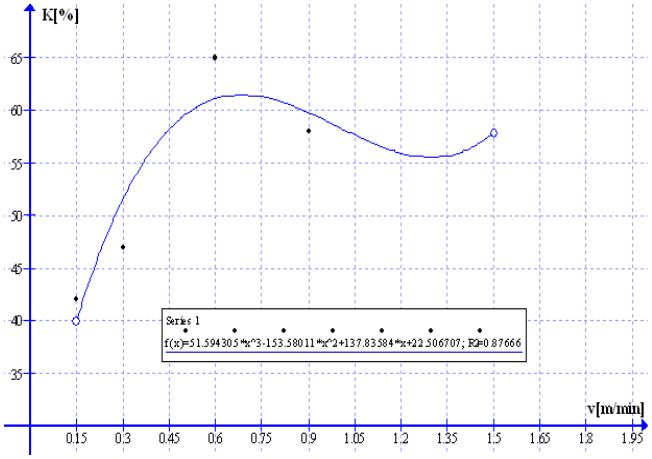

Fig. 11 Melting efficiency depending on welding speed at laser power 2kW for defocusing $\delta = 0$

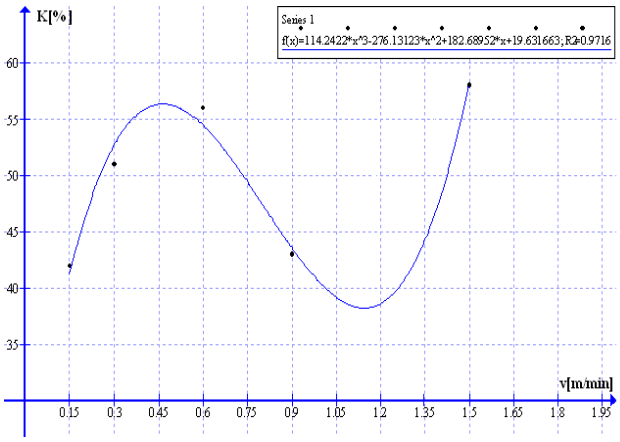

Fig.12 Melting efficiency depending on welding speed at laser power 2kW for defocusing $\delta = -2\,mm$

Defocusing at $\delta = -4$ mm will be noticed only decrease after maximum stage. Such a combination between high speed and defocusing within piece can generate a disadvantage due that the second reflection of radiation is missed. And thus decreases the coupling between radiation and material and therefore the material melting.

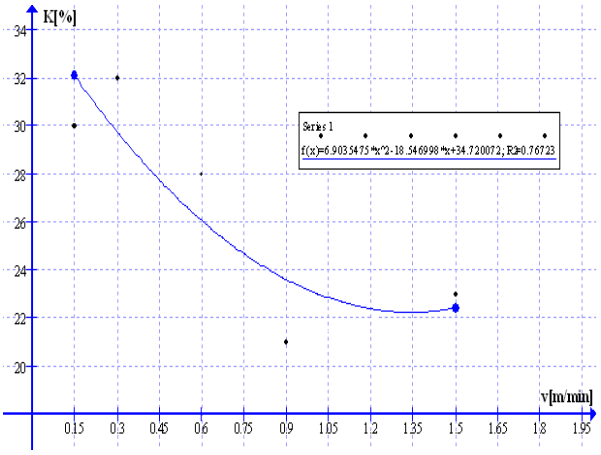

Fig.13 Melting efficiency depending on welding speed at laser power 2kW for defocusing $\delta = -4\,mm$.

5. CONCLUSIONS

Analysis of the effects of power, welding speed and defocusing on weld characteristics revealed that laser power has the main effect. Produce High levels of laser power in produce keyhole in welding bath and as result keyhole welding regime characterized by high penetration welds. Welding speed has an important role in determining the level of magnitude of thermal effects in the material. Low welding speed produces large molten areas. Defocusing effect is small but its interaction with power and welding speed are important. Focusing the laser beam inside piece lowers the intensity of laser beam on the piece surface. Laser beam intensity at piece surface is controlled simultaneously by power and defocusing. Such interactions between defocusing and power are important.

Welding process efficiency analysis has shown that the obtained keyhole welding regime lead to increased efficiency. This is due to multiple reflection in keyhole which increase absorbed laser radiation. The efficiency for keyhole welding regime are obtained close to those presented in the paper [7]. Extended

molten weld zone is obtained at high power and low welding speeds. Melt efficiency is much higher at high power than low welding speeds. This is strong evidence of prezence of keyhole welding regime.

Showed that weld depth is mainly controlled by laser power. Weld depth show the melting front penetration in the material and is the main indicator for the choice of material thickness and welding filler material.

Experimental studies presented are useful for welding process control and design of welded joints.

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RELIABILITY A NEW FIELD OF STUDY EMERGED FROM THE PRACTICAL NECESSITIES

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Abstract: *The concept of safety in operation is used in a simplistic way to describe the reliability. Reliability representing actually a generic term that includes reliability, availability, maintainability and safety. Reliability is a technical characteristic of quality products, in fact an extension of its time and by its importance, is usually treated as one property, special in its own right.*

Keywords: *Reliability,, sustainability, reconditioning, etc.*

Theory of reliability this new field of study emerged from the needs of practice, aims to study failure, the causes and processes of their emergence and development.

One can say that based on targeting reliability concerns, considerations were the reliability and durability.

As recommended by the International Electronics Commission (IEC), "Reliability is a characteristic of a device expressed by the probability that he performs a necessary function in given conditions over a period of time."

STAS 8174/1-77 defines reliability as a product's ability to perform the function specified in the given conditions, over a given period.

In terms of "quality" reliability is the ability of a product to meet for a certain time, the function for which it was created, and the point of the "quantitative" means that the product can guarantee to meet the deadline. The It may also be considered a parameter summary, the appreciation of which, in the context costs and delivery times can be expressed graphically (Figure1) by triangle FCT (Reliability, cost, completion dates).

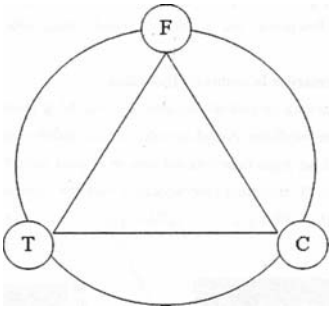

Figure1. Triangle FCT

Today when we witness a shortage of raw materials and energy, when mankind becomes increasingly aware of the importance of sustainable development concept, attention is paid to the reliability of refurbished products. This new trend in the industry, assess the reliability of refurbished products as the most important element in quality assurance system of technological equipment subject to corrective action.

For the future, it may be that reliability tends to become a general theory of systems, aiming to predict the evolution and development of methods for providing a required level of operational safety and security systems.

Arising from practical needs, moving with accelerating the pace of development of science and technology studying a wide

circle of theoretical and practical problems, covering all the activities and stages through which a product (conception, design, manufacturing, mining), reliability theory is a branch of science. Ensure reliability in the manufacturing process by choosing the correct processes and technological equipment, manufacturing under the conditions prescribed by conducting a quality control of raw materials and semifinished materials used and maintained by using appropriate storage, transport , commissioning, operation and service. All this relationship between reliability and various stages of life is presented in Figure 2.

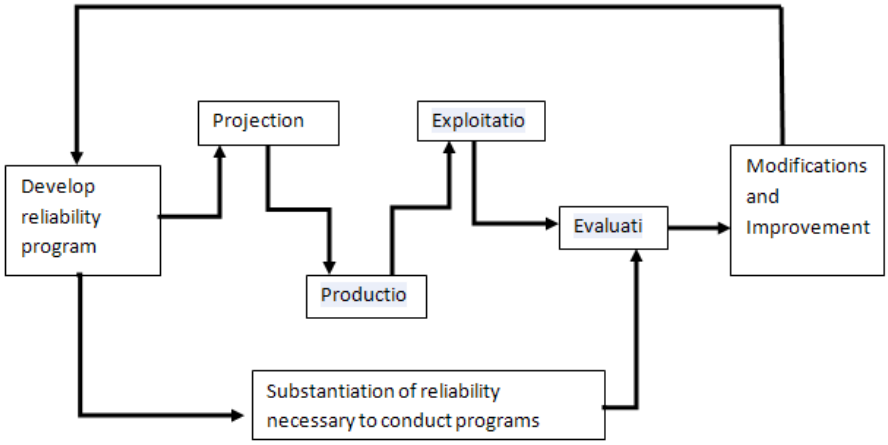

Figure.2 Relation between reliability and life stages of a product

The product is a commodity 'resulting from an employment and satisfying acertain requirement and the process is the ensemble of interrelated resources and activities that transform input into output data.

Processes are influenced by several factors which contribute to product development, they constituted one of the technological equipment-1 Figure 3.

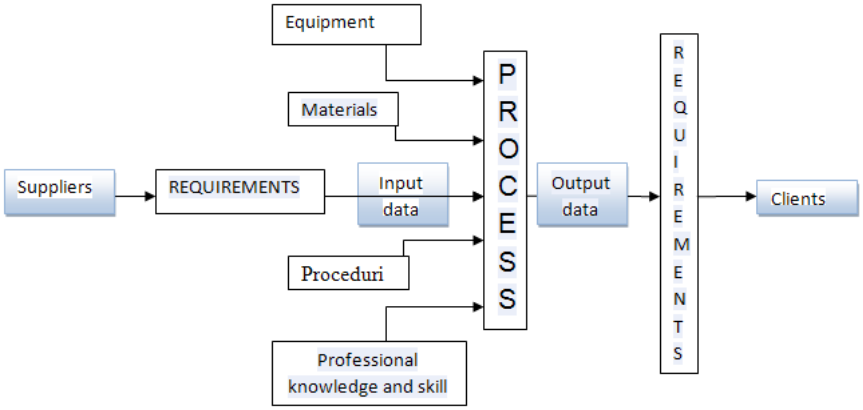

Figure.3. Factors influencing processes

Equipment (technical) are machines, equipment, facilities, equipment, devices, tools and other similar means necessary at work.

Overall reliability of technical systems theory and applied customizations year held industries led to:

- assess and predict the functioning of various technological equipment;

- establish ways and means to increase their reliability.

In the current economic context particular attention is paid to study the reliability of technological hipamentelor ec reconditioned study arose as a consequence of the importance eosebite that they must provide in-1 operation and are also required by modern conditions of work:

- intense regimes operating in order to increase productivity;
- operation of equipment for a period greater performance as prescribed;
- working to increase accuracy during the operation;
- reducing costs of operation of equipment involved in the production process.

The concepts, if considering the concept of reliability in terms of stages in assessing key indicators Characterised.

Design reliability - reliability of a product is determined by considerations of operational requirements by analogy with similar products or appropriate calculations in this area.

Experimental reliability - reliability of a product is determined on an experimental, laboratory, test facility or test stands, where conditions were similar to those created in the environment.

Operational reliability - reliability of a product is determined by the behavior of the operating results for a certain period of time, a specified number of items with identical characteristics.

If the concept of reliability analysis is performed in terms of how the expression of key indicators of reliability.

Rated reliability - reliability is a product specification or shown in passport delivery of product to customer.

Estimated reliability - reliability of a product is determined, punctual and gave a confidence interval based on results from laboratory tests or service.

Technological equipment are part of complex mechanical systems whose failure occurs during operation due to wear or elements moving relative to material fatigue.

Quality: reliability of equipment is its ability to perform specified functions or basic (conservation performance) in given conditions, over a prescribed period.

Quantitatively the reliability of equipment is defined by its characteristic probability that it will meet the conditions specified function over a given duration. Quantitative expression of reliability may be making use of reliability theory in reliability theory is the fundamental hallmark of a defect or falling equipment. The failure means the unmet conditions of use set.

Failure can have different causes related to design, manufacture and operation of equipment as can be:

- the inherent when is due to hidden defects in fabrication, assembly, provided that the applications being placed on equipment not exceeding precise values;
- due to misuse as a result of overstressing the equipment has been subjected.

Mathematically speaking, reliability is determined quantitatively by probability of operation without an equipment failure during an interval time t, under the circumstances. The time in which the equipment will operate without failure is a random variable, called for operating without fault, denoted T.

If we note by p (t) the probability of functioning without failures in time t taking account of those expressed above, we can deduce:

$$p(t) = P(T > t) \qquad (1)$$

Function p (t) function is called and equipment reliability denoted R (t). Often used the concept of probability of exit from service equipment within the prescribed time t, given conditions. Noting this probability with q (t), follows:

$$q(t) = P(T \leq t) \qquad (2)$$

The probability that the equipment to break in (0, t) is even repair function F (t) T operating time without failure called nonfiabilitate function (operating uncertainty).

Since the probability that an item be damaged in (0, t) is the probability that it evenimantul otherwise not be damaged in the same range and taking the sum of two events that probability is unity that expresses the opposite function of reliability function reliability.

Thus we have:

$$P(t) + q(t) = 1 \qquad (3)$$

Or,

$$R(t) + F(t) = 1. \qquad (4)$$

To have a clearer representation of the character distribution of run time, it can also use the concept of probability density (distribution) operating time without failure, denoted f (t) and defined as:

$$f(t) = \frac{dq(t)}{dt} = -\frac{dp(t)}{dt} \qquad (5)$$

Or,

$$f(t) = \frac{dP(t)}{dt} = -\frac{dR(t)}{dt} \qquad (6)$$

In many practical cases when equipment is damaged, appear uncertain situation to decide between you repair or replace-1. Thus we can define metenabilitatea as the property must have a lifetime equipment to be maintained or restored in the state to perform specified functions when maintenance is carried out in conditions, with prescribed procedures and remedies . Maintainability, denoted by M (t) actually represents the probability that a device: which failed at time t = 0, be repaired within a time interval (0, t).

If random variable Y is the length of failure or repair the item, the distribution function will be:

$$G(t) = P(Y \leq t) \qquad (7)$$

When the random variable Y is continuous, then it has a probability density, denoted by g (t) with the words:

$$g(t) = \frac{dG(t)}{dt} \qquad (8)$$

In conclusion, the function G (t) is called all Maintainability (denoted above by M (t)). Related to the above features can be appreciated that an equipment (product) can fulfill the function for which it was created , that may be available, if reliability and maintainability is appropriate.

Availability is the most complex technological chiparnentelor show quality (products) in the process of their exploitation, whereas both reliability and maintainability include them in Figure 6.

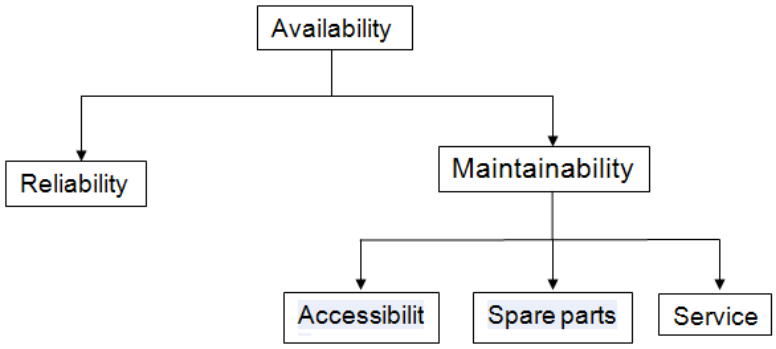

Figure 6. The availability

Thus it appears that the availability of equipment is the result of two events:

- operating at a good time as long, depending on reliability;
- repair within the shortest possible, which depends on the maintainability. The relationship between the three

may be expressed by using the relationship:

$$D\left(\frac{t_1}{t_2}\right) = R(t_1) + [1 - R(t_2)] \cdot F_{men}(t_2) \quad (9)$$

Fmen (t) is the distribution function of time of maintenance;
R (t 2) expresses the probability of operating in (0, t 1) without work maintenance;
[1-R (t 2)]-F men (t 2) expresses the probability of producing a failure in that time but can be repaired but at time t 2 (t 2 <t 1).
Having determined the above it appears that availability is the measure of technological equipment allows its use when needed, ie bility that the equipment is to be in working order when t.
To express the availability of statistically availability using coefficient D, which can be determined from the relations:

$$D = \frac{MTBF}{MTBF + MTR} \quad (10)$$

Where:
MTBF is an average of better functioning;
MTR - average repair times.
Or:

$$D = \frac{TF}{TF + TR} \quad (11)$$

TF is the time of operation;
TR – where is the time of repair.

Is also noted that availability is calculated only for a period corresponding to the useful life of equipment, it can not be calculated nor. Or for the initial period of attrition, during which non accidental failures, and the number is very large compared to the normal.
Given that during operation of technological equipment are subject to complex applications they need to provide durability.

Sustainability technological equipment is estimated quantitatively by the number of parts making up the total wear of the active parties, highlighted by their inability reconditioned and inadequate amounts of specific dimensions. Thus can be identified two types of sustainability.

Long-term (two reconditioning of equipment), which refers to the qualitative aspect of parts, and overall sustainability, which refers to the dimensions of parts, between the two types of sustainability are inter-relationship of mutual, so we can say that overall sustainability is directly influenced by the term.
Sustainability depends on factors that technological equipment is presented in Figure 7.

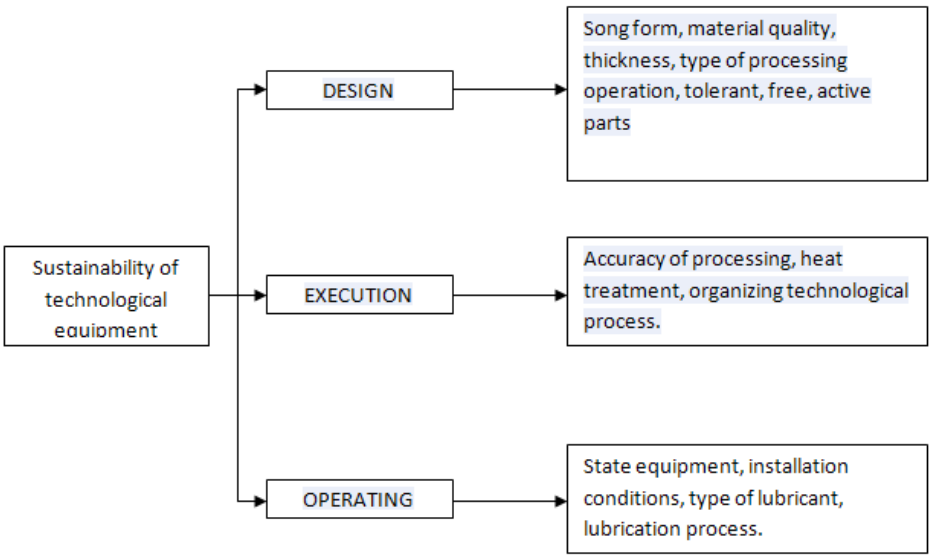

Figure 7. Dependencies

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ENLARGEMENT PROCESSES OF RESISTANCE TO WEAR OF PARTS OF THE MOLD BY HARD CHROME

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Abstract: *In modern construction dies achieve working parts of dies with indices as high wear resistance and fatigue is one of the most important concerns of all enterprises producing molds. In this direction, apart from achievements in the development of materials with substantially improved mechanical characteristics, another method found in the application of advanced technological processes, such as superficial heat treatment, which was obtained by increasing surface area resistance of the active parties.*

Keywords: *heat treatment, sustainability, wear, etc.*

Mechanical properties of superficial layers determine the operating characteristics, particularly the parts subject to dynamic stresses or direct applications in surface area, specific molds.

Among the most commonly used technological processes, particularly those active in increasing the resistance of surface area, are: hard chrome, use metal carbides, hardening by electric sparks, welding deposition, etc.

Assets to parties, these processes result in increased durability, thus increasing the sustainability of all dies default.

Hardening by electric spark (Figure 1) is to deposit a high quality material, transported from one electrode to the workpiece, whose sustainability will be increased. This transport is by flow of electrons that occurs when electrical discharges caused between electrodes, connected to the positive pole and connected to the negative track.

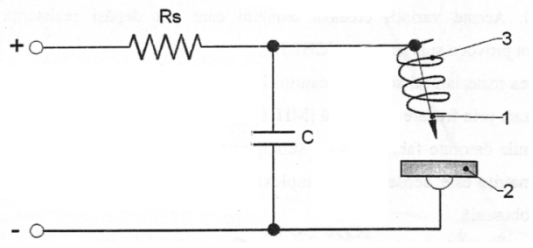

Figure. 1 Electrical diagram of the process of hardening by electric spark: 1 - hard metal electrode, 2 - Part, 3 - vibration.

Hardening is achieved by causing electrical discharges with a duration of 1 / 1000 sec at interval of 1 / 100 s. This makes heating the piece to occur only in the surface and practically do not take place any reversion phenomenon. For to prevent short circuit effect occurs when the electrode reaches the track, the device has a series resistance R s and to increase the amount of electricity carried during unloading, is mounted parallel to a capacitor C.

Following the process play surface height formed three more or less distinct, namely:

- an outer layer composed of material deposited, which is a very hard coating, resistant to wear and virtually unassailable by ordinary metallographic reagents;
- an intermediate layer formed by

alloying metal intake with basic material;
- an inner layer consisting of basic material which has undergone structural changes after heating.

Hardness of 1200-1500 HV can reach the outer layer and the intermediate layer, about 700 HV. After operation of electric spark hardening, the parts do not require any heat treatment and ulteri or no machining.

Hardened layer thickness depends on the system load. Work hardening regime where mold is following pressure from 60 to 80 V, 100 μF capacity specified duration 2 min / cm ² using hard metal electrodes (1.5 x 1.5 x 20 mm).

Best material for hardening is Ferrochromium punches containing 75-80% chromium and up to 0.15% carbon. Hardening by electric spark is applied in particular to hot forging dies, which increases their durability by up to 70%.

When performing hardening by electric spark that should be considered:
- heat treatment of basic material is identical to the treatment that is running when molds are hardened by electric spark;
- de-carburization and to avoid oxidation, protects the mold profile during heating for quenching and tempering with charcoal;
- before applying the layer of hard metal molds must be completely finished.

A particular advantage of the hardening process is that the electric spark ready made molds (finished and heat treated) may be hardened, then we require any technological operation (heat treatment, grinding, etc.). Another advantage of this process is that heating occurs only in the hardened, without changing the basic metal structure.

Deposit a layer of chromium on the surface of a piece in order to obtain a layer with higher hardness is called hard chrome. Hard chrome operation is running in a bath of electrolyte containing chromic acid, the main source for production of chromium ions are deposited on the coated parts.

Electrolytes for plating with a low dispersal ability, which makes the current density is uniform and so the metal to be deposited evenly on the surface parts. For this reason, should pay particular attention to the election form and anode from placing their pieces. For parts with a certain configuration is required using special anode, which form parts to follow.

By applying a layer of hard chrome on the surface of steel, its wear resistance increases by 3 to 10 times, which allows in many cases to replace costly alloy steel with carbon steel.

Deposition conditions (current density 25-100 A / dm and a temperature of 35-65 ° C) layer of chromium can reach 1250 HV hardness of the order, resisting wear well.

Preparing the mold for plating is completing implementation of manufacturing processes including heat treatments and the specific materials from which mold is made. After heat treatment to improve the profile matrix is neatly polishing to achieve a uniform deposition.

Type electrode	Content					
	Cr O3 g / l	Cr2O3 g / l	Sulfuric acid w / l	Iron g / l	Current density / dm ²	Temperature ° C
I	245	3.03	1.20	2.45	75	58
II	240	3.5	2.2	2.30	64	55
III	245	1.2	1.92	2.50	70	59
IV	113.77	4.63	2.59	3.42	50	60

Table 1. Content indicative of electrolyte used in hard chrome.

Variation in thickness of the chromium deposited on a piece based on current density and temperature, the use of an electrolyte containing 2.5 g 250g Cr0 3 and H 2 S0 4 per liter is shown in Figure 2.

Particular attention should be paid to correct, that maintaining the concentration of electrolytic bath. Corrections must be made before an appearance notice is inadequate chroming hard surface.

Success of hard chromium is dependent on the electrolyte composition can maintain the allowable limits, a working bath care supervision.

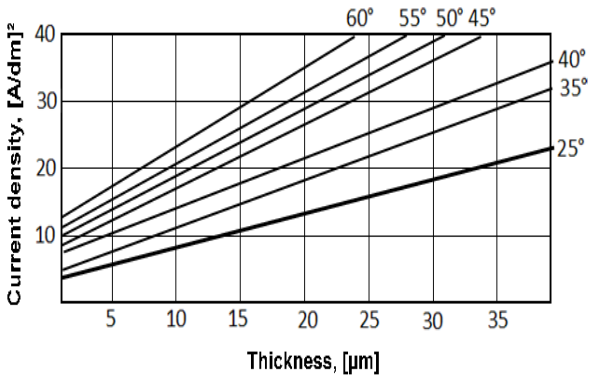

Figure 2. Changes in thickness of the chrome deposited on a piece based on current density and temperature.

Deposited chromium layer should be compact and sleek. For cold punching dies, the optimal thickness of the layer of hard chromium is 25 to 35 pm.

In forging dies for hot hard chromium layer deposited reaches 50 um. To obtain the thickness for a mold that has such basic material NI5 requires a duration of time for 1,8-2 hours. Hard chrome thickness variation depending on the length of deposit is shown in figure.3

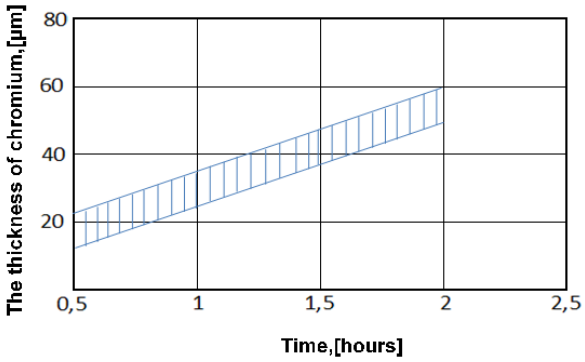

Figure 3. Variation of thickness of chromium deposited on a piece based on current density and temperature.

Chrome plating is a thermochemical treatment that gives the pieces of steel or cast iron high wear resistance (surface hardness of 1200-1600 HV) and very good resistance to high temperatures up to 900 ° C.

Chrome plating is a thermochemical treatment that gives the pieces of steel or cast iron high wear resistance (surface hardness of 1200-1600 HV) and very good resistance to high temperatures up to 900 ° C. mixture consists of the following components, expressed in percentage by weight Ferrochromium 65, 32 kaolin, 3-5 ammonium chloride (țipirig). It makes the dry mix very well, for cromizare pieces placed in a vat to be tight and the gap is filled with this mixture. The box is placed in an oven preheated to a temperature of 800 ° C. Chrome plating occurs at temperatures of 1060-1150 ° C. Chrome plating occurs at temperatures of 1060-1150 ° C. life is min. 6 o'clock and the thickness cromizat superficially pursued.

The above processes generally made active surface hardening on shallow molds.

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EXPERIMENTAL RESEARCHES REGARDING THE PROPERTIES OF THE METALLIC MATERIALS USED IN MILITARY TECHNIQUE

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Abstract: *The materials used within the production of the military technique must have a series of physico-chemical features. These features influence the behaviour of the military technique during its functioning process.*

The present paper illustrates the results of the research made by the authors upon the physico-chemical features of two types of materials used in the making of the military technique.

Keywords*: experimental researches, properties, materials, metallic, technique, military.*

1. INTRODUCTION

The physico-chemical analysis made for the metallic materials used in the making of the military technique are:

- the determination of the chemical composition: Sn, Pb;
- the determination of the oxides, the quality of the protective atmosphere in the installation that makes the powder;
- the granulometrical analysis for the powders that are used in the making of the antifriction composites based on Cu-Pb;
- the determination of the time required by the flow and the apparent density of the powders used in the making of several types of bushings;
- the analysis of the microstructure of the metallic materials that appear in the composition of the making of the bushings in several stages of the making process: Cu-Pb, Al-Sn;
- spectrometric analysis of the composition of the antifriction materials based on Al-Sn;
- the determination of the Sn in the Al-Sn alloy;
- the determination of the Cu in the Al-Sn alloy;
- the determination of the Ni antifriction alloy Al-Sn;
- the analyses have respected the legal standard norms.

2. CHEMICAL METHODS REGARDING THE ANALYSIS OF THE METALLIC MATERIALS USED IN THE MILITARY TECHNIQUE

The tin is determined volumetrically by the titration with iodine of the 0.1 N solution – after a previous chemical fixation of the other Cu-Pb elements as follows: 1g of powder is being weighed, with a 0.0002g precision at the analytical scales; we pour it in an Erlenmeyer glass with the volume of 500 cm^3 over which we add 20 cm^3 of HCl 3:5 parts in order to obtain a violent reaction; after approximately 10 min, the sample is being boiled at a low fired adding 80 cm^3 HCl 3:5 volumetrically parts of 10 cm^3 of a mercuric chlorine, solution 30 g/l, 10 cm^3 of an hypochlorous acid with a concentration of 30%; the boiling continues for approximately 5 min until the sample becomes clear; we cool it in a water

bath under a dioxide carbon current; after it is cooled we add 10 cm^3 of a sodium sulphocyanide, potassium or ammonium, solution of 50 cm^3 potassium iodide, solution of 5 cm^3 of starch 1%, and we titrate it with a solution of 0.1 N.

The quantity of tin (g) is being determined with the help of formula no. 01:

$$g[\%] = \frac{V \times f \times 0.00593 \times 100}{a} \qquad (01)$$

where: V=the volume of the iodine solution, consumed within the titration [cm^3];

f=the factor of the iodine solution 0.1 N;

0,00593=the quantity of Sn^{4+}, [g], that corresponds to 1 cm^3 of iodine solution 0,1 N;

a=the mass of the sample.

The lead is being determined electrolytically by using a platinum electrode (the sieve) as an anode. The weighed sample is being dissolved in a solution of azotic acid 25 cm^3 1:1, and a violent reaction takes place with precipitate deposits. The clear solution obtained by filtration is submitted to electrolysis in certain conditions. After the lead dioxide is being deposited on the anode, it has to be weighed and we calculate the lead quantity that exists in the sample. The depositing mechanism can be explained in the following way: on the anode we witness an oxidation of the Pb^{2+} and Pb^{4+} ions. This is how we obtain the tetra leaded nitrogenous and as a consequence of the hydrolysis, the lead dioxide is being formed, according to the reaction no. 02:

$$Pb^{2+} + H_2O \rightarrow 4H^+ + PbO_2 \qquad (02)$$

insoluble that is disposed on the anode.

The determination of the lead is being made in the following way: we weigh on an analytical scales (with a precision of 0,0002 g) the quantity of 0,25 g of powder in a Berzelius glass over which we add 25 cm^3 of HNO_3 1:1 (the acid is added carefully, the reaction being violent) we cover it with a watch galss and it is slowly warmed until the liquid's volume is being reduced up to its half, with the formation of a white rough-grained precipitate; we dilute it with hot water up to a volume of 125 cm^3 and then we boil it; we live it in a warm environment for an hour, and then we filter it still hot through a double filter with a blue stripe, we wash it with hot water until the blue marks dissapear from the filter paper, the clear solution obtained after the filtration is submitted to an electrolysis; before hand the electrodes have been weighed on the analytical scales (with a precision of 0,2 mg) and after them being introduced in the electrolit (the sample) we can make the necessary connexions and the agitator is being turned on, the depositing duration being of 45 minutes at the tension of 2,5-3,5 V with th intensity of 2,8 amperes; in order to see the end of the pepositing process we will complete the electrolit with distilled water and the depositing will continue for another 10 min; if nothing else gets deposited, the lead oxide that is already deposited on the electrilite is being washed without turning off the electrical current, replacing the electrolysis glass wiht another one that contains distilled water; the washing is being repeated 2 or 3 times, after which the current and the agitator are being turned off; the anode is being let loose from its holder and is quickly introduced in a galss full of alcohool after which it is beig dried in a drying stove at 100°C for 5min; we cool it then in the dryer and then it is being weighed on the analitycal scales. Knowing the initial weight of the anode (g_1) and the final one (g_2) as well as the weight of the analized powder (powder that here has 0,25 g) and the percentage content of lead we can obtain results with the help of formula no. 03:

$$G[\% = \frac{[(g_2 - g_1) \times 0.8662 \times 100]}{0.25} = \qquad (03)$$
$$= (g_2 - g_1) \times 346.48$$

where: 0.8662=the transformation factor of the leaded dioxide in lead.

In the end, the leaded dioxide gets away from the platinum through the process of decomposition into hydrochloric acid (with a dilution concentration of 1:1) and the copper deposited on the cathode will be disolved with nitrogenous acid (dilution 1:1). The electrodes are being washed with distilled water, then dryed in the drying stove and kept in the dryer.

3. PHYSICAL METHODS REGARDING THE ANALYSIS OF METALLIC MATERIALS USED IN THE MILITARY TECHNIQUE

In order to determine *the fluidity* of the powder we use a flowing funnel that has a calibrated orifice, a device that holds the funnel (without any vibration) and a timer [1, 2].

The fluidity of the powder is determined as follows: 50 g of samples are being weighed on the technical scales (precision of 0,1 g), the sample is being poured into the funnel so that it is completely filled; we measure the time during which the powder flows – time that represents the fluidity and it is expressed in seconds.

The apparent density is being determined as following: we weigh with the technical scales (with a precision of 0,1 g) a quantity of 80 g of powder in a bucket shaped pot that has a volume of 14 cm³; the powder is leveled at the surface with the help of a spatula, avoiding the trepidation of the pot, that might influence the volume; after the leveling the extra powder is being removed in order to avoid the weighing losses; we weigh it again full of the subsided powder.

The calculus of the apparent density [g/cm^3], is made with the help of formula no. 04:

$$\rho = \frac{m}{v} \qquad (04)$$

where: m = the quantity of powder, [g] weighed after the flowing;

v = the volume of the bucket shaped pot where we collected the sample.

The granulometrical analysis determines the proportions of different sizes of granules from the granular mixture Cu-Pb with a set of standard sieves with a mechanical stirring [3, 4].

In table no. 1 we have presented the equivalences between the number of the sieve and the powders used in the making of the bushings.

Table 1.
The compulsory characteristics of the powders

No. of the sieve	Tyler-Nesb equivalent	The size of the sieves expressed in microns
80	80	177
100	100	149
110	150	105
200	200	74
270	-	-
325	325	44
tray	remaining	-

The craniometrical analysis is being made as follows: we weigh at the technical scales 100g of sample and we put it in the sieve no.80; we cover it with a tin made of steel, we make sure that the sieves do not move; we start the steering, we stop the sifting after 15 min.

On a cut paper we successively empty every sieve and we weigh all together all the powder in all the sieves, in the end the quantity representing precisely 100 g.

Determining the oxides. The devices that we used is being made out of: the sinthetizing installation, porcelain gondolas, dryer and analytical scales. The method that we used verifies the drying system of the powder as well as the quality of the protective atmosphere used in the installation that produces the powder. [2, 3]

The steps are the followings: we weigh at the analitycal scales (with a precision of 0,2 mg) 20 g of powder in a porcelain gondola, on the bottom of which we added a thin layer of aluminium carbonate in order to prevent the impregnation of the lead in the gondol; the gondola with the poder on the margings of a sttel stripe in the synthetizing installation has a neutral atmosphere; after the technological synthetizing flux, the gondola with synthetized powder is being removed from the stripe and it is being kept in the dryer until it is fully colled off, after which it is being weighed.

The weigh loss of the sample in the atmosphere [G%], oxides, is being determined with the help of formula no. 05:

$$G\% = \frac{g_1 - g_2}{g_1} \times 100 \qquad (05)$$

where: g_1= the weigh of the sample quantity, [g] before the sintering;

g_2= the sample weigh, [g] after the sintering.

In table no. 2 are presented the compulsory characteristics of the powders used in the making of the bushings.

Table 2. The compulsory characteristics of the powders used for different types of bushings

The quality of the powders	The granulometrical analysis Taler, [%]	Flowing time, [seconds]	The apparent density, [g/cm³]	The chemical analysis		Max no. of oxides
				% Sn	% Pb	
CP10S10	max. 82	18-30	4.06-5.47	9.5-11.5	10.2-11.7	0.55
CP23S2	max. 77	17-30	4.17-5.73	1.2-2.2	21.2-26.7	0.55
CP22S4	max. 80	17-30	4.23-5.70	3.8-4.8	20.2-25.7	0.55
CP26S6	max. 70	max.30	4.8-5.5	1.2-2.2	24-30	0.55

The qualitative results obtained after the granulometrical analisys (by sifting) have been interpreted as to result the granulometrical distribution

4. CONCLUSIONS

Since the antifriction material based on sintered Cu-Pb powders has a metallic structure, the connections are being established during the process of sintering between the granules of the powder and they can be explained by the interatomical forces that appear in the crystalic network that metals have.

Theoretically speaking between the granules of the powder we have a metallic contact; practically it is very rarely made because of a layer of oxides that is to be found at the surface of the granules.

The concentration that these oxides have is controllable and it must not overcome the imposed value of 0.55%, when talking about the researched powder, in order not to change the already formed metallic structure.

When sintering throughout warm up, the atoms of the powder are being rearranged within the network so that the structure of the crystalic network can be formed.

Due to the heat, in the sintering oven, the powder put on the steel pot is subdued to the diffusion phenomenon (in a solid stage) at the surface and upon the volume as well. It is explainable through the fact that the atoms situated on the tops of the granules of the powders are moving on the surfaces, gathering themselves on the non-uniform parts of the surface. At higher temperatures we can witness diffusion at the level of the granules of the powder and the ones of the steel as well.

After the research made we ended up to the conclusion that the apparent density is influenced by the way in which the powdered is being obtained, by the drying temperature as well as by the granulometrical class. The softer powder has a higher apparent density than the rough one.

It can also be seen that if the apparent density of the alloy is higher, the powder is much more compact, and the spaces within the granules are smaller.

The powder density is lower than the one of the alloy, thing that underlines a higher porosity of the sintered material.

The size of the granules and their granulometrical distribution are physical properties that have a tremendous importance that may influence the technological

properties of the powders and of the sinterised finite products.

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CHARACTERIZATION TOOL STEELS

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ABSTRACT: *In this paper is a reference to the characteristics of tool steels and the influence of nitrogen used in the thermal treatment on AISI M41 steel. In order to attain the goal of this study, to investigate the effect of nitrogen alloying and the electroslag refining (ESR) process on the properties of AISI M41 steel, two high-speed steels were melted in an air induction furnace (IF). The first one is a standard AISI M41 high-speed steel. The second one is nitrogen-alloyed M41.*

KEY WORDS: alloy steel; high-speed steels; *treatment.*

INTRODUCTION

Tools is a product category that is used to carry out the various processing operations. Multiplicity of processing operations, backed by the variety of materials (metallic and nonmetallic) which processes led to a wide variety of tools. The correct choice of steel and heat treatment for many types of tools is only possible with an appropriate classification, both tools, and steels used in their confection.

Characterization Tool Steels

A rational classification tool can be made taking into account the specific processing operations are used, in the conditions in which they work. After the specifics of their processing operations can be:

- Cold-processing operations by cutting or filing (with chips or swarf clearance) in this group are included the actual cutting operations (turning, milling, planing, tapping, etc..) filing operations and cutting operations sawing;

- Operation of cold or hot without chips or swarf clearance, in this group are included the operations of forging, cutting knife or chisel, the process impact, drawing, rolling, casting, and operations and measurement verification.

Under specific conditions of different groups working tool can determine the characteristics that need to have these steels. These characteristics are taken into consideration in the choice of steel and heat treatment.

Tool steels are characterized by:

Operating characteristics, properties which are obtained after final heat treatment and determines the behavior of tools in operation;

Technological features, properties that characterize the behavior of steel processing operations for manufacturing tools and their heat tratment. Between the two groups of properties can not be a strict division, so depend on conditions of tools manufacturing, operating characteristics must be considered simultaneously and technological characteristics, because they take account of both the mechanical operations processing and heat treatment.

Both operating characteristics and technological and depend largely structure

steel that, as well as how it changes from plastic or thermal processing.

Operating Characteristics Of Tool Steels

Hardness - is one of the most important operating characteristics, determine the strength alloy steel at contact stresses that occur on the shear, and friction resistant to wear. Tool steels should have larger hardness, because in a hardness decrease, for example from 62-63 HRC to 58-60 HRC, when cutting tools, the result is deforming tool in the premature wear while working. Although obtaining a maximum hardness is a primordial condition, you must keep in mind though, that hardness does not characterize the behavior of steel in conditions of complex application (bending, twisting, shock) that may occur in different parts of the tool.

Resistance small plastic deformation - must be high, especially for confection tool parts, which must be provided with dimensions accurate of the active parties to execute precision operations. Resistance to small plastic deformation is an operating characteristic which is not uniquely determined and characterized by hardness value.

Resistance - a feature generally not operating properly condition the only tool in operating behavior, in some cases the tools necessary to have a high resistance. Increased resistance value of a flexion tool steel quickly from 220-250 kg/mm2 to 300-325 kg/mm2 increases of 2-3 times the durability of spiral drill diameter up to 1 mm.

Tenacity - this feature operating largely determine the sustainability tools. In general, the tenacity can be characterized, in value, by figures of resilience, this feature is not the proper tool if that martensitic structure, but only if those who structure normalization or return (array).

Heat stability - defines the ability to keep steel at temperatures from reaching the active during the work, structures and properties required for forming or cutting, is defined by the maximum heating temperature that causes such a change of structure and properties, that no longer meets the purpose tool.

Resistance to wear - is caused by loss of tool material and plastic deformation of the active surface. The main causes of tool wear are active surface warming during the work and efforts of compression occurring in this area. After working conditions of the tool are distinguished:

- Tool wear is not heated during the work (an active part of the tool does not exceed 100-1500C). Meets the tools that are designed for cold operation (stamping, cutting, checking) or cutting operations at low speeds. Here, wear resistance and tool hardness depends not depends on the alloying of steel.

- Wear warm tools that during the work (the active reach fear. of 580-6000C) and thus cause decomposition and martensitic hardness decrease, which cause a decrease of wear resistance. This decrease depends on the structure and chemical composition of steel that actually determine the stability of hot.

Penetration of quench - characterized hardness distribution in the tool body, is an operating characteristic tool steels. Thus, for some types of steel tools (drills, and dim matrix with complex configuration. Small, etc.). Which should have the same hardness throughout their mass, smooth quench requires a complete penetration. Steels for cold deformation tools for working in dynamic application, must have a higher toughness, which is obtained with a deeper penetration quench the mother than the tool section. To the extent that the depth of penetration is taken into consideration quench both steel choice unasked for a particular type of tool, and to establish conditions to tool steel processing finite, this feature is also technological.

Refractoriness – characterized resistance to the decarburare tool steels and oxidation in the active layers. A large number of types of tools for materials processing group of hot metal is heated strongly in superficial layers, where contact with oxygen in the atmosphere may occur decarburarea and oxidation of iron and alloying elements. Due to high carbon tool steels, decarburation can become extremely dangerous, if the alloy and

a proper structure is not necessary to ensure refractoriness steel.

Thermal shock resistance - due to repeated heating and cooling of tools for hot machining of metallic materials, produced repeated dilatation and contracting. This may lead to the formation of a network of small surface cracks, while working tool may be lengthen or upsetting or depthing, imposing prematurely placing out of operation.

Thermal conductivity - is an operating characteristic that determines the ability of steel to eliminate as soon as heat stored in the active tool to avert overheating which leads to lower thermal shock resistance and heat stability. This feature is even higher as the carbon content and alloying elements are lower. Structure sorbite provides the highest thermal conductivity.

Experimental investigations have established that, depending on the structure of steel, these factors have a different impact on cutting tool wear. For example, the processing of steel with medium carbon content, where the structure consists of globular pearlite, the intensity of cutting tool wear is higher compared with the same cutting steel with lamellar pearlite structure, although if cutting globular perlite the temperature of the cutting surface structure active area material and cutting tools, is higher.

Better machinability of steel with globular pearlite structure is explained by the fact that it has a capacity of erosion wear much smaller than the same steel structure of lamellar pearlite. Steel processing faster, because low coefficient of conductivity, temperature, tool wear is the key though, these steel structure consists of globular pearlite (steel structure that has fast prior to heat treatment) cutting speed is two times lower than for cutting a steel receiver with lamellar pearlite structure. One key determinant of all the machinability of this steel and alloy steels, is the size and fuel distribution network and getting smaller as their size reduced, which will improve machinability by cutting and for cutting austenitic steels, also serves cutting temperature determining the intensity of cutting tool wear.

High-speed steels are employed in cutting tools operating at high speeds. The properties of high-speed steels depend to a large extent on production and refining technology, which affect the recovery and homogeneity of alloying elements as well as the cleanness of the produced steel. Nitrogen has been used in recent years as an alloying element in many steel grades. It seems very attractive to examine the possibility of alloying the high-speed steel with nitrogen and to study its effect on the refining and mechanical properties of one of the most common high-speed steel grades, AISI M41.

Better known for its aging and embrittling reactions, nitrogen also produces some very beneficial effects. In addition to its role with aluminum as a grain-refining agent, nitrogen produces marked solid solution hardening and precipitation strengthening reactions, which form the basis of many high strength grades.

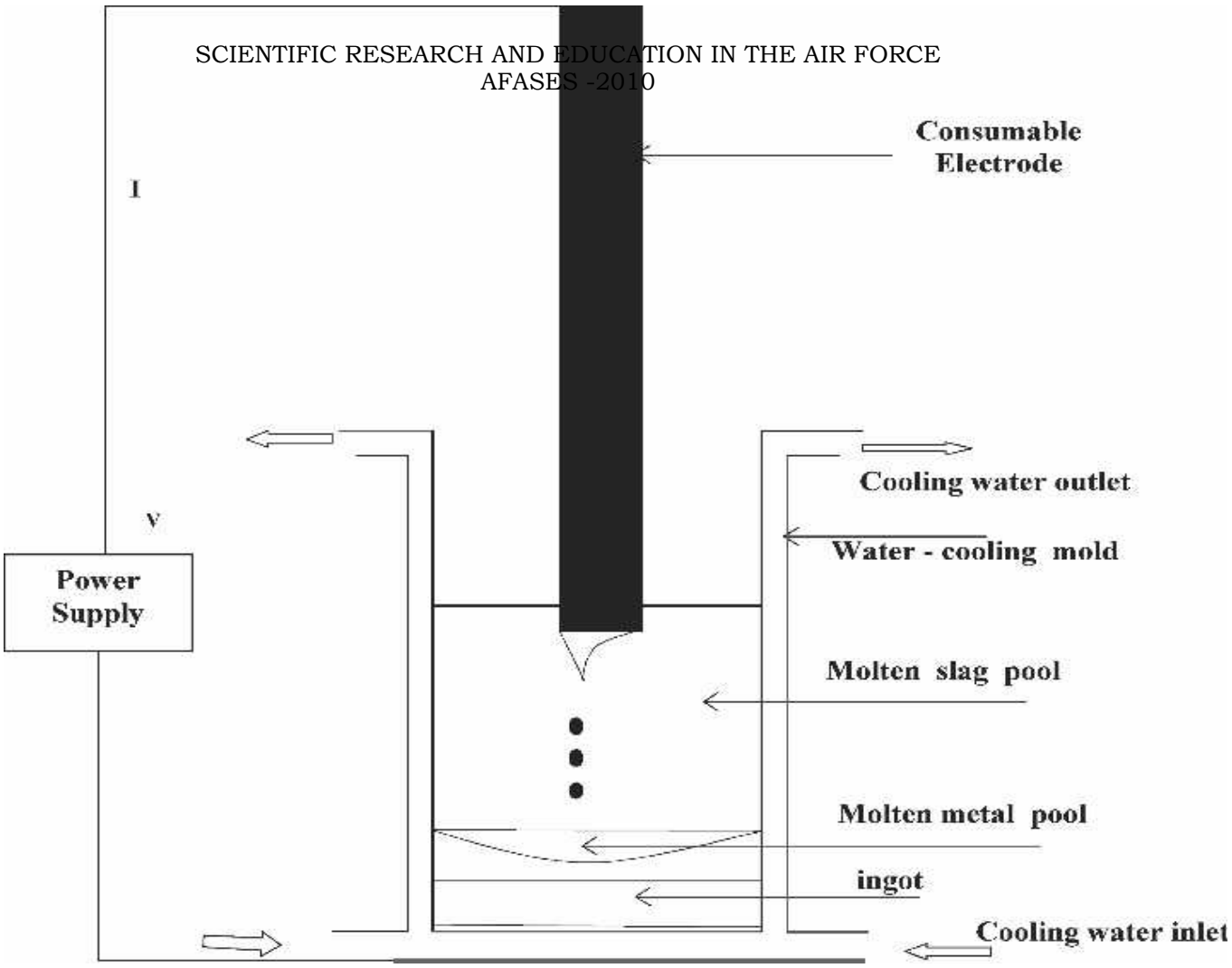

Fig. 1 Construction of ESR unit.

Electroslag refining (ESR) is an attractive and feasible secondary refining process due to its economy and powerful effect in decreasing the steel content of nonmetallic inclusions (NMIs), gases, and sulfur. Improving the cleanliness, soundness, and homogeneity of steel results in improving its mechanical properties. Additionally, the ESR has a pronounced effect on the as-cast structure as a result of the positive influence of decreasing the local solidification time of the molten metal that results in the formation of fine carbides rich in alloying elements and Carbon.

Effect of the ESR Process and Nitrogen Alloying on the Precipitates

Steel Grade	Process	ESR Flux	Dissolved Metal, g	Weight of precipitate, g	Wt Pct of Precipitate	Precipitate Identification: Carbide + Nitride		NMI		Elements Chemical Composition in the Precipitate, Wt Pct					
						wt. gm	wt. %	wt. gm	wt., %	C	V	Cr	Mo	Co	W
M41	IF		19.79	0.752	3.80	0.517	68.7	0.235	31.3	0.178	8.65	5.8	2.2	—	4.7
	ESR1	F1	36.30	2.138	5.89	1.842	86.2	0.296	13.8	0.147	21.2	23.0	12.2	—	23.4
	ESR2	F2	25.40	1.131	4.45	1.095	96.8	0.036	3.2	0.223	22.2	20.3	23.4	—	16.8
	ESR3	F3	36.20	1.740	4.81	1.312	75.4	0.428	24.6	0.463	36.2	28.7	14.2	—	15.6
M41N	IFN		10.60	0.633	5.97	0.456	72.0	0.177	28.0	0.127	12.7	6.1	16.4	—	7.7
	ESR1N	F1N	43.20	2.120	4.91	1.911	90.1	0.209	9.9	0.178	31.2	19.6	17.0	3.2	25.8
	ESR2N	F2N	29.40	1.410	4.80	1.390	98.6	0.020	1.4	0.107	32.5	17.0	20.7	—	17.8
	ESR3N	F3N	37.20	2.383	6.41	2.173	91.2	0.210	8.8	0.241	22.0	21.0	18.7	7.8	16.8

CONCLUSION

This article aims at developing a new grade of steel comparable to AISI M41 high-speed steel and alloyed with nitrogen. It aims also at studying the role of nitrogen alloying and ESR in improving the properties of high-speed steel (AISI M41 grade) through microstructure, hardness, and secondary hardening evaluation. This improvement can allow the duplication of the service lifetime (durability) of the steel tools manufactured by this technique. It also improves the performance of the cutting process using the developed nitrogen-alloyed steel in manufacturing high-speed cutting tools.

The nitrogen-alloyed AISI M41 high-speed tool steel grade (designated here as M41N) has also been electroslag refined under three grades of calcium fluoride–based slag. The steel scrap, the produced steels, and the slag were chemically analyzed. The obtained results showed that both ESR and nitrogen alloying improve the microstructure, hardness, and secondary hardness of AISI M41 high-speed tool steel

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BASIC ELEMENTS TO ESTIMATE THE EXPLOSIVE CHARGE IN EXPLOSIVE FORMING

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ABSTRACT*: In explosive forming, chemical energy from the explosives is used to generate shock waves through a medium (mostly water), which are directed to deform the workpiece at very high velocities.Explosives such as, cyclotrimethylene trinitramine (RDX), pentaerythritol tetranitrate (PETN), trinitrotoluene (TNT) are commonly used as the explosive charge. The type of explosive used depends on the thickness and yield strength of the material to be formed.*

To find the optimum parameters for explosive charge, a theoretical analysis is necessary, as well as the experience gained from previous programs. These ones offer some general guidelines and some limits which restrict the search area.

The aim of the paper is to present some considerations regarding basic elements to estimate the explosive charge parameters in explosive forming.
Key words: *Explosive forming, explosive charge.*

1. INTRODUCTION

Explosive forming uses the high dynamic pressures of shock waves to press a metal sheet in the form of a die. Usually, explosive forming is done with the explosive charge in water, at a certain standoff distance of the part to be formed. The technique has a high accuracy and is suitable for forming small series of metal sheet and tubular parts. Especially of interest are the forming of complex shapes,as double curved surfaces and the forming of large thick parts.It is an enabling , since the high forming rate leads to improved formability for some hard steel and aluminium alloy.

A metal sheet (blank) is waterproof positioned on top of a die. The die is put under water (or water in a plastic bag is put on top of the metal sheet) and a controlled amount of explosive, thus representing the required amount of energy, is positioned above the metal plate halfway between the plate and the water surface. Upon detonation, a strong shock wave collides with the water and the gas bubble it produced pushes the water away in all directions. The metal plate is accelerated to a velocity in the range of 20-100 m/s.

The plate can be free-formed or formed by the impact of it against the die. Depending on the level of clamping the metal deforms by a combination of stretching, bending, pull-in of material from the flanges or even compressive strains. In the latter case the material increases in thickness during its deformation. For the forming of cones and half-spheres this process is particularly suitable.

This process is not restricted by limitation of forces or size, like in a standard pressing machine. Due to the use of an explosive as energy source, very large metal plates, or large thicknesses and difficult-to-form metals (titanium and nickel alloys) can be formed. Depending on the difference in forms between the starting blank and the required form, the forming process may take one1 or several forming steps. The manufacturing facilities require good understanding of the process and its possibilities.

Explosive forming is employed in aerospace and aircraft industries and has been successfully employed in the production of automotive-related components. Explosive forming can be utilised to form a wide variety of metals, from aluminium to high strength alloys. Peak pressure at the work piece may range from a few thousand bari to several hundred thousand bar depending on the parameters of the operation.

Explosives can be classified in two general categories depending on the speed of the chemical reaction:deflagrating or low explosives and detonating or high explosives. Explosive metalworking employs high

explosives exclusively as the energy source. They are two types, primary and secondary explosives. Primary explosives are used in small quantities in detonating caps, but secondary explosives make the basic charge. Secondary explosives have a much higher energy content than primary explosives, but are much less sensitive, and can be detonated only by sudden and intense shock, as provided by a detonating cap.

In explosive forming, chemical energy from the explosives is used to generate shock waves through a medium (mostly water), which are directed to deform the workpiece at very high velocities.Explosives such as, cyclotrimethylene trinitramine (RDX), pentaerythritol tetranitrate (PETN), trinitrotoluene (TNT) are commonly used as the explosive charge. The type of explosive used depends on the thickness and yield strength of the material to be formed.

Because of their convenience, since thei require only storage facilities Primacord and sheet axplosive (Detasheet) have been widely in explosive metalforming. Only a knife is required to cut the primacord or sheet explosive to the required size [1].

However, for large scale metal forming applications (10 kg and over) pressed or cast explosives are much more convenient.They be formed into a rigid shape and machined or sanded to very close tolerances on weight and dimensions. Since the process details for larger scale forming applications must be worked aut on a small scale, facilities must also be available for casting or pressing small scale charges.

2. SINGLE CHARGE EXPLOSIVE FORMING

Explosive forming operations can be divided into two groups, depending on the position of the explosive charge relative to the workpiece: standoff method and contact method. The system used for standoff operation, commonly utilised in explosivs forming, consists of following parts: an explosive charg, an energy transmitted medium, a die assembly and the workpiece (fig. 1).

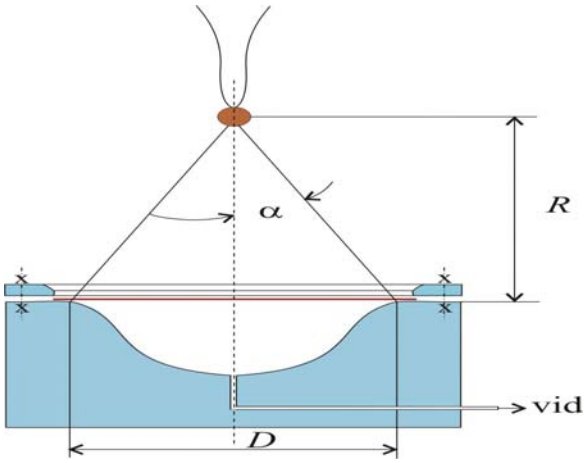


Fig. 1. The system used for standoff operation

Since water is such a widely used a energie transfer medium, it is important to understand the mecanics of energy transfer from underwater explosions. When chemical explosive is detonated underwater, it is converted in a equal mass of gas under a very high pressure. A primary shock wave travels aut from the gas bubble through the surrounding water. It has been estimated by Cole[1] that at a short distance from the source this primary shock wave carries with about 50% of the total energy of the charge. The bubble thus continually expands and contracts, while it moves through the water surface and emit at each pulse a shock wawe. The secondary shock emitted each time from the bubble, reaches a small fraction of the total energy from the charge. The primary shock wave and the afterflow of the water immediately behind it, do all the work in a metal forming operation [2].

In order to be a useful technology, it is important to be able to estimate the amount of energy delivered by an explosive charge to a metal work-piece.

The total energy E_a transfered to the blank is given by [3]:

$$E_a = \eta_T E_e \qquad (1)$$

where:

E_a is the necessary energy for blank forming, J;

E_e –the energy generate by the explosive charge, J;

η_T –the total eficiency of energy transfer.

The necessary energy for blank forming are two component: the strain energy of plastic deformation of the metal part and the frictional energy.

The energy contained in the explosive charge E_e is dependent of the explosive nature and his weight:

$$E_e = GE_1 \qquad (2)$$

where:

G is the mass of the charge,kg;

E_{1e} - specific energy of the charge, J/kg

Specific energy and properties of different explosives are listed in tables with properties of explosives.

The total efficiency of energy transfer mai be considered as a product as two factors: the geometric efficiency η_g and the work-medium transfer efficiency η_m.

Therefore:

$$\eta_T = \eta_g \eta_m \qquad (3)$$

The geometric efficiency η_g take in account the fact that the solid angle subtended by the metal work-piece or blank at the centre of the charge is $2\pi(1-\cos\alpha)$ steradians and the total solid angle subtended by a point (the centre of the charge)is 4π steradians. Hence the geometric efficiency is [2]:

$$\eta_g = \frac{2\pi(1-\cos\alpha)}{4\pi} = \frac{1}{2}(1-\cos\alpha) \qquad (4)$$

The transfer work-medium efficiency η_m take care the energy loss in the reflected wave of blank or medium limit, friction or irreversible changes in transfer-medium [4]. This may be given by the following approximate formula:

$$\eta_m = b_1 L^2 + b_2 \quad [\%] \qquad (5)$$

where:

L is the medium thickness ower the explsive charge, m;

b_1 and b_2 are constants.

For $\eta_m < 0,25$, value: $b_1 = 0,2$ and $b_2 = 1,5$ at water explosions and $b_1 = 0,6$ and $b_2 = 1,5$ at sand explosions

To compute the necessary energy for blank forming E_a, we consider a stress-strain law: $\sigma = K\varepsilon^n$. Integrating, resulte the specific mecanic work of deformation at uniaxil loading:

$$U = K \cdot \varepsilon^{n+1} / n+1 \qquad (6)$$

Using St. Venants theory of plastic flow for stress strain relationship, based on the assumption that the deviator stress tensor is proportional to the deviator strain rate tensor, and that the spherical strain rate tensor is zero(the material volume remains constant during deformation), we get the following equation for computing the strain energy of deformation per unit volume U, for a strain hardening material:

$$U = K \cdot \varepsilon_i^{n+1} / n+1 \qquad (7)$$

where:

$$\varepsilon_i = \frac{\sqrt{3}}{2}\left[(\varepsilon_1-\varepsilon_2)^2+(\varepsilon_2-\varepsilon_3)^2+(\varepsilon_3-\varepsilon_1)^2\right]^{1/2} \qquad (8)$$

The values K and n (the strain hardening exponent) are conveniently obtained from uniaxial test.

The total strain energy of a piece forming is given by [4] :

$$E_a = \left(U_1V_1 + U_2V_2 + U_3V_3 + ... + U_jV_j\right) + L_f \qquad (9)$$

where:

U_j is the strain energie per unit volume at j piece zone;

V_j – material volume contained at j piece zone

L_f – energy consumed through friction betwem plate and die.

3. MULTIPLE CHARGES EXPLOSIVE FORMING

If the deformation obtained after the first shot is less than the desired depth of draw, or the piece is very complexe, the final shape can be attained after a second shot. Also, for complexe forme of the piece, the first shot may be to contain multiple charges simultaneous exploded [4]. In the folloving exemples we expose two situation in wich on utilise multiple charges: the first-a rotary table, in wich the transfer medium is sand and the second- a half-toroidal piece, in wich the transfer medium is water.

3. 1. - Rotary table- explosive forming in sand.

The main specifics features of the explosive forming process have been(fig.4):

- material 10TiNiCr180;
- diameter of piece D = 1525 mm;
- plate thickness s_0 = 1,5 mm;
- relative thickness s/D = 0,00095;
- maximum profile depth f = 75 mm;
- dies material cast iron Fc24;
- blank diameter D_0=1740 mm;
- explosion medium sand with:
  density ρ=1,64 g/cm^3;
  humidity= 4,7 %;
- explosive presed cakes TNT at 0,5 and 01 kg

To compute the explosive weight, relationship (7,8,9) can be used, where the explosion medium efficiency is $\eta_m = 0{,}2...0{,}4$. The specific energie of the TNT charge is $E_1 = 393 \cdot 10^4$ J/kg.

The explosive weight has computed at three zone: central zone of the piece, with exterior diameter Φ314 mm; lateral zone with complex deformation (between Φ810 mm at Φ1560 mm) and lateral channel zone (near Φ1495 mm).

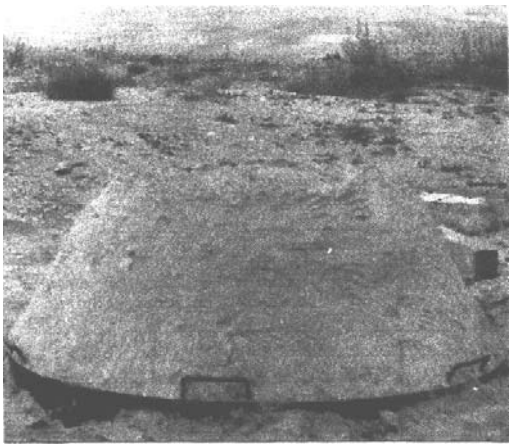


Fig. 2. Explosive device forward forming.

Fig. 3. The piece after explosion

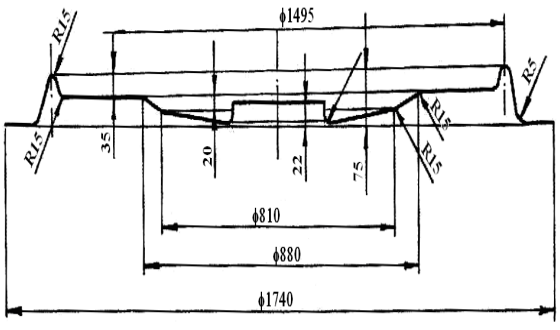
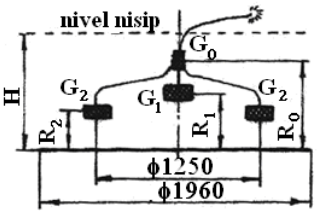
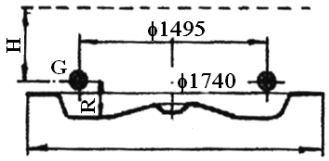
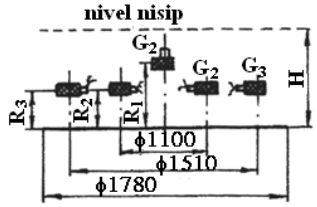


Fig. 4. Design of explosive formed piece: rotary- table

Table nr. 1. Work schemes for explosive forming for rotary- table

Nr.	Charges scheme	Charges weight [kg]	Distance to piece R_i [m]	Observations

1	Operation 1. Forming 	G_0=0,1 G_1=2x0,5+1x0,1 = 1,1 G_2=12x0,5=6 G_{total}=7,1	R_1=0,55 R_2=0,4 H=1	Detonation with an electric detonating cap and 4 pyrotehnics caps; complete deformation, except canal of Φ1495mm, incomplet formed. Need a second explozion for calibration (next).
	Operation 2. Calibration 	G=46x0,10=4,6	R=0,09 H=0,3	Detonation with 4 electric detonating caps and 4 pyrotehnic caps (for sensibility). Result an adequate form.
2	Operation- variant 	G_1=2x0,5+1x0,1 =1,1 G_2=44x0,75=3,3 G_3=46x0,1=4,6 G_{total}=9,0	R_1=0,5 R_2=0,3 R_3=0,2 H=0,7	Detonation with electrics detonating caps for each charge ; incomplet formed.

3. 2. *Half-torus form piece - explosive forming in water.*

Two pieces in half-torus form, with an outside diameter of 869 mm and an inside diameter of 419mm, have been formed using as an explosive the HITEX-NH8 type. Each piece is formed in two shoots and after the first shoot heat treatment is made. Fig 3 shows the die ready for underwater detonation, while fig. 4 shows the piece drawn into forming die.

The main specifics features of the explosive forming process have been:
- material stainless steel 347/ASME A240
- plate thickness s_0 = 3,18 mm;
-out side diameter of plate D_0= 1140 mm;
- outside diameter of piece D = 869 mm;
- inside diameter of piece d= 419 mm;
- maximum profile depth f = 117,48 mm;
- dies material: metal- epoxy- concrete;
- explosion medium water;
-type of explosive:
first explosion- plastic-HITEX-NH8;
calibration detonating cord P16.

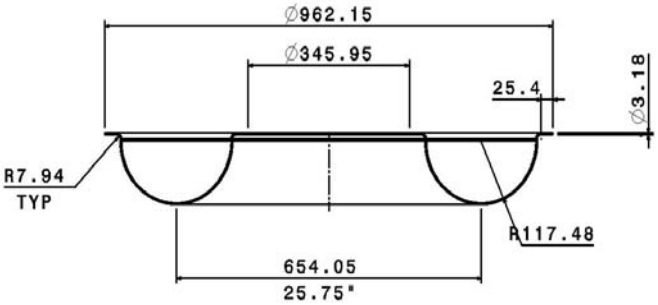


Fig. 5. The design of piece

The peak pressure from an underwater TNT explosion, has been calculated by the following empirical formula[2] for a linear charge:

$$p_m = 720\left(\frac{\sqrt{q}}{R}\right)^{0,72} \quad [daN/cm^2]$$

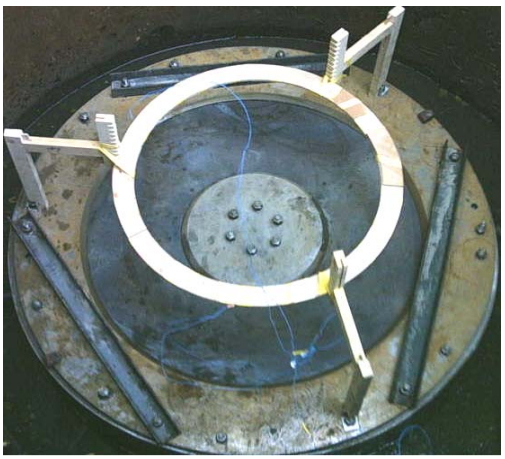


Fig. 6. Die ready for underwater explosion

Fig. 7. Piece drawn by explosive forming

where:

p_m is the peak pressure at R distance from the linear charge axis, daN/cm^2;

q - the charge weight per unit lenght, kg/m;

R - distance from the linear charge axis to the piece, m.

After an analise of literature informations and to ours experience base, we have establish a necessary pression for plastic deformation: p_m= 1600 daN/cm^2. For an equivalence HITEX to TNT equal at 1,3 and R = 0,28 m , resulte an explosive plastic cord with: q = 0,61 kg/m and (at diameter 650 mm) a total weigh G = 1,26 kg.

The water head $L_{m,}$ which is the depth of submergence of the charge below the water surface, has an appreciable effect on the efficiency of the energy transfer from the charge to the work-piece. The water head has been L_m= 0,7 m and the total water level :

$$L_H = L_m + R + H_{matr} = 0{,}7 + 0{,}3 + 0{,}25 = 1{,}25 \text{m}$$

The method used in these experiences is the tank-forming underwater. The blank is clamped to the die with a vacuum-tight joint. A vacuum of approximately 6…8 mm Hg is then drawn in the cavity between the sheet and the die. After the vacuum has been drawn, the explosive charge is positioned at a carefully calculated distance from the work-piece. Next, the die and the charge assembly are lowered into the water tank and the charge is detonated. The die with the formed part is then removed from the water and the parts are taken out for inspection.

Each piece is formed in two shoots and after the first shoot heat treatment is made. Fig 3 shows the die ready for underwater detonation, while fig. 4 shows the piece drawn into forming die.

4 .CONCLUSIONS

The paper present some considerations regarding basic elements to estimate the explosive charge in explosive forming. In order to estabilish a useful technology, is give a method to estimate the amount of energy delivered by an explosive charge to a metal work-piece and hence, the weight of the explosive charge.

To find the optimum parameters for explosive charge, a theoretical analysis is necessary, as well as the experience gained from previous programs. These ones offer some general guidelines and some limits which restrict the search area.

Since they require only storage facilities, Primacord and sheet explosive (Detasheet) have been widely in explosive metal forming. However, for large scale metal forming applications (10 kg and over), pressed or cast explosives are much more convenient. They be formed into a rigid shape and machined or sanded to very close tolerances on weight and dimensions

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SPECIAL CLOTHING AND EQUIPMENT FOR THE AIR FORCE OF THE ARMY OF THE CZECH REPUBLIC

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Abstract

Special clothing and equipment for the Air Force of the Army of the Czech Republic is described in the article. Attention is paid to the garment worn by pilots and aircraft technical support both in cockpits and on the ground while performing combat and training tasks. The requirements for high quality, protection and comfort of Air Force personnel clothing and equipment are discussed in more detail.

Introduction

Clothing and equipment of the Air Force personnel of the Army of the Czech Republic and namely those of pilots have to satisfy specific requirements following from their highly demanding activities. Emphasis is laid namely on the preservation of properties of used materials, utility of garments and clothing comfort. Pilots´ garments must be compatible with high-altitude clothing and equipment and individual components must be certified before being put into use.

The package of clothing and equipment for flying personnel as well as for aircraft technical support (ATS) personnel has been solved within the departmental task assigned by the Air Force commander and called “Clothing and Equipment of Air Force”.

1 CLOTHING AND EQUIPMENT FOR FLYING PERSONNEL

The basic item of special clothing and equipment of air force personnel is a t**wo-piece garment for pilots.**

The garment is worn by pilots and other flying personnel in the cockpit and on the ground while performing combat and training tasks.

The suit consists of a jacket and overalls. The jacket is of a shorter length with a zipper, fully lined and finished with a waistband. The overalls are with a shirt-front, upper back piece and braces. The garment is worn with a hood and underwear with reduced flammability.

Fig. 1 Two-piece garment for pilots

Both types of suits are made of special fabric (NOMEX® Comfort) providing protection against fire. This fabric has also an anti-static and hydrophobic finish and enables transport of sweat.

Fig. 2 Coveralls for pilots

Coveralls for pilots are worn by pilots and other flying personnel working in the cockpit and on the ground in combat and training conditions.

The coveralls for pilots are of a close fit with a two-way zipper. The front part is in one piece, the back part is cut in the waist area. Sleeves are long and with air vents. The coveralls are worn with a hood and underwear with reduced flammability.

The material used is a plain weave cloth (NOMEX® Comfort) with oleophobic treatment to reduce staining. Its square weight is min. 165 g/m^2.

Waistcoat for pilots is a complement to the above mentioned suits. The garment is worn by pilots and other flying personnel in the cockpit and on the ground while performing combat and training tasks.

Sleeveless waistcoat of a shorter length has a waistband at the bottom. It is fastened with a zipper. It is made from the basic material, lined and complemented with a climatic membrane. The liner is made from the lining material, only sleeves are from the basic material. It is lined with fleece, sleeves have also the membrane. The liner can be fastened with zippers in the waistcoat.

The basic material is of NOMEX® Comfort with square weight of min. 220 g/m^2, twill weave and oleophobic treatment.

Fig. 3 Waistcoat for pilots

The 2008 Water-resistant suit for pilots was purchased for the ACR pilots in 2009.

The garment is designed for pilots and other flying personnel performing combat and training activities over the sea after the emergency abandoning of aircraft over water surface (sea). It has to enable pilots to put on high altitude equipment, fasten all accessories and sit comfortably in the cockpit. The garment is fire, cold and water resistant.

The material is a three-layer laminated fabric. The upper layer consists of 93 % of meta-aramid (Nomex), 5 % of para-aramid (Kevlar), and 2 % of antistatic biconstituent fibre with carbon core. The middle layer is a climamembrane – a two-component cellular polytetrafluoroethylene (PTFE).

The square weight of laminated fabric is approx. 300 g/m^2, the resistance against water vapours is max. 10 Ret (m^{2}Pa/W) and tensile strength is min. 1000/800 N.

Fig. 4 The 2008 water-resistant suit for pilots

Underwear for pilots serves as an additional fire-protecting layer. We have two types of underwear put into use: **light underwear and winter underwear.** Both versions are made of knitted fabric with reduced ignitability (Nomex Comfort). The winter version has a loop finish on the reverse side in order to increase its thermo-insulating properties. The material provides a very good transport of moisture to other clothing layers.

The sets of both types of underwear consist of long-sleeved undershirts and pants. Winter undershirt is furnished with a polo neck with a short zip fastener.

Foot protection

Flying personnel may use two types of boots: summer boots and winter boots.

The winter boots for pilots are designed to be used as a standard item in winter. They protect feet against cold weather and ensure the mobility of wearers while performing their tasks under low temperature thanks to special climatic membrane and thermo insulating non-woven textile.

They are half-shine boots of derby style with lace closure. The boots are fully lined and have a special climatic membrane and thermo insulating non-woven textile. The lace closure is covered with a separate leather piece with a zipper for quick putting-on. The upper is glued to the sole unit. The sole is abrasion and POL resistant. The boots are antistatic due to inserted antistatic insoles.

Fig. 5 Winter boots for pilots

The summer boots for pilots are designed to be used as a standard item in spring, summer and autumn. They protect feet against unfavourable weather and ensure the mobility of wearers while performing their tasks.

They are half-shine boots of derby style with lace closure. The upper is a combination of natural leather and textile. The ankle part is reinforced with a textile band. The upper is glued to the sole unit. The sole is abrasion and POL resistant. The boots are antistatic due to inserted antistatic insoles.

Materials - Upper: natural cowhide leather, synthetic textile; Lining: natural lining leather (heel), synthetic non-woven textile (toe); Sole unit: rubber and polyurethane (POL resistant, antistatic, abrasion resistant).

Fig. 6 Summer boots for pilots

2 CLOTHING AND EQUIPMENT FOR GROUND PERSONNEL

Clothing and equipment for ground personnel not only protect the wearers against unfavourable weather effects, but also meet some other specific requirements, e.g. camouflage, tearing strength and oleophobic treatment. The ground personnel may use a number of accoutrements designed for the members of Land Forces (thermo underwear, socks, etc.).

Two-piece garment for aircraft technical support (ATS) personnel is designed to be used all-year-round.

The set consists of a jacket and overalls with winter accessories (a zipped-in insert and a fur collar). The jacket is of a shorter length with a zipper covered with a trimming and finished with a waistband. The overalls are with a shirt-front, an upper back piece and braces.

The basic material is a Ripstop weave cloth, 50 % polyester / 50 % cotton, with antistatic treatment, conductive fibres and oleophobic treatment to reduce staining. The zipped-in insert is a polyester micro-fibrous fleece covered with a lining cloth.

Fig. 7 Two-piece garment for ATS personnel

Two-piece waterproof garment for ATS personnel is designed to protect against

rain and unfavourable weather conditions. It is used as an overgarment.

The garment consists of a jacket, trousers and a cover. The jacket is not lined. It has half-kimono sleeves and a hood and it is fastened with a zipper and two trimmings. The trousers are not lined either. The front and back pieces are made of one cut piece.

The basic material is a Twill weave cloth, polyamide or polyester with vapour permeable coating (polyurethane).

Fig. 8 Two-piece waterproof garment for ATS personnel

The distribution of accessories for ATS personnel has been carried out at air bases so far. As the system was inefficient for a long time the accessories were removed to the Base of unrepaired materiel in Brno. On 14 January, 2010 exclusive distribution of all the accessories for ATS personnel was started at the only distribution point of accoutrements in Olomouc.

Fig. 9 Distribution point of accoutrements for ATS personnel in Olomouc

Conclusion

The development and research of new accoutrements is continuously carried out by experts from the Department of Development, Research and Testing of Accoutrements Service at the Base of unrepaired materiel in Brno. It is a process ensuing from particular needs of future users fulfilling their tasks. However, the process primarily depends on financial possibilities. Due to financial constraints the old accoutrements are replaced for new ones gradually.

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THE INFLUENCE OF ELECTROSLAG REMELTING ON THE MECHANICAL PROPERTIES OF COMBINED STRESSED FORGED PARTS

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Abstract

A quality of forgings of large dimensions with diameter 350 mm and length 8500 mm of a bar profile are described. The forgings are made of ingots of mass approximately 6 tons. Steel is melted in the electric furnace of volume 15 tons of molten steels. About 18 tons of steel can be reduced in the furnace using enforce and from this amount four ingots are molten by casting process.

The forgings are used for special technology in tank gun barrels, thus a product is combined stressed mainly by high pressure, impact and temperatures. Medium alloyed steel is suitable for these conditions and for mechanical properties higher requirements are imposed. The lowest magnitude of lower yield point, contraction and impact strength are appointed.

Molten ingot is forged by a hydraulic press. After flattening giving a shape of bar forging and its heat treatment follows take of samples for determination of mechanical properties. Their results often didn't achieve standard parameters. Technical conditions allow to make a forgings on the heat treatment maximum twice. Forging was disabled such a defective work because of deficient mechanical properties after heat treatment adaptation. More than twelve per cent forgings from a whole year production was disabled y this way and coefficient of heat treatment adaptation was K=1.7. The reasons of inconvenient properties are in content, shape and imensions of tne impurities.

A substantial in the quality of investigated steels was enabled due to technology of refinement which is designated as the elecroslag remelting (thereinafter ESR) .

INTRODUCTION

Higher requirements for metallurgical semiproducts used for cannon guns production brings substantial increase of amount of defective products. The main reasons were low level of the plastic properties and yield point. The repeated heat treatment leads only to partial success. Close study of forgings production technology and adaptation of its constituent phases don't bring the quality improvement of the forgings. Cannon gun steel has a favorable relation between plastic and strength properties and high hardening capacity (over 150 mm). Those conditions make the steel suitable for forgings of large dimensions.

Analysis of interstage treatment shown that interstage procedures were done correctly. Thus the problem was searched in the phase of casting technology [1,2,3].

MATERIAL AND METHODS USED FOR EXPERIMENT

a) Used material

Chemical composition of studied steel is shown in tab. 1.

Table 1 Chemical composition of studied steel (w. %) [4]

C	**Ni**	**Cr**	**Mo**	**Si**
0.35	3.0	1.0	0.25	0.30
Mn	**P_{max}**	**S_{max}**	**Cu_{max}**	
0.40	0.025	0.025	0.030	

Required mechanical properties are as follow:

- Minimal yield strength – 873 MPa
- Maximal impact strength – 34 J/cm^2
- Minimal contraction - 25%

b) Experimental methods

Experimental methodic consist of following steps:

- Close analysis of solid phase and evaluation of metallurgical quality of steel based on analysis results
- Affecting of metallurgical quality of steel by change of its production technology
- Confrontation of results from both technologies

ANALYSIS OF SOLID PHASES

The solid phase was analyzed through the fractures surface study with using electron microscope on the samples from tensile strength test and Charpy impact test. Also the qualitative analysis of the unfamiliar particles located on the samples fracture surfaces was realized.

Nanoparticles on the fracture surfaces were classified to various different types but only two types of non-metallic particles had the high priority. The first type was fanout aligned baculiform particles (Fig. 1). Chemical analysis confirmed the presence of the manganese sulfide MnS (Fig. 2) [2]. The second type of the inclusions was consisted of small cumulated particles segregated in lines, strips or clusters (Fig. 3). Polyhedral particles are angular and in some cases were nearly formed to a regular hexagon. Chemical analysis by EDAX system confirmed the presence of the complex chemical compounds created with O, Si, Ca, Al, Ti, S, Mn (Fig. 4) [2,3]. Those compounds are the complex of sulfide oxides separated by strip of metallic base.

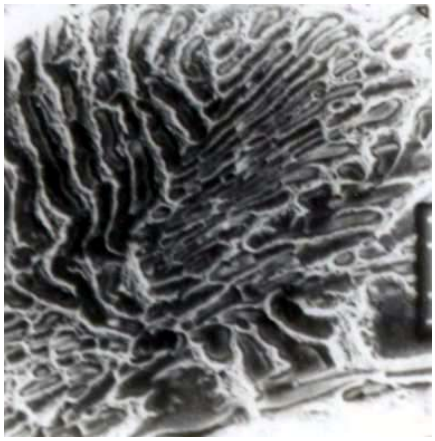

Fig. 1 Fanout aligned baculiform folds – magnification 600x

3000x 100 sec.
250 sec.
Sec. Electrons: SK_α

3000x 100 sec.
250 sec.
Sec. Electrons: SK_α

Fig. 2 Area distribution of characteristics X-radiation K_α Mn and S in folds of baculiform shape

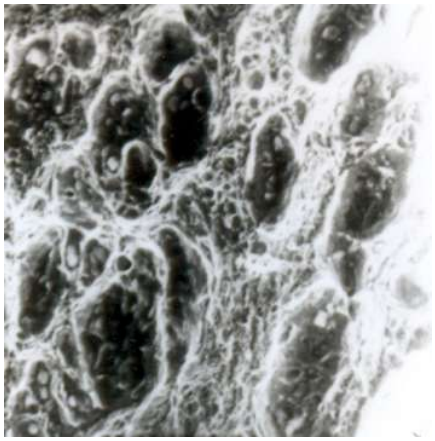

Fig. 3a Polyhedral shaped clusters and rows of folds - magnification 600x

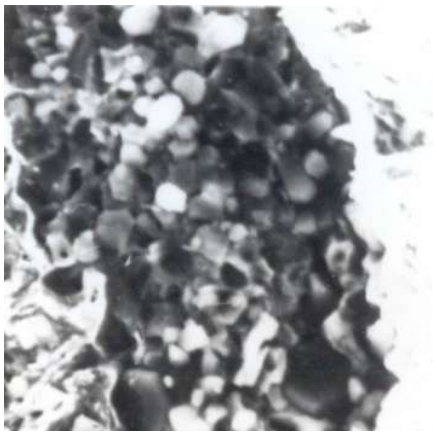

Fig. 3b Polyhedral shaped clusters and rows of folds - magnification 2000x

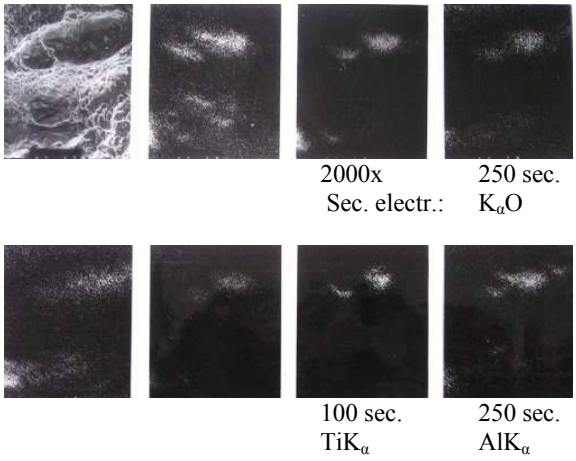

Fig. 4 Area distribution of characteristics X-radiation $K_\alpha 0$, Si, Ca, Ti, Al, S, Mn and S in folds segregated in clusters

The highest amount of defective products was occurred in those forgings where fanout aligned baculiform folds were detected.

INCREASE OF METALLURGICAL QUALITY OF STEEL

Close analysis of fracture surfaces indicated clearly that the way to increase of the studied product quality is to affect the inclusions in the melting phase of the production process.

The primary liquid alloy could not be affect noticeably during casting process of ingot. Therefore the experiments were focused to secondary melting as a product of electroslag remelting of the ingot to the forged electrode. The electrode was forged using hydraulic jack CKV – 2500 and remelted in the electroslag device (Fig. 5) under the refining slag with composition of 70% CaF_2 a 30% Al_2O_3.

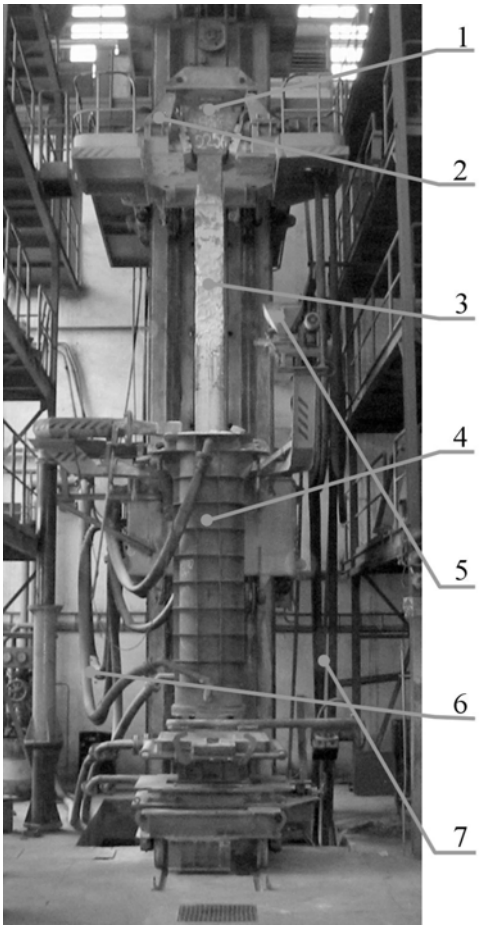

Fig. 5 Equipment for electroslag remelting of steel [3]
1 – Inventory head
2 – Seating clamps
3 – Electrode (forged and remelted product)
4 – Crystallizer
5 – Feeding device
6 – Cooling of crystallizer
7 – Input power

COMPARISONS BETWEEN BOTH MENTIONED TECHNOLOGIES

Forgings of the cannon guns were produced with using non-remelted and electroslag remelted steel. Results of

mechanical properties from both technologies showed significant differences as is stated in tab. 2 and tab.3 [1, 2].

The final value each of mechanical characteristics (tab. 2, and tab.3) is the average from values of five samples. The samples were taken from places in transverse direction to forgings line. If any of characteristics taken from the sample did not meet the requirements, the sample was heat treated again. If the requirements still were not reached after three cycles of heat treatment, the product was excluded as a defective.

Table 2 Results of mechanical properties acquired from remelted steel

Forgings No.	**Yeld point [MPa]**	**Contr. [%]**	**Impact resistence [J.cm^{-2}]**
4742	958	26,4	48
4743	974	30,9	52
4744	959	29,7	51
4745	964	24,6	54
4832	866	19,5	43
4833	909	18,6	42
4834	886	19,3	42
4835	953	21,2	42
5748	982	21,3	40
5749	915	30,5	48
5751	945	22,1	42
5752	1001	27,8	42
5753	922	35,9	48
5754	1013	32,2	40
5756	947	28,0	50
5757	947	34,9	58
5758	953	36,7	54
5759	962	36,6	51
Average of 18 forgings	**947**	**27,5**	**47**

Table 3 Results of mechanical properties acquired from non-remelted steel

Forgings No.	**Yeld point [MPa]**	**Contr. [%]**	**Impact resistence [J.cm^{-2}]**
6395	1182	42,6	61
6396	1165	43,2	62
7482	1187	44,3	67
7483	1092	44,7	68
Average of 4 forgings	**1131**	**43,2**	**64,5**

Comparison of both technologies unambiguously shows the increase of all followed characteristics at remelted steel.

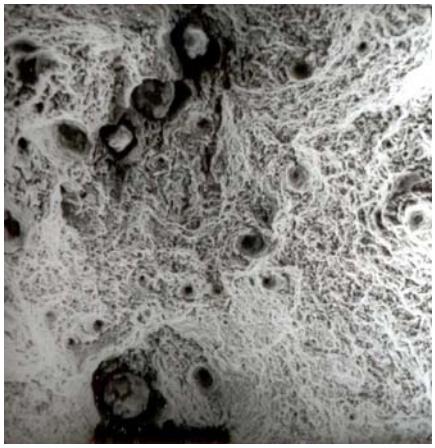

Fig. 6 Typical folds of ESR forgings

There were found absolutely different types of non-ferrous inclusions on the fracture surfaces of ESR steel as on the fracture surfaces of steels without ESR. Inclusions are dispersed in steel, not segregated in any clusters and they have almost globular form as is shown on Fig. 6. The inclusions were identified as a complex sulfide oxide by chemical microanalysis (Fig. 7) .

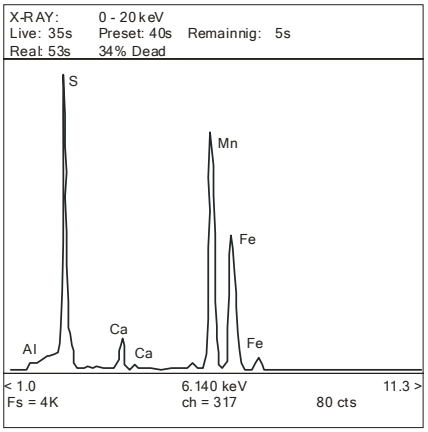

Fig. 7 Chemical microanalysis of folds in ESR forgings

CONCLUSIONS

The presented results showed that the electroslag remelting forgings have significantly higher values of mechanical characteristics as are the prescribed requirements. Therefore steel produced in arc furnace and then refined by ESR technology follows to its conditions suitable for the designer to design product with better utility properties.

Important asset of ESR technology is in plastic properties distribution homogenously through volume of forging. The plastic properties of ESR forgings are also significantly higher at high yield point level as the properties of forgings without ESR [5].

This positive effect of ESR forgings is caused by distribution of non-ferrous nano particles in the steel. Forgings without ESR had inclusions segregated in cluster but this effect did not appear at ESR forgings. The refinement effect causes that some inclusions got stuck in the slug (a third of them according to analysis) and the rest, breaking off the slug, are segregated individually in the liquid. Individual segregation of inclusions affecting mechanical properties of steel not so negatively than inclusion segregated in clusters.

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BEHAVIOR IN THE SERVICE OF TECHNOLOGICAL EQUIPMENT OF PLASTIC DEFORMATION

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Abstract: *The paper presents specific failure processes of technological equipment of plastic deformation. Malfunction due to design and technology are premature failure and accident occurring at different test. Defects generated by technological design and implementation occur mainly due to structural applications of materials used, in terms of macro and micro structural , with that prescribed by the designer.*

Keywords: *plastic deformation, reliability, durability.*

Array of technological equipment failures give an insight into the multitude of varieties such as successive points possible in the classification are presented below:

Classification

- After discovering how: visible hidden.
- After elimination of fault mode: by changing the active parties, by regulation.
- After effects: due to improper use, inherent, due to wear, critical problems.
- After the failure dependence: dependent, independent.
- Can cause defects after removal: remove, not eliminated.
- After surgery to remove the fault complexity: simple, complex.
- After the speed of occurrence: suddenly; progressive.
- Progressive: single routine.
- After the failure: total, partially.
- After the order of occurrence: primary, secondary.

Damage due to premature failure of design and technology are accidental and occur at different approval testing phase. Mean defects, material defects, faulty execution, defects caused by wrong calculation of resistance made by the designer.

Considering and damage caused by underestimating the task and ambient conditions, and using empirical methods or inadequate relief material. Choosing an inappropriate constructive solutions may compromise early stage of technical design, reliability of technological equipment.

In addition to those listed should be considered tools that are installed such equipment and which induce various voltages.

Failures caused by technological design and implementation appear in particular the applications of structural materials, in terms of macro and micro, from those prescribed by the designer. Stringent control of materials and making organizational and technological measures to stay within specifications is reliability growth.

After processing, mechanical failure of the active surfaces, the clamping surfaces, the surfaces of guiding and positioning

bearing capacity decreases, especially in contact fatigue.

Assembly technology can generate factors that can change the system reliability. Technical control, quality of reception by technology vendors, along the way and may ultimately prevent the delivery of equipment tehnolgice. Efficiency but quality control is influenced by technology manufacturing capability.

Defects caused by wear process generated by the process of friction between contact surfaces of parts metalicele energy loss effect (manifested by loss of heat) and natural aging (manifested by separation of material and changes to the original state of these areas) . Material losses were a result in changing the size and geometric shape of the contact surface. For certain conditions of temperature and structural changes may occur simultaneously in superficial layers. All these influences directly or indirectly, capacity, precision work, kinematic functional working arrangements, leading to a malfunction and ultimately to scrapping them.

Causes of removal from service of machinery are:

1. Improper operating 59% - inadequate work rate 9%; Incorrect maintenance 9%

12% misuse; Incorrect maintenance 16%; Untrained staff, 6%; Untrained staff, 6%; 7%, other reasons.

2. Technical deficiencies 32% - 11% wear;

- 7% for other reasons.

3. Other causes 9%

Wear metal surfaces is a complex phenomenon determined by many factors and conditions. Co-intervention in the composition or nature of materials in contact, mechanical properties, surface quality, functional parameters (load, speed, temperature), the quality of lubrication and lubricant, wear of metal surfaces to make it appear as a consequence of different mechanisms action which overlap.

Phenomenon of friction between two metal surfaces in relative motion, is an important component of the additional energy losses.

Friction is the process of molecular interaction, and mechanical energy that occurs between the contact surfaces in relative motion in the presence or absence of a force lubricant under normal pressure. Friction is a force tangential to the contact surface between the two bodies in relative motion, is acting in the opposite direction of motion and is governed by increased resistance to relative motion, thus generating heat and wear surfaces. Depending on the presence or absence of lubricant between surfaces in relative motion, friction can be of two types: dry and in the presence of lubricant.

Dry friction is characterized by direct contact of metal surfaces in relative motion, without any kind of lubricant between the surfaces. This friction is characterized by high values of the coefficients of friction. Dry friction is considered harmful because its main effects (heat and wear) that lead to the development and maintenance of vibration (motion) or scrapping of equipment. Despite these negative effects, there are situations where friction is a phenomenon known as useful, as is the case: ambreajelor, brakes, transmission friction wheel.

After analyzing these theories that friction is a sum of several components such as those necessary for: shearing of micro microasperităților any harder metal, overcoming resistance to movement and scratching surfaces by abrasive particles,

producing local elastic or plastic deformation , overcoming the adhesion contact area, overcoming resistance to friction in the lubricant film.

Friction is influenced by a complex of factors indicating: normal pregnancy Speed of relative sliding bodies , Like contact, quality and surface roughness in contact, accidentally materials, rigid or flexible nature of the surface, surface temperature, the presence of lubricant or dirt.

Due to the direct influence of friction on the performance of machinery is necessary to act to reduce the friction coefficient in sliding, rolling or pivoting. in situations where the phenomenon of friction is used to transmit motion and mechanical power, the coefficients of friction should be as large.

The construction and operation of mining machinery in dry friction is the only way to wear producer, because under certain conditions even in the presence of lubricant can occur between contact surfaces in contact microasperitățile.

Adhesion wear (contacts) appear in all forms of friction when surfaces conjugates are not completely separated from the lubricant film. This type of wear occurs
by welding and breaking bridges between micro contact welding, characterized a high friction coefficient and wear intensity.

If adhesion is found that wear this type of wear is purely mechanical and can be recognized by the microaşchiere traces the hard parts or sharp particle roughness in the direction of motion, or deformation when rounded roughness and load large.

Fatigue wear is the result of cyclical surface contact, followed by plastic deformation in the atomic network of the superficial layer, the cracks, voids or exfoliation. Factors affecting fatigue wear are: the structure of parts in friction materials, temperature, type of application, focusing, variable frequency applications, the dimensions of parts. They wear occurs generally in the form of separation of material particles, leaving traces specific to each type of wear. Fatigue wear are prineiupire wear (pitting), wear by spalling and wear by cavitation.

Wear by pinch (Pitting) is a form of surface fatigue wear of the contact point or linear feature can be recognized as craters or voids.

Aging by exfoliating (peeling) is characterized by the separation of small metal particles, the order of 1 um, or order of 0.01 um oxides, which occur in metallic materials with high plasticity when it is exceeded shear strength in concentrated areas of contact with friction. Scaling is enabled by internal tensions remaining after the defective heat treatment tempering, case hardening or nitriding by decreasing mobility of atoms in the network.

Wear by cavitation can be defined as a process of destruction and displacement of surface material in the form of small particles produced by liquid or gaseous environment in contact with metal, without the presence of the second friction surfaces. This type of bearing wear in May and called cavitation erosion and cavitation corrosion.

Wear corrosion damage is manifested through surface, and therefore loss of material due to simultaneous or successive action of aggressive chemical factors in the composition of the working environment and the mechanical.

Wear mechanism requires correlating the effects of chemical corrosion, electrochemical AND mecanochemical.

Chemical corrosion, action is a continuous chemical environment of the area. Chemical corrosion can evolve

differently, depending on the physico chemical parameters of the material. Rest during corrosion phenomenon of chemically acting only on open areas to pass through the contact area.

Failure to take account of environmental stress factors, may cause many primary defects. Types of failures that must be included and those caused by preservation, packaging and transportation technology equipment.

Lure of environmental stressors are: temperature, pressure, humidity, vibration, solar radiation, nuclear radiation, salt fog, sand, dust .

Because hot working dies wear at temperatures between 300 ° C -600 ° C is produced by the mechanical action of rubbing the blank edges of the material heated mold profile. Typical wear surface with maximum surface friction in the separation plan between the mold cavity and the containment of bavurii Figure. 1

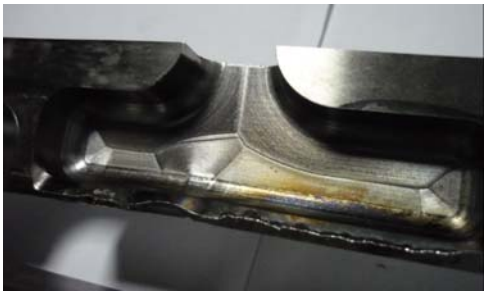

Figure 1. Different types of molds used

Adhesion areas required more compression, essentially there is no friction. Due to high deformation forces, the material heated surface oxides on the surface appear fine prints while advancing, causing surface irregularities Forgings (ill appearance).

The phenomenon is also clearly visible on the surface burrs magazine that although its influence on the accuracy of material flow in forging difficult burrs magazine.

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INFLUENCE OF THE TECHNOLOGICAL PROCESS ON THE RELIABILITY OF TECHNOLOGICAL EQUIPMENTS

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Abstract: *With increasing interest to studies of reliability and in the present context, the world economy is currently facing a shortage of prime matter, materials and energy, attention turned to the reliability of remanufactured products. This paper is review of achievements and current trends of research on technology and reliability of technological equipment reconditioned.*

Keywords: *reliability, reconditioning, heat treatment, sustainability*

Plastic deformation processing is the method by which to obtain semi-finished and finished parts, is made permanent deformation of solid materials (hot or cold) without macroscopic cracking.

Wrought processing of metallic materials based on the property of plasticity of metals, ie their ability to achieve permanent deformation under the action of external forces (1). Using the increasingly widespread plastic deformation as a method of obtaining parts and the result is that it has advantages compared with other processing methods (2) such as:

- Significant savings of material;
- Completion of a piece with the simplest configuration to the most complex, with weights ranging from several grams to hundreds of tonnes and overall dimensions of a few millimeters up to tens of meters;
- Production of parts with different functional properties and improved section;
- High productivity due execution of processing with wide possibilities of mechanization and automation, and because obtaining simple or complex product configuration, the same section, the great length;
- Achieve a very low price necessary to other semi-processing methods;
- Possibility of achieving greater precision parts with high dimenisională;
- Significant savings of labor.

One of the processes by plastic deformation process commonly used in machine building industry is forging (hot plastic deformation).

The experimental research contributions in bringing new technologies into the overall deformation and in particular the decisive factor in forging process, namely matrix.

Molds are the essential factor productivity of forging machines being the most requested item in the complex process of plastic deformation. They run a wide range of typo-dimensions and forms, some examples of these are presented in Figures 1, 2, 3 and 4.

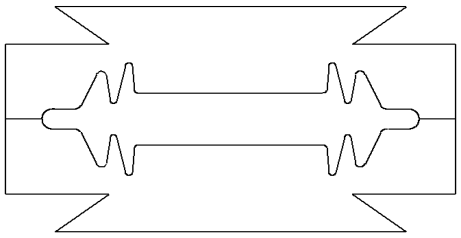


Fig.1 Die for execution semi – pulleys

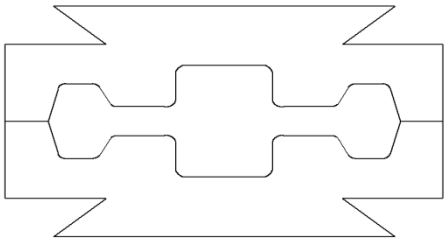
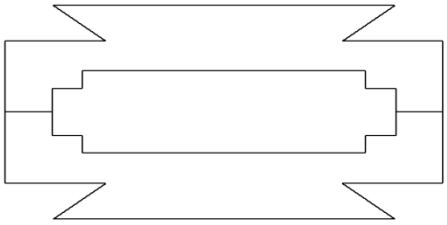
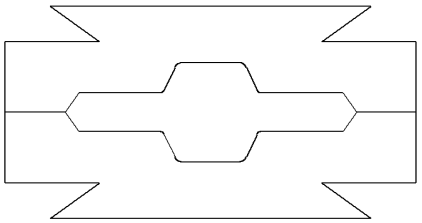


Fig.2 Die for execution semi - wagon wheel



semi – cover



semi – Wheel

Fig.3 Die fo

Technological process for obtaining blanks requires separate two stages ie primary development blocks their molds and machining.

Die blocks are executed in most of the forged ingot. In forging ingots required a number of conditions that result from the steel mold, or are in the category of high alloy steels and the need to ensure maximum possible isotropy of physical and mechanical characteristics. Cast ingots after cleansing to face a surface to remove heat for forging defects.

During heating is calculated by well-defined formulas. INGOT is heated forjează on hydraulic presses.

The main variants of forging die blocks are:

- Forging dimensional (bars);
- Dimensional forging with repression;
- Forging dimensional with complex discharge.

Blocks of alloy forgings are subject to heat treatment to avoid the occurrence of flakes resulting in cooling cycle, after forging under 350 ° C due to the effect of atomic hydrogen in molecular hydrogen transformation resulting snapshot, with significant releases of heat and formation voltages exceeding the strength of steel.

Emergence is favored by the presence of flakes dentritice segregation and uneven transformations occurring within the block, the presence of oxide inclusions, structural stress, etc..

Sensitivity is higher occurrence flakes large ingots, the semi-May 150 x 150 mm high and alloy steel in the following descending order: Cr - Ni - Mo, Ni - M n Cr - Mn. Directed cooling is slow or cyclical practice different arrangements ecemplu Figure 5.

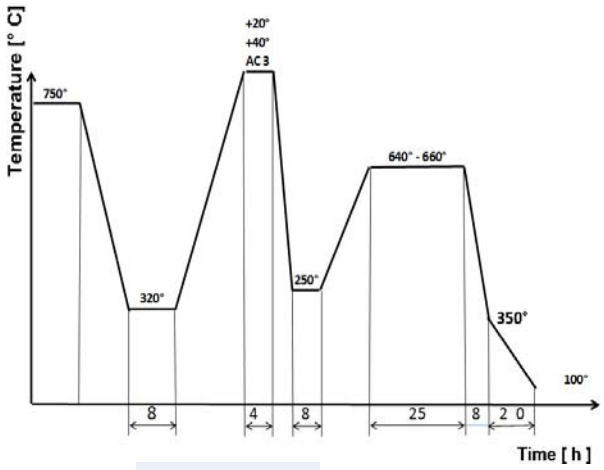


Figure 5. Chart regimen

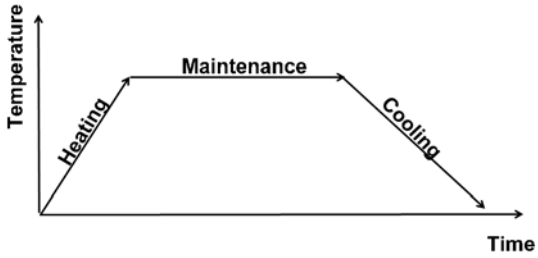


Figure 6. Thermal cycle.
for the prevention of heat lightning.

After cooling directed (to at least 150 ° C) blocks are subject to cleaning, burning, control layout and eliminate surface defects such as: printing oxide, overlap, surface cracks, etc., by cleaning the pneumatic hammer and chisel or grinding.

Next operation is the primary heat treatment. It seeks to eliminate residual stresses from forging, removal supraîcălzire trend, the size of grains resulting from forging neuniformității and preparing the structure for removing and final heat treatment.

Any heat treatment operation can be represented graphically by a diagram with temperature-time coordinates. This representation called the thermal cycle figure 6.

Heat treatments were obtained for technological and consist of normal structures (balance), a slow cooling of steel. This operation is called primary thermal annealing softening. Block matrix obtained by one of the technological structure presented is a rough and uneven, having a high proportion of perlite structure. Perlite cementite plates containing thin and very hard (HB 800), which are actually some abrasive particles acting on the cutting edge and cutting tools. Annealing is achieved by heating the steel at a temperature above the point of A_1 (figure 7), respectively from 750 to 780 ° C.

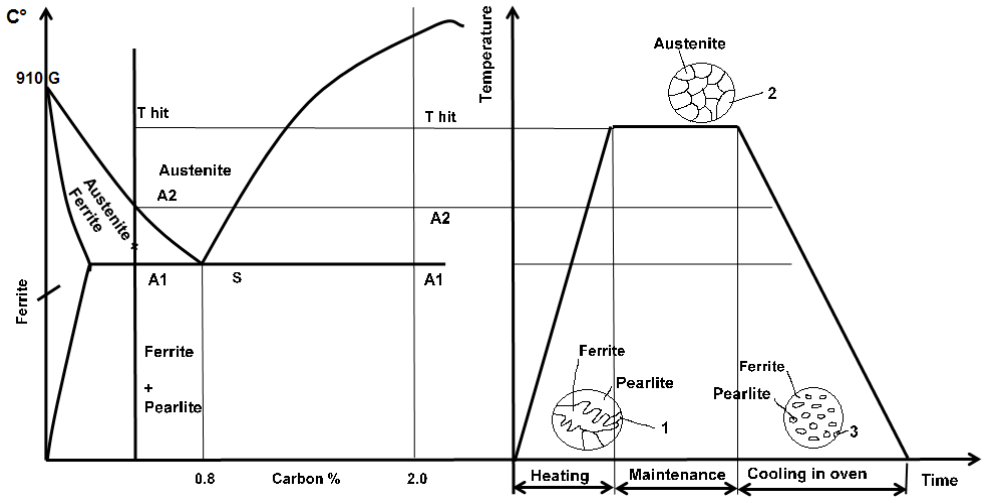


Figure.7 Linkage equilibrium diagram Fe - Fe3C and how to make a steel annealing regeneration hipoeutectoid: 1 - the original structure, 2 - austenitic structure, the heating; 3 - structure after cooling.

Processing blocks are cast in two distinct phases:

- External processing;
- Processing enclosure.

External processing blocks are cast in three distinct phases:

- Exterior surface treatment;
- Clamping surface treatment;
- Surface treatment guidance.

Processing enclosure is the most important phase, resulting in direct precision forgings and sustainability matrix. It is the operation with the highest costs of implementing the technological process, requiring a highly skilled professional staff. Enclosure of mold processing is an operation can be performed with low productivity and requires further finishing operations are usually executed through manual processes.

Processing enclosure is advisable to negative tolerances field that will be part matrix, leading to a first maximum durability to repair the mold operation. Enforcement of the enclosure are made by various processes, including the most common enumărându is following;

Car-processing on normal unelete, working on the copy machine defrezat, working on machining centers, electrical erosion processing, special processing procedures.

The design and implementation of training necessary to achieve manufacturing equipment array were considered the main factors determining the overall level of technological equipment, given the complexity of the product which is made by them and the technical conditions imposed by documentation constmctivă .

Series production (production schedule) array of technological equipment is small, mold needs can be established rationally on technical-economic indicators, according to the weight of parts to be forged.

Structure design - shape, geometry, and the technical quality of equipment by sea technology department are equipped with specific equipment for hot plastic deformation.

Production capacity - have been set for production lines:

- primary processing machinery equipped with molds blocks specific processing by forging (cicane mold presses) and specific equipment tratamententelor thermal
- machining of mold blocks equipped with cutting machines, lathes, milling machines, machining centers, electrical erosion processing machines.

Accuracy and precision of geometric form part microgeometriei processing accuracy are determined.

Research on increasing the sustainability of technological equipment array showed that the design and enforcement is necessary to take into account several factors namely:

- mold design and processing technology of its construction elements to do so during its use does not appear to internal tensions or deformed after quenching operation;
- selection and preparation of materials depending on the degree of application! matrix and the number of pieces to be performed;
- use materials with higher durability in the form of pills mounted active matrix board;
- mold assembly so that the die attachment tenon to be placed

in the center of gravity of the workpiece;
- exact ram car race, according to gauge the mold.

Construction factors are determined by technological factors.

Technological factors affecting the reliability of technological equipment array can be listed:

- Processing technology of active elements of the mold;
- Active control technology of mold elements;
- Assembly and fastening technology dies.

Analysis of opportunities in the manufacturing process to assess what may cause processing machinery and devices, the performance in terms of accuracy can reach them. These statements are intended to determine which is the accuracy of processing time which is constant and can control the technology. The aim of the study precision processing equipment array technology by introducing statistical control is to establish the relationship between specifications and tolerances required by the possibilities of achieving process while these requirements. As is known, the variation in quality characteristics in a production process influences the result of production causes random and systematic.

Quality of the product variation can be attributed to action following groups of factors:

- raw materials;
- work equipment (tools, devices work, instruments, etc.)
- employment;
- environment.

Cases that can be removed after removing systematic influences are particularly numerous, difficult to identify individual and measured, they act in all respects, subjecting them driving directions chance. These causes are called random. Random vibration explanations of process is that any machinery consists of a large number of subassemblies, components, each showing the manufacturing tolerances, deviations from manufacturing specifications, installation, assembly deviations, different applications operation.

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NUMERICAL DETERMINATION OF ELASTIC PROPRIETIES OF A FABRIC COMPOSITE

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Abstract: ***Geometrical models needed for finite element discretization of plain-weave fabric-reinforced composites are developed from measurements taken on photomicrographs of single lamina and laminated composites. The stiffness and strength depend upon the fabric architecture and material properties of fiber and matrix. Then, a numerical model is needed for further implementations into FEM software as a user-defined material model for predicting the non-linear behavior of plain-weave reinforced laminates under tensile loading.***

Key words: *laminate, finite element method*

1. INTRODUCTION

Unidirectional laminated composites are used where the in-plane properties are important. However, the laminated composites have poor inter-laminar properties, as there are no reinforcements in the thickness direction. As a result, the stiffness and strength in the thickness direction are greatly reduced. This leads to poor damage tolerance and impact resistance when out-of-plane stresses are present. Also, the handling and fabrication cost of such composites are high. To overcome these problems, woven fabrics are used as reinforcements in composites in order to obtain balanced ply properties and improved inter-laminar properties. Also, their ability to drape and conform to irregularly shaped structures makes woven fabrics easier to handle. Other advantages of such fabrics are low fabrication cost, handling cost, and improved de-lamination resistance. But these advantages are at the cost of reduced stiffness and strength in the in-plane direction. Thus, it is important to study the mechanical behavior of such composites in order to fully realize the potential of woven fabric composites [5]. The stiffness and strength depends upon the fabric architecture and material properties of fiber and matrix [4]. The fabric architecture depends upon the undulation of the yarns, yarn crimps, density of the yarns, etc. A yarn is a twisted strand of fibers. The undulation or waviness of the yarns causes crimps (bending) in the yarns, which significantly reduces the mechanical properties of the composite [2]. The geometry of the woven composites is complex and the choice of possible architectures is unlimited [4]. The present article concentrates on the modeling the in-elastic behavior of simplest of the woven fabrics - plain weave fabrics, using finite element methods.

2. THE GEOMETRICAL MODEL

The geometrical model for the representative volume element (RVE) and the yarns for plain weave fabrics were developed using the geometrical parameters measured by CERL [1]. The RVE consists of four intertwined yarns surrounded by the matrix (isotropic). There are two warp yarns in the longitudinal direction and two fill yarns in the transverse direction. Each yarn is a unidirectional composite in the material coordinate system with orthotropic properties. 2-D and 3-D views of the fabric are shown in Figure 1.

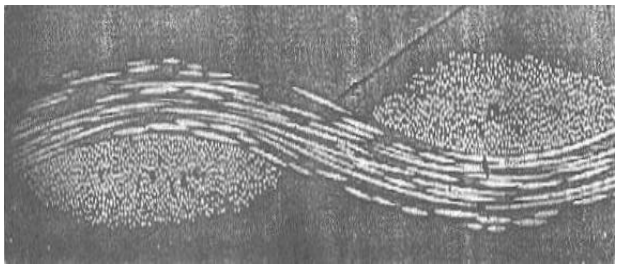


Figure 1: 2D picture of the plain weave fabric from CERL. (the data is from [1])

The 2-D geometrical model describing the internal geometry of the RVE of a single lamina is developed from the measured values of the yarn parameters. The measured values are given in Appendix A. The parameters describing the geometry are shown in Figure 2.

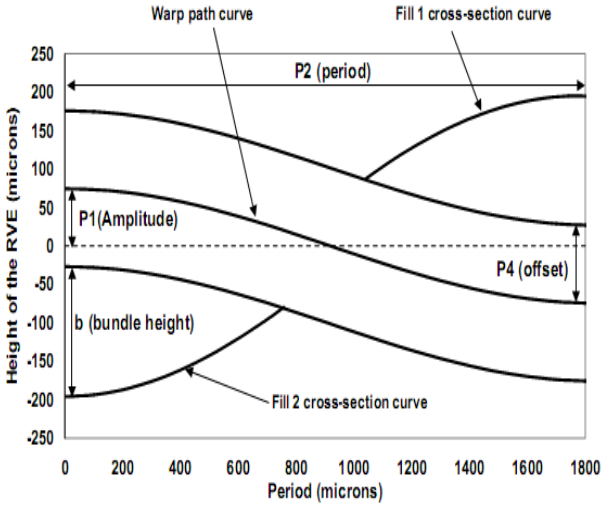


Figure 2: Yarn parameters measured by CERL. (the data is from [1])

The boundaries of the yarns on the faces of the RVE are measured in longitudinal and transverse directions since the shape and size of the yarns are different in these two directions. The above equations are plotted using MathCAD to verify whether the curves from the longitudinal and transverse directions match (do not overlap nor gap exists). The plot spans the thickness and the period of the RVE. The curves in the longitudinal direction did not match with the curves in the transverse direction, as shown in Figure 3. This is due to error in the measurement of amplitude of the fill yarn curve in the transverse direction. Hence, the amplitude of the curve (P1) is adjusted in the transverse direction so that the curves in the two directions match as in Figure 3.

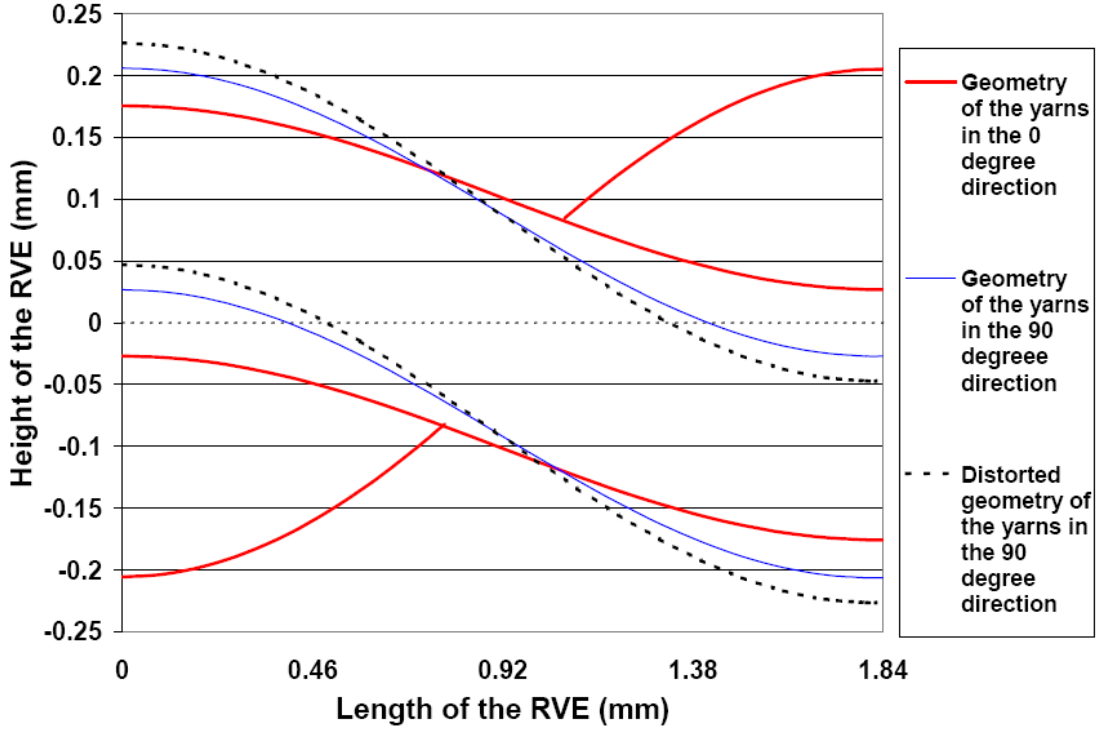


Figure 3: Adjustment of the yarn parameters

The measured parameters for developing the mathematical model of the RVE are those measured by CERL [1]. The geometrical model was developed using this set of equations

$$y = P1\sin(P2 \cdot x + P3) + P4 \quad (1)$$

$$P4 = \frac{b}{2} \quad (2)$$

$$a = \frac{\pi}{P2} \quad (3)$$

$$h = 2b \quad (4)$$

3. Finite Element Models

The closed form solutions provide simplified stress-strain distributions whereas numerical models provide detailed stress-strain distributions. The geometrical description of the unit cell architecture with the yarns and matrix is the most important aspect in finite element analysis. Mathematical models have been developed describing the geometry of a unit cell. Averill et. al. [3] developed a simplified analytical/numerical model for predicting the elastic properties of plain weave fabrics. The unit cell of the fabric is discretized with solid elements (Figure 4), with one element through the thickness of the cell. The tow volume fraction and tow inclination are calculated based on the assumed unit cell geometry. The stiffness properties of each element are calculated from the fiber volume fraction, orientation of fibers, and fiber and matrix properties using effective moduli theory. These properties are given as input to the finite element model and the overall properties of the unit cell are obtained by applying necessary boundary conditions. The model is simple in the sense that 3-D modeling of tows is not required. Therefore, a fewer number of elements are required for the model and hence the computational time is small. The model yields good results for the stiffness values except for inter-laminar shear modulus G_{13}.

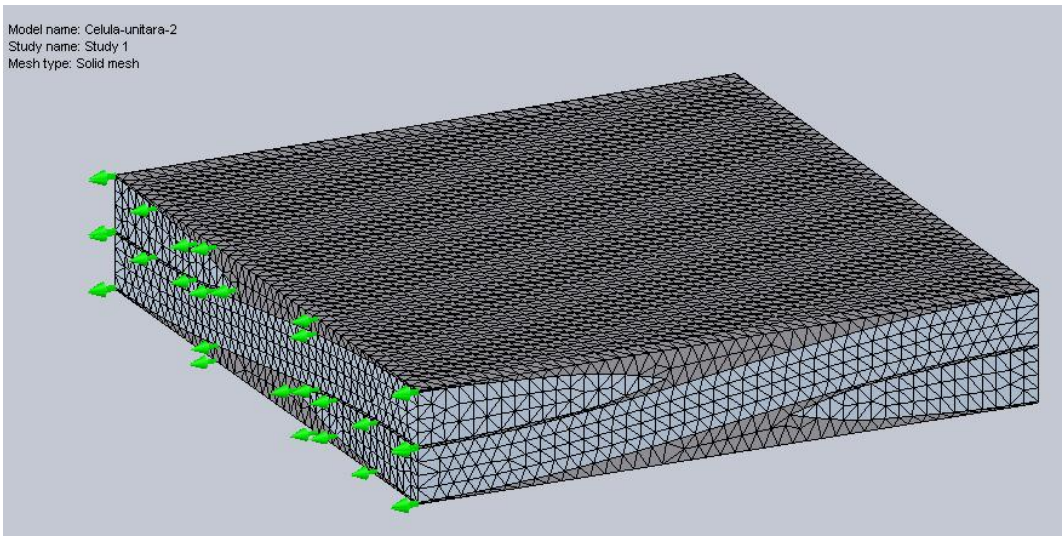


Figure 4: Meshing the REV (the final model around 200,000 elements)

Several analyses were made to establish the minimum number of elements for an acceptable variation of results, refining the mesh for 7 models (30,000; 50,000; 60,000; 100,000; 150,000; 200,000 and 250,000) and the final model was chosen that with 206,017 elements (Figure 5).

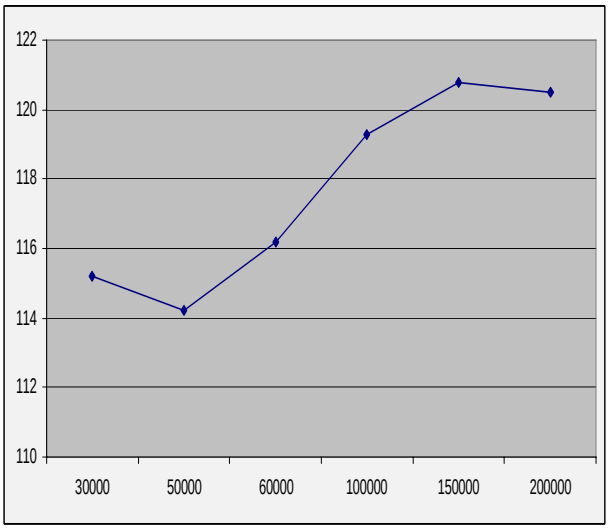
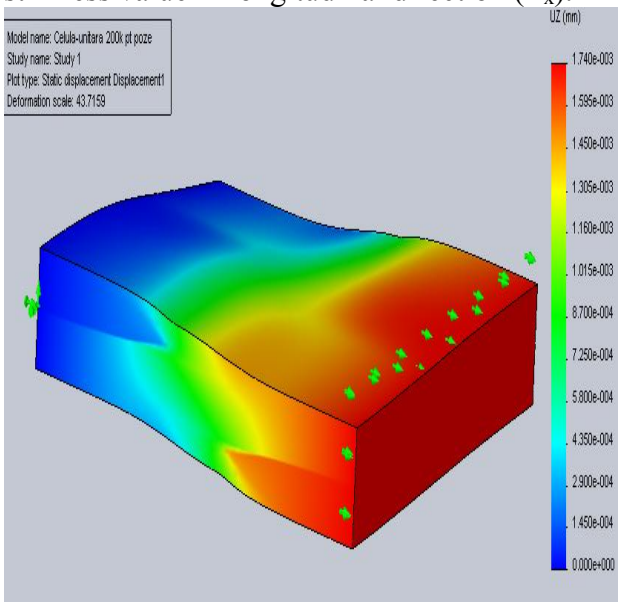


Figure 5: Maximum stress versus number of elements

In case of all laminated configurations, the RVE represents the quarter of a full model of the laminated plain weave fabrics. So, symmetric boundary conditions are assigned to the nodes in the back surfaces in the warp direction (*xz* plane) and to the nodes in the right surfaces in the fill direction of the RVE (*yz* plane, Figure 6). Then, nodes in the left surfaces are coupled to move along a straight line the *x* direction to enforce periodicity compatibility conditions. This simulates the full model. Then, a 0.1 percent strain ($\varepsilon = 0.1\%$) is assigned to the nodes in the *z* direction at the front surfaces in the fill direction as illustrated in Figure 6. The conditions are given in order to predict the stiffness value in longitudinal direction (E_x).



ure 6: The constant displacement on free *xz* face

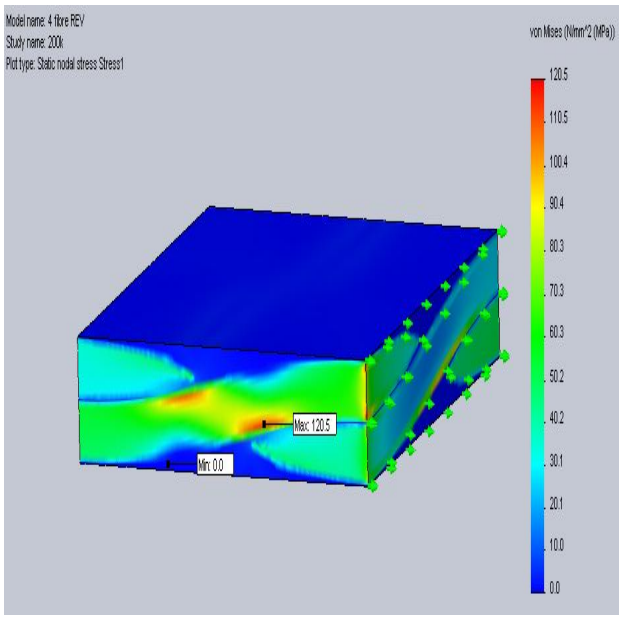


Figure 7: Static analysis of the REV

During the post processing stage, the results of the reaction forces in the *z* direction are obtained. For calculating the value of stiffness (E_x), the sum of the reaction forces (F_z) in the *z* direction, in the loading surface of the RVE, was obtained. Taking F_z and dividing it by the cross-section area of the RVE, the average stress acting on the surface is calculated (σ_z). Finally, E_x was obtained by dividing σ_z with the strain (ε). The results are summarized below:

Model	
Number of elements	206,017
Number of nods	291992
Maximum equivalent stress	120.5 N/mm^2
Strain	0,001017544
Elastic tensile modulus	24522,98 N/mm^2

4. CONCLUSIONS

The FE model of the laminated plain weave composite is developed and analyzed using CosmosWorks software. An adaptation of geometrical model was made for further other configurations. The laminate is subjected to uniaxial tensile load. The stiffness of the CERL model is predicted using Finite Element Analysis.

The model is simple in formulation and the computation time required for the analysis is acceptable. The model gives a good strength prediction for plain weave laminates subjected to tension. Also, a similar analysis could be made for the transversal elastic modulus.

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SOME ASPECTS OF MICROCRACKS ANALYSIS FOR LAMINATED COMPOSITES

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Abstract: *Matrix microcracking is a very common damage mode in composite laminates. Because microcracks cause degradation in properties and act as precursors to other forms of damage leading to laminate failure, it is important for anyone designing with composites to have a basic understanding of microcracking processes. This article has summarized the experimental observations about microcracking and offered a fracture mechanics or energy analysis method as a tool for understanding and predicting microcracking under a variety of conditions.*

Key words: *microcracks, fracture mechanics, laminated composites*

1. INTRODUCTION

Microcracks can be observed during tensile loading, during fatigue loading, during changes in temperature, and during thermocycling. Microcracks can form in any plies, but they form predominantly in plies off-axis to loading directions. The immediate effect of microcracks is to cause degradation in the thermomechanical properties of the laminate including changes in all effective moduli, Poisson ratios, and thermal expansion coefficients. If a given design can not tolerate microcrack-induced degradation in properties, then the formation of microcracks constitutes failure of the design. A secondary effect of microcracks is that they nucleate other forms of damage. For example, microcracks can induce delaminations, cause fiber breaks, or provide pathways for entry of corrosive liquids. Such damage modes may subsequently lead to laminate failure.

2. EXPERIMENTAL OBSERVATIONS

The first form of damage in laminates is usually matrix microcracks [1], which are intralaminar or ply cracks that traverse the thickness of the ply and run parallel to the fibers in that ply. The most common observation of microcracking is cracking in 90° plies during axial loading in the 0° direction. These microcracks are transverse to the loading direction and thus sometimes called transverse cracks.

The first form of damage in laminates having 90° plies is often microcracking in those plies. The formation of the first crack is the initiation of microcracking. Garrett, Bailey, et al. [2-8] did a series of microcracking experiments, including observations of microcrack initiation on $[0/90]_s$ laminates made from glass-reinforced polyester [2,3] and from glass-reinforced epoxy [4-8]. By working with home-made $[0/90]_s$ laminates, they continuously varied the thickness of the 90° plies from less than 0.1 mm to 4.0 mm while keeping the thickness of the supporting 0°plies constant at 0.5 mm [4]. Their results, replotted in Figure 1, show that there is a significant effect of 90° ply thickness on the strain to microcrack initiation. As the thickness of the 90°plies decreases and becomes less than the 0.5 mm thickness of the 0° plies, the strain to microcrack initiation increases.

Besides the increase in strain to initiate microcracking, the thickness of the 90° plies affects the entire microcracking process. For 90° plies greater than 0.5 mm thick (or equal to or greater than the 0° ply thickness),

microcracks form as instantaneous fracture events. On the experimental time-scale, the microcrack initiates and propagates over the entire cross-sectional area of the 90° plies instantaneously. For thicknesses between 0.1 mm and 0.4 mm, individual microcracks can sometimes be observed to initiate on the free edges and propagate across the width of the laminate. For thicknesses less than 0.1 mm, the microcracks are suppressed entirely and the laminate fails before initiation of microcracking.

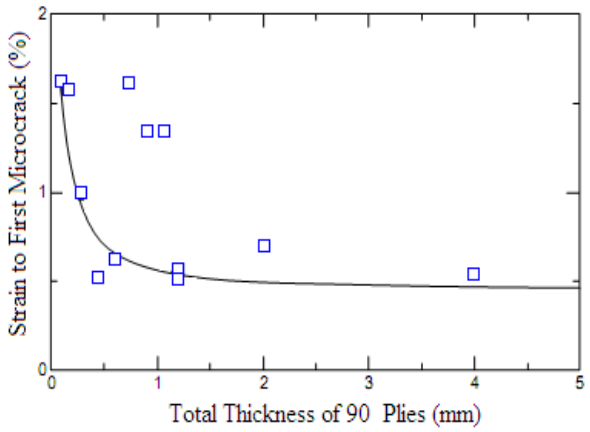

Figure 1: The strain to initiate microcracking in glass-reinforced $[0/90]_s$ laminates as a function of the total thickness of the 90° plies. (the data is from [2])

A common method for designing with composites to avoid failures is first-ply failure theory. In first-ply failure theory, it is assumed that the first ply cracks or fails when the strain in those plies reaches the strain to failure of those plies [9]. Furthermore, it is usually assumed that the ply failure strain can be determined from experiments on isolated unidirectional laminates. The results are not good if one tries to use first-ply failure theory to predict microcrack initiation. In laminated plate theory of $[0/90]_s$ laminates under tensile loading, the strains in the 0° and 90° plies, including residual strains due to thermal stresses, can be easily calculated and they are nearly independent of ply thicknesses. Thus, first-ply failure theory predicts that the strain to initiate microcracking will be independent of ply thickness; this prediction contradicts all experimental observation of microcrack initiation. Attempts to use more sophisticated ply-failure criteria [10] to account for multi-axial stresses when the plies are in a laminate are no help; all components of stress are nearly independent of ply thickness and thus all strength-based models predict microcrack initiation to be independent of ply thickness. No strength-based, first-ply failure model can be used to predict microcrack initiation unless the ply failure properties are treated as in situ properties that depend on laminate structure.

Modification of first-ply failure theory to use in situ properties severely limits it predictive capabilities. The energy methods discussed in this chapter can predict microcracking properties without resorting to the use of in situ failure properties.

It is interesting to consider a design case-study using laminated plate theory software with failure analysis by first-ply failure theory and a quadratic failure criterion [10] that attempts to account for multi-axial stress state effects. Imagine seeking to design a $[0/90]_s$ laminate with the goal of preventing all microcracks in the 90° plies. Although axial strain in the 90° plies is independent of thickness, the quadratic failure criterion predicts that the axial strain required to cause first-ply failure increases slightly as the 90° plies get thicker. The optimal design based on such a strength-based theory is thus to make the 90° plies as thick as possible. In contrast, the correct optimal design, based on experimental results (Figure 1), is to make the 90° plies as thin as possible.

3. MULTIPLE MICROCRACKING

The first microcrack causes very little change in the thermomechanical properties of the laminate. Continued loading, however, normally leads to additional microcracks and continued degradation in thermomechanical properties. A logical experiment to characterize the microcracking properties of laminates is to follow the microcracking process and record the number of cracks or microcrack density as a function of applied load. Such microcrack density experiments have been done on many different systems [1,2,4,6,7]. We focus on the analysis of Nairn [12] that studied the most number of different

laminates, 21 different layups, for a single material system, AS4/3501-6, carbon epoxy laminates. Other results as a function of laminate stacking sequence in the literature show the same trends [12].

Some multiple microcracking results for several different $[0/90]_s$ AS4/3501 carbon/epoxy laminates are given in Figure 2, where The symbols are experimental results. The lines are fits to the experiments using the fracture mechanics analysis of microcracking with $G_{mc} = 230 \pm 20 \quad J/m^2$ and assuming fixed-displacement boundary conditions. For all laminates, the characteristic microcracking curve has no microcracks until some onset stress that corresponds to the initiation of microcracking. After the initial microcrack, the microcrack density typically increases very rapidly. At high crack density, the microcracking slows down and approaches a saturation damage state. The initial rapid rise varies between different material types with some laminates having a slower increase in crack density or a more sigmoidal shape than other laminates. The rate of the initial rise has been associated with manufacturing defects or statistical inhomogeneities in the ply material [1,11,12].

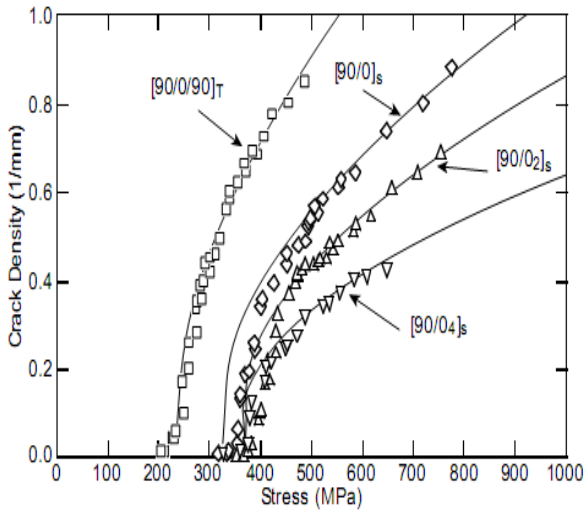

Figure 2: Microcrack density as a function of applied stress for three AS4/3501-6, $[0/90]_s$ laminates.

The three experiments in Figure 2 are for laminates with the same thickness of 0° plies but different thicknesses of 90° plies. The onset stress decreases as the thickness of the 90°plies increases. This effect is another observation of the microcracking initiation properties discussed above where microcracks form more easily in thicker 90° ply groups or microcracking is suppressed in thin 90° ply groups. On continued loading, however, the situation reverses | thinner 90° ply groups eventually develop more microcracks than thicker 90° ply groups. In other words, the saturation crack density is inversely related to the thickness of the 90°plies. Some analogous microcracking experiments on very thin, 50-100 nm, SiO_x coatings on polymeric substrates yields final crack densities of 200 cracks/mm suggesting that an inverse relation between layer thickness and saturation crack density is general for microcracking phenomena [13,14]. Finally, the smooth lines in Figure 2 are fits to the experiments using a fracture mechanics analysis of microcracking that is discussed below.

Microcracking in off-axis plies is a common damage mechanism for composite laminates. It is thus important to develop analysis methods for predicting microcracks and for designing with laminates that might have microcracks. These analysis methods have two separate goals. The first goal is to consider a laminate with a given amount of microcracking and predict the effective thermomechanical properties of that laminate. The second goal, the more difficult goal, is to predict the conditions for which the microcracks form in the first place.

4. ENERGY RELEASE RATE

The key problem to analyze for a finite fracture mechanics model of microcracking in the 90° plies of $[(S)/90]_s$ laminates, where (S) is any set of supporting plies, is illustrated in Figure 3. Figure 3A shows a unit cell of damage as the zone between two existing microcracks; Figure 3B shows the same unit cell but with a new microcrack formed at the location of highest stress which is midway between the previous existing microcracks. The key problem is to calculate the total energy released per unit crack area due to the

formation of the new microcrack in the unit cell of damage. That energy release rate is denoted here as G_m. In conventional fracture mechanics with infinitesimal amounts of crack growth, the energy release rate is independent of the loading method. In finite fracture mechanics with a finite amount of new crack area, however, G_m depends on loading method and thus the analysis must use loading conditions that match the experimental loading conditions.

Recent work on fracture analysis of composites has derived exact results that are helpful in calculating energy release rates for composite fracture events [16]. One effective tool is to partition the stresses into the initial stresses existing before the fracture event and the perturbation stresses, or the change in stresses caused by the fracture event. Using the stress partitioning methods [16], the microcracking energy release rate under constant strain (displacement control) can be written exactly as

$$G_m = \frac{1}{2}\sigma^0_{xx,1}\left[2\left\langle\delta(\rho/2)\right\rangle - \left\langle\delta(\rho)\right\rangle\right] \qquad (1)$$

where $\sigma^0_{xx,1}$ is the initial stress in the 90° plies at the location of the microcrack before any microcracks form and $\left\langle\delta(\rho)\right\rangle$ is the average crack opening displacement for a microcrack in a unit cell of damage of aspect ratio $\rho = a/t_1$ (see Figure 3). From the potential energy results in Ref. [16], it is possible to express the effective axial modulus for a unit cell of aspect ratio ρ, $E_A(\rho)$ in terms of the average crack opening displacement in that cell as

$$E_A(\rho) = E_{A0} - \frac{E^2_{xx,1}\left\langle\delta(\rho)\right\rangle}{\sigma^0_{xx,1}\rho B} \qquad (2)$$

where E_{A0} is the effective axial modulus in the absence of microcracks, $E^2_{xx,1}$ is the x-direction modulus of the 90° plies, $B = 2h$ is the thickness of the laminate. By substituting **Error! Reference source not found.** into **Error! Reference source not found.**) the energy release rate for microcracking under displacement control can be written as

$$G_m = -\frac{1}{2}\rho B\left(\frac{\sigma^0_{xx,1}}{E_{xx,1}}\right)^2\left[E_A(\rho/2) - E_A(\rho)\right] \quad (3)$$

(displacement control)

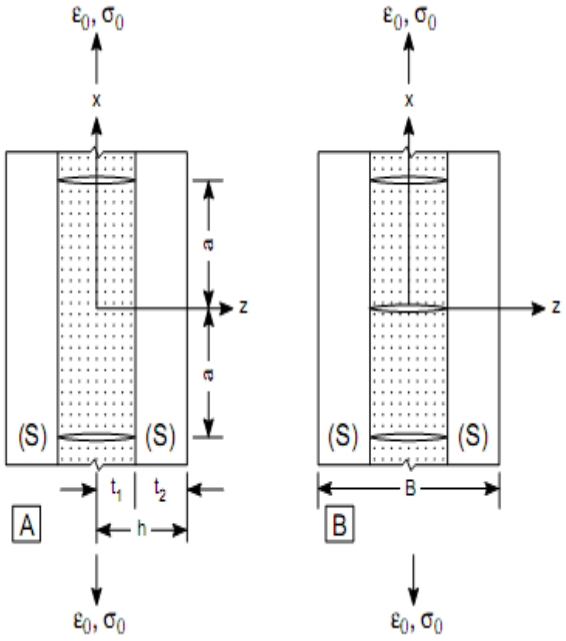

Figure 3: A unit cell of damage for microcracking in $[(S)=90_n]_s$ laminates.
A. Two existing microcracks spaced by a distance 2a.
B. The same laminate after formation of a new microcrack midway between the existing microcracks.

A similar type of analysis but for load control conditions was derived by Nairn [17]; the result is

$$G_m = -\frac{1}{2}\rho B E^2_{A0}\left(\frac{\sigma^0_{xx,1}}{E_{xx,1}}\right)^2\left[\frac{1}{E_A(\rho/2)} - \frac{1}{E_A(\rho)}\right]$$

(load control) (4)

Clearly effective modulus, $E_A(\rho)$, is a material property that does not depend on loading conditions. The energy release rate, G_m, is a function of $E_A(\rho)$, but that function depends on loading conditions and thus G_m depends on loading conditions.

By using Equations **Error! Reference source not found.**), **Error! Reference source not found.**) and **Error! Reference source not found.**), the energy release for displacement control and for load control can each be

expressed exactly either in terms of average crack opening displacement or in terms of the effective axial modulus of a laminate with periodic microcracks. Thus, once crack opening displacement or effective properties of a microcracked laminate are known, the energy release rate for microcracking can be calculated. It is important to note that G_m for displacement control is not equal to G_m for load control. The difference is a consequence of microcracking involving a finite amount of fracture growth in contrast to conventional fracture mechanics which analyzes an infinitesimal amount of crack growth. The boundary condition effect is illustrated in Figure 4 which plots loading and unloading load-displacement curves for a finite amount of fracture growth. The area of the ABC triangle is the total energy released by crack growth under load control. The shaded area of the ABD triangle is the total energy released by crack growth under displacement control [18].

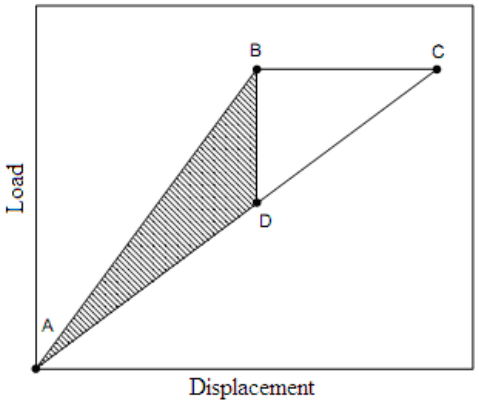

Figure 4: Load-displacement curve for a finite increase in crack area

For fixed-load boundary conditions, the total energy released is equal to the area of the ABC triangle; for fixed-displacement boundary conditions, the total energy released is lower and equal to the shaded area of the ABD triangle. Clearly, the energy released for fixed-displacement conditions is different and less than the energy released for fixed-load conditions. In the limit of infinitesimal fracture area, the areas become equal to each other or the energy release rate for conventional fracture mechanics is independent of loading conditions. When analyzing real experiments with finite fracture area, however, it is important to use the correct result for the specific experimental conditions. Similarly, the displacement and load control results for microcracking are the same in the limit of zero microcrack density. When analyzing any microcracking experiment, except initiation of the first microcrack, however, it is important to use the correct energy release rate equation. Most static microcracking tests are done under displacement control while most fatigue tests are done under load control. Thus G_m in **Error! Reference source not found.** should be used for analysis of static tests while G_m in **Error! Reference source not found.** should be used for analysis of fatigue tests. Some consequences of using the wrong G_m will be discussed below.

The energy release rate results in **Error! Reference source not found.** and **Error! Reference source not found.** are exact results for a two-dimensional plane stress analysis of the cracked laminate assuming an exact result for $E_A(\rho)$ is known. These results can be converted to an exact two-dimensional plane strain analysis by replacing ply properties with reduced ply properties. These two-dimensional results, however, ignore possible three dimensional effects caused by differential Poisson contraction between the 90° plies and the supporting plies in the z direction. It is possible to extend the above two-dimensional methods to account for three-dimensional effects. The resulting energy release rates then depends on effective axial modulus $(E_A(\rho))$, effective transverse modulus $(E_T(\rho))$, and effective in-plane Poisson's ratio $(\nu_{xz}(\rho))$ of the microcracked laminate instead of just on the effective axial modulus [19, 20, 21]. The additional terms involving $E_T(\rho)$ and $\nu_{xz}(\rho)$ correct for differential Poisson's effects and are generally small.

The finite fracture mechanics analysis for laminates with 90° plies on the surface ($[90_n/(S)]_s$ laminates), needs to account for the development of staggered microcracks in the two 90° ply groups. The key problem to

analyze for microcracking in $[90_n/(S)]_s$ laminates is illustrated in Figure 5. Figure 5A shows a unit cell of damage with staggered microcracks. It is not possible to add a single new microcrack to the unit cell while still representing the damage laminate with unit cells of damage. Instead, microcracking of $[90_n/(S)]_s$ laminates can be analyzed by considering the new state in Figure 5B where enough new microcracks are formed to generate three unit cells of damage from the initial single unit cell of damage. By the methods used to analyze $[(S)/90_n]_s$ laminates, the energy release rate for the discrete fracture process illustrated in Figure 5 using a two-dimensional analysis under displacement control can be written exactly as

$$G_m = -\frac{1}{4}\rho B\left(\frac{\sigma^0_{xx,1}}{E_{xx,1}}\right)^2\left[E_A(3) - E_A(\rho)\right] \qquad (5)$$

(displacement control)

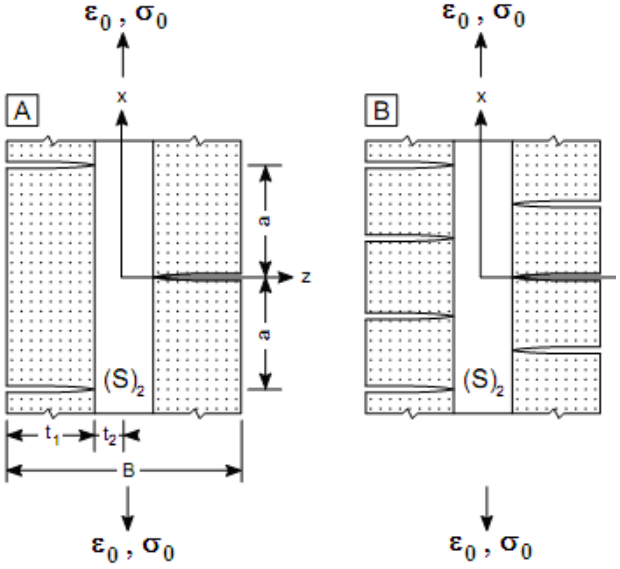

Figure 5: A unit cell of damage for microcracking in $[90n=(S)]_s$ laminates

A. Two staggered microcracks spaced by a distance 2a on each side of the laminate
B. The same laminate after formation of a four new microcracks convert the single unit cell of damage into three unit cells of damage.

For load-control conditions, the result is

$$G_m = -\frac{1}{4}\rho B E^2_{A0}\left(\frac{\sigma^0_{xx,1}}{E_{xx,1}}\right)^2\left[\frac{1}{E_A(\rho/3)} - \frac{1}{E_A(\rho)}\right] \qquad (6)$$

(load control)

Thus, the energy release for formation of microcracks in $[90_n/(S)]_s$ laminates is different than in $[(S)/90_n]_s$ laminates. The form of the G_m equations are different and the analysis method for finding $E_A(\rho)$ should account for the presence of staggered microcracks in $[90_n/(S)]_s$ laminates. In other words, $E_A(\rho)$ for $[90_n/(S)]_s$ laminates will be different than $E_A(\rho)$ for $[(S)/90_n]_s$ laminates. The experimental observation is that the microcracking properties of $[90_n/(S)]_s$ and $[(S)/90_n]_s$ laminates are different; finite fracture mechanics can potentially explain those differences. The G_m results for $[90_n/(S)]_s$ laminates could alternatively be expressed in terms of average crack opening displacement instead of in terms of effective axial modulus. Finally, these two-dimensional results could be extended to include three dimensional effects. Like the analysis of $[(S)/90_n]_s$, however, the three-dimensional Poisson effects on G_m are small.

Experimental observations show that the microcracking process is influenced by the presence of residual stresses. All residual stress effects are included in the above analyses through the $\sigma^0_{xx,1}$ term or the initial stress in the 90° plies. This initial stress is the total initial stress or the sum of mechanically applied stresses and residual stresses in the 90° plies of the undamaged laminate. All G_m expressions can be written in terms of the effective axial modulus $E_A(\rho)$. For linear thermoelastic materials, $E_A(\rho)$ is independent of the level of residual stresses and thus can be found by stress analysis methods that ignore residual stresses. Once the results are substituted into the G_m expressions along with $\sigma^0_{xx,1}$, however, the resulting G_m gives the total energy release rate or the energy release rate due to both mechanical and residual stresses.

There are other generalized analyses of microcracking that can be shown to be equivalent to the above discussion but are in a

different form. For example, McCartney [19,20] considered triaxial loading and was able to express many results in terms of a "damage" parameter $\phi(\omega)$ defined by

$$\phi(\omega) = \frac{1}{E_A(\omega)} - \frac{1}{E_{A0}} \qquad (7)$$

where ω expresses the state of damage. McCartney's analysis considered load-control experiments only; clearly the load-control G_m result in **Error! Reference source not found.** could likewise be expressed in terms of $\phi(\omega)$. McCartney's analysis does not include analysis of cracking in surface plies ($[90_n/(S)]_s$ laminates), but it does extend the above results for triaxial stress states and for Poisson effects. Varna [22] has chosen to express modulus and energy release rate in terms of average crack opening displacement. Because of relations like equations **Error! Reference source not found.** and **Error! Reference source not found.** most important results for analysis of microcracking can be reduced to the problem of finding either the average crack opening displacement or the effective axial modulus each as a function of microcracking spacing. Results in terms of either average crack opening displacement or effective modulus are exact and equivalent.

The energy release rate equations for G_m in the previous section and the principles of finite fracture mechanics can be used to predict the formation of microcracks for a wide variety of laminates with 90° plies and for experiments under differing loading conditions. For both $[(S)/90_n]_s$ and $[90_n/(S)]_s$ laminates and for both displacement-control and load-control experiments, the energy release for the formation of the next microcrack can be written generically as

$$G_m = \left(\sigma^0_{xx,1}\right)^2 G_{unit}(\rho) \qquad (8)$$

where $G_{unit}(\rho)$ is the energy release rate for formation of new microcracks in a unit cell of damage of aspect ratio ρ when there is unit stress in the 90° plies in the absence of microcracking. $G_{unit}(\rho)$ will change depending on laminate type and loading conditions, but the generic form of G_m will remain the same. For linear thermoelastic materials, the initial stress in the 90° plies can be written as

$$\sigma^0_{xx,1} = k_{m,1}\sigma_0 + k_{th,1}\Delta T \qquad (9)$$

where σ_0 is the total applied axial stress and $\Delta T = T_s - T_0$ is the difference between the specimen temperature, T_s, and the stress-free temperature, T_0, and $k_{m,1}$ and $k_{th,1}$ are mechanical and thermal stiffnesses for the 90° plies. These stiffnesses will depend on laminate structure and ply properties and they can easily be calculated from laminated plate theory [1]. To predict microcracking using finite fracture mechanics, we equate G_m to G_{mc}, or the microcracking fracture toughness, and solve the resulting equation for applied stress; the result is:

$$\sigma_0 = \frac{1}{k_{m,1}}\sqrt{\frac{G_m}{G_{unit}(\rho)}} - \frac{k_{th,1}}{k_{m,1}}\Delta T \qquad (10)$$

For any laminate geometry and loading conditions, equation **Error! Reference source not found.** gives the stress as a function of crack density, $D = 1/(2t_1\rho)$. Inverting this result gives a prediction for crack density as a function of applied load that can be compared to experiments. McCartney [19, 20] derived a result that is equivalent to equation **Error! Reference source not found.** for axial loading, but additionally extends it for microcracking during triaxial loading. Some typical results for comparison of equation **Error! Reference source not found.** to experimental results are given in Figure 2 and Figure 3.

The $G_{unit}(\rho)$ required for the predictions used $E_A(\rho)$ calculated using two-dimensional variational mechanics [1,12,15]. Previous finite fracture mechanics models for microcracking were for load-control boundary conditions [1, 12]. The new predictions in Figure 2 and Figure 3 calculated $G_{unit}(\rho)$ for the experimental loading conditions which were displacement control [12]. The comparison between experiments and theory

shows that finite fracture mechanics does a good job of simultaneously predicting the microcracking properties for all laminates. All experimental results can be fit with a single value of $G_{mc} = 230 \pm 20 \quad J/m^2$ .Thus G_{mc} is a useful material property characterizing a particular composite material's resistance to microcracking.

5. CONCLUSIONS

There are two common discrepancies between experiments and finite fracture mechanics predictions. First, the experimental crack density often rises slower than the predicted crack density. These low-crack density deviations have been attributed to flaws or by structural imperfections such as unfavorable fiber distributions. By either mechanism, the 90° plies can be treated as having regions of lower toughness and regions of higher toughness. The lower toughness regions can be caused by unfavorable fiber distributions. The first few microcracks form at regions of low toughness and thus deviate from the theory which assumes a single-value for G_{mc}. At higher crack density, the weak regions get used up and later predictions agree better with experimental results.

The second common deviation is that experimental results often yield higher crack density at high stress than predicted those predicted. This type of deviation can be explained by distributions in microcrack spacing. When the microcrack spacings are not periodic, the new microcracks will tend to form in regions with wider crack spacing because such cracks release more energy than cracks in regions with shorter crack spacings. There are two effects of this tendency for microcracks to form in regions with crack density lower than the average crack density. First, it naturally drives the microcracking process to give a roughly periodic array of microcracks. Second, it causes laminates to develop more microcracks than predicted by theory.

The energy analysis can correlate most experimental results. In static tests, a given material can be characterized by a microcracking fracture toughness, G_{mc}. Once G_{mc} is known, the microcracking properties of any laminate constructed from that material can be predicted. An energy analysis with a single-valued G_{mc} misses a few second-order effects in experimental results. More refined analyses accounting for such things as statistical variations in G_{mc} and imperfect interface effects between the cracking plies and the supporting plies can be developed to explain the missed second-order effects. In other words, existing energy models capture perhaps 90% of experimental observations. If necessary, refined models can capture the remaining 10% of experimental observations.

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ENERGETIC POTENTIAL OF BIOFUELS USED IN SMALL COGENERATION POWER PLANTS

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Abstract: *The major problem of the existing Power Plants is emissions causing harmful conservancy upon the environment and human health. Actual limits imposed by the European Union represent a great "danger" for the existing power plants. At this moment for several states in the EU this plants represents the major energy resource that the states relay on, and it is not expandable. The paper presents a comparison study from the environmental impact and economical point of view of pilot plant working in cogeneration, with reciprocating diesel combustion engine, using blended fuels. In the beginning, the reference values were established, by using as primary fuel in the pilot plant pure diesel. Then the primary fuel it was replaced with a concentration by volume parts of 2, 5, 7, 10 % biobutanol in diesel. The pollutant emissions levels for the species CO, and CO_2 can be kept in normal limits, without being significantly affected by the mixture with biobutanol. The emission level for the NO_x species is slightly affected by the mixture of biobutanol in diesel. The study was made on pilot plant mounted in the multifunctional Laboratory of Renewable Energy Resources at the University "POLITECHNICA", from Timişoara.*

Key words: *power plant, environmental impact, emissions, biobutanol*

1. INTRODUCTION

The paper introduces to a technology that is not novel but should much more applied in order to demonstrate the advantages and disadvantages, from different points of view (environmental, economical, technical) of using blended fuels (fossil diesel with biobutanol, in different mixtures) and at different loads. The pilot plant is working in cogeneration, thus assuring the optimum energy flow [1].

2. RESULTS AND DISSCUSIONS

One will focus on the NO_x emission and CO_2 reduction potential, as well on the efficiency variation, by blending into diesel the butanol, in different values, by volume (up to 10 %) [2].

Cogeneration is a well known technology to perform efficiency improvement, in addition to pollutant diminution (but not always) in the exhaust gases. In the multifunctional Lab for renewable energy resources tests performed on a cogeneration plant using a small four stroke diesel engine, with one cylinder. The first step of the study was measuring the parameters of the cogeneration plant, in three load steps (2, 4, 5.5 kW), using pure diesel. The results obtained, ware considered as reference values that are use later on to show the differences, when the fossil fuel is replaced with blends [3].

In fig. 1, is presented the calculation for the total efficiency, of the cogeneration plant, when it was used as primary fuel pure diesel.

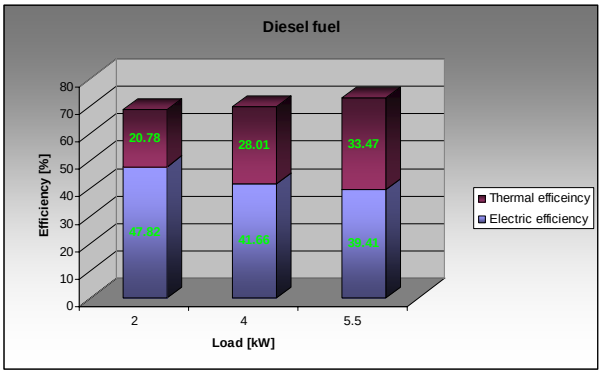

Fig.1 Efficiency – thermal and electrical - of the cogeneration plant, using diesel as primary fuel [4]

The efficiency calculation of the cogeneration plant for the fuel with a concentration of 2, 5, 7 and 10 % by volume biobutanol in diesel, has been accomplished using the same principle as for the reference fuel - diesel. These data are the reference values for the comparisons. The results are presented in fig. 2-5.

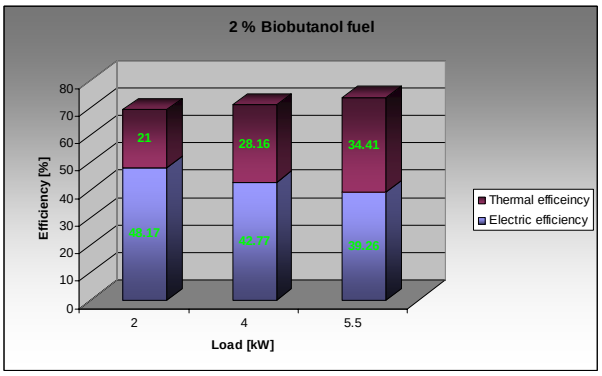

Fig. 2 Efficiency of the cogeneration plant when 2 % biobutanol by volume parts is inserted in diesel fuel [4]

Fig. 2 indicates the calculation results for the cogeneration plant efficiency for the concentration of 2 % biobutanol in diesel. Also the figure shows the percentage for the electrical and thermal power from the total efficiency of the cogeneration plant. As compared to the efficiency of the cogeneration plant, obtained by using diesel as a fossil fuel, in average it has increased with 1 percent at each loading step

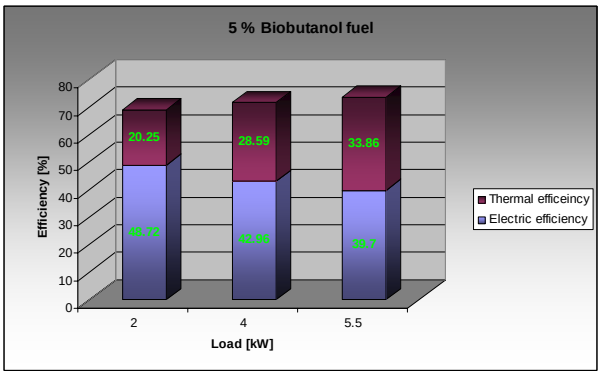

Fig. 3 Efficiency of the cogeneration plant when 5 % biobutanol by volume parts is inserted in diesel fuel [4]

For the concentration of 5 % (figure 3) by volume biobutanol in mixture with diesel, one has recorded higher values of the cogeneration plant efficiency for the loading steps of 2 kW, 4 kW and 5.5 kW, than in the case of using only diesel. In average these do not exceed values of 1 % but there is still a difference. 5 % by volume of the fossil fuel has been replaced by alternative fuel and it has been obtained an efficiency increase. This growth has been observed already since the moment of starting with the preliminary parameters measurements.

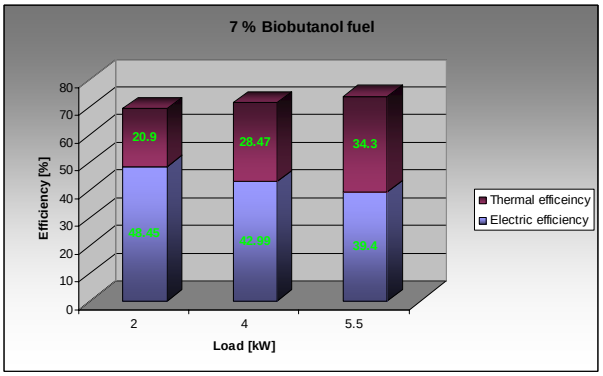

Fig. 4 Efficiency of the cogeneration plant when 7 % biobutanol by volume parts is inserted in diesel fuel [4]

Also for the concentration of 7 % by volume of biobutanol in diesel it has been registered an increase of the cogeneration plant efficiency. Figure 4, presents the values of thermal and electrical efficiency for each

loading step. This increase was due to the improvement of heat transfer from the exhaust gases to water, through the heat exchanger, but also through a slight change of fuel consumption, obtaining a better electrical efficiency.

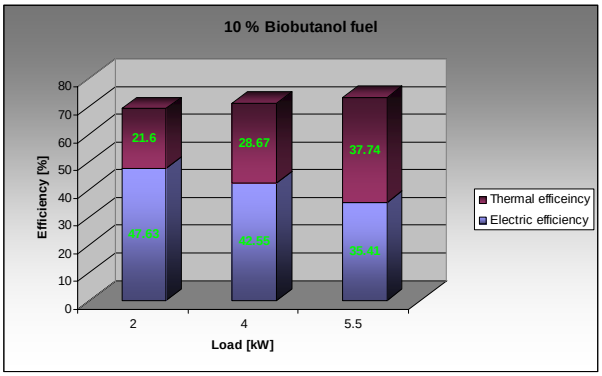

Fig. 5 Efficiency of the cogeneration plant when 10 % biobutanol by volume parts is inserted in diesel fuel [4]

For the last concentration of 10 % biobutanol in diesel, the results of the values for the cogeneration plant efficiency are presented in Figure 5. In this case it has been also registered an increase of the small cogeneration plant efficiency. One can observe that in all cases that the cogeneration plant efficiency increases [4,5].

The increase in the efficiency is considered to be a result due to the improvement of heat transfer from the exhaust gases to water, through the heat exchanger, but also through a slight change of fuel consumption, obtaining a better electrical efficiency.

Other experiments concluded that adding biobutanol in diesel, largely does not modify significantly the level of emission (major parameters have remained constant in order to ensure the possibility comparison). With reference to the emission of CO, one states that the research should be continued and directed towards deepening the combustion mechanism related to emission of NO_x. The temperature of the combustion gases to enter the heat exchanger varies within ± (1-2) %, but generally increase. These findings should be linked to the consumption. Of course it is very difficult to observe in practice the conditions that make possible interpretations relevant comparative of the experiments. Thus, the drawn conclusions are clear about the intensification of emission of NO_x (even if the percentage is reduced) [6,7].

The interpretation is based on calculated values of the CO_2 emission, for the maximum fuel flow, and takes into consideration the material balance of carbon (introduced with assimilated diesel as $C_{18}H_{32}$, biobutanol with the formula $C_4H_{10}O$). Combustion is considered perfect (no CO, CnHm in the combustion gases).

The CO_2 emission reduction, of fossil origin, is explained by the increase of „bio" fuel percentage in the fuel mixture. Basically, the annual reduction is 2605 t of CO_2 (the case of maximum load and using 10 % biobutanol by volume percentage in the fuel mixture). This value is determined by the „bio" presence, so it is a neutral emission and is considered to have no worsening influences on the greenhouse effect [6].

In conclusion the paper demonstrates by theoretical and experimental research advantages of cogeneration, using blends of biobutanol with fossil diesel fuel in the generator powered by a diesel engine. Conclusions regarding the best practice related to cogeneration with diesel engines, mostly based on experiments, are presented. It is demonstrated the critical advantages and limits, when biofuels used in blends with diesel are use as a primary fuels on small power generators operating in cogeneration and based on diesel engines.

As presented, one demonstrated that if one uses 2-10 % biobutanol by volume parts in diesel a rising of the efficiency and a preservation of the fuel consumption is experienced. The result showed that when using 2-10 % biobutanol by volume parts in diesel it is a gain from the economic point of view. Another aspect that must be investigated and that is of major importance is the environmental impact of the cogeneration plant used mixtures of biobutanol in diesel. Figure 6 presents the results for the NOx emission using as primary fuel diesel [7].

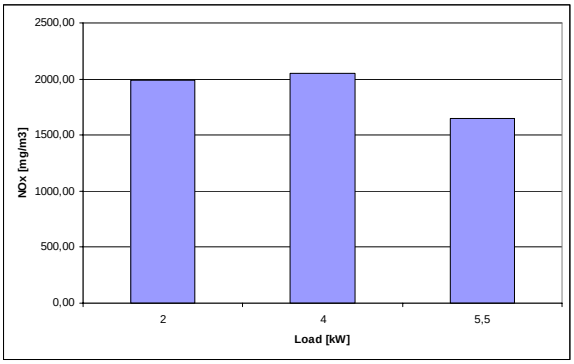

Fig. 6 Variation of NO_x concentration when the engine diesel [4]

The values have been obtained after relating to the reference oxygen of 5 % [xxx], the recorded values with the TESTO 350 X/ML gas analyzer. It can be noticed that along with the increase of the power of engine the NO_x emission value decreases.

A cogeneration plant system has the highest efficiency at maximum load. Thus it is necessary to focus on this loading step regarding the emission of NO_x. When the concentration of biobutanol in diesel was raised, it was measured a higher concentration of NO_x in the exhaust gases. This increase of the NO_x is due to the lack the catalyses on the combustion exhaust gases route of the engine on which the measurements have been made. The increase of NO_x emissions in relation to the reduction of fuel is profitable from the economic point of view. If we would use only fossil fuel, we would have a lower NO_x emission value, compared to the value obtained in the case of using 10% by volume parts of biobutanol in diesel, but there is the major disadvantage of using fossil fuel. The NO_x evolution when the cogeneration plant has reached maximum load and concentration of biobutanol blended with diesel [7].

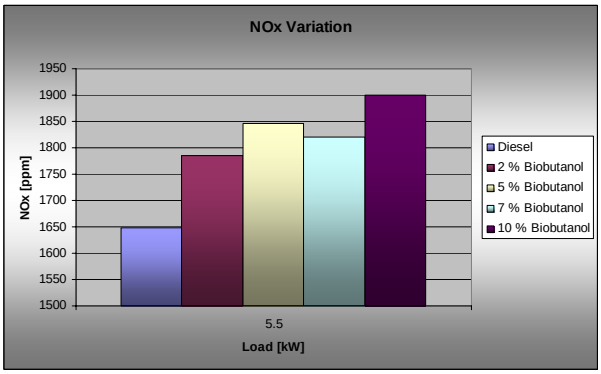

Fig.7 NO_x emission dependency based on the concentration [4]

3. CONCLUSIONS

As first conclusion, the concentration of nitrogen oxides in the flue gases generally increases with the concentration of biobutanol in diesel.

Similar grids (for the loading of 2 and 4 kW) demonstrates the same effect, but less as values.

An optimal point for the emission has been recorded for the concentration of 7 % biobutanol in diesel.

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METHOD FOR TESTING MATERIALS IN THERMAL EXTREME CONDITIONS

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Summary: *Extreme operational conditions and increased functional parameters of turbine, turbine blades, and rocket engines require new methods and equipment for quick thermal shock testing materials. Of all the wear factors acting simultaneously on component and subassemblies, the thermal shock is most disturbing. To achieve fast thermal shock test was designed and developed by the authors a versatile facility that allows high-speed heating and cooling of samples of 100 ° C / second. The facility and associated method permit to study the behavior in extreme thermal conditions of mono and multilayer materials, metal alloys NiCrBSi complex type and those based on partially stabilized Zirconia on stainless steel and nimonic support. Depending on the number of cycles and temperature at which survived the developed multilayer without damages previously established, a ranking of the materials tested is obtained, then the natural models is made as per optimum technology.*

Key words: quick, thermal, shock, test, heating, cooling

METHOD PURPOSE

The test method allows ranking of materials on thermal shock resistance quickly, using samples of rectangular shape.

Can be tested mono and multilayer materials, metal, ceramic, alloys NiCrBSi complex type, Zirconia partially stabilized with calcium oxide, magnesium or yttrium, etc.

The proposed method is qualitative, after each test specimen to view and check if there are changes:

- Change the color of the deposit
- Cracks in the surface deposit
- Exfoliation layers deposited

After each step of temperature samples are investigated, computer microscopy SEM, TEM, X-rays, etc.

In Figure 1, 2, 3 and 4 is presented specimen N66, deposit NiCr/$ZrO_2Y_2O_3$ on nimonic support , before and after thermal shock tests at temperatures of 900^0C, 1000°C and 1100°C.

Fig.1. N66 specimen on Nimonic 80 support / deposit NiCr/ZrO $_2$Y $_2$O $_3$ before testing

Fig.2. N66 specimen on Nimonic 80 support / deposit NiCr/ ZrO $_2$Y $_2$O $_3$ after quick thermal shock test at 900 ° C

Fig.3. N66 specimen on Nimonic 80 support / deposit NiCr/ ZrO $_2$Y $_2$O $_3$ after quick thermal shock test at 1000 ° C

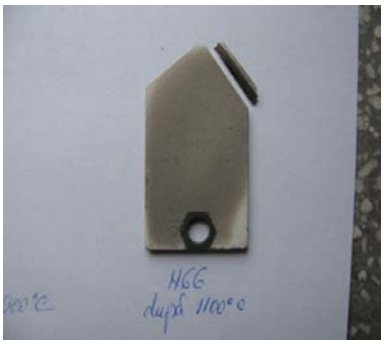

Fig.4.N66 specimen on Nimonic 80 support / deposit NiCr/ ZrO $_2$Y $_2$O $_3$ after quick thermal test shock at 1100 ° C

Fig.5. shows a sample of N66 used for microscopy investigations.

Fig.5. N66 sample for microscopic investigations after quick thermal shock test at 1100 ° C

Fig.6. shows surface cracks of N66, deposit NiCr/ ZrO $_2$Y $_2$O $_3$

Fig.6. Surface crack specimen N66, above left, after quick thermal shock test at 1200 °C.

Fig.7. shows exfoliation of deposit layer, N66 specimen after quick thermal shock test at 1200 ° C.

Fig.7. Exfoliation of deposited layer, N66 specimen after quick thermal shock test at 1200 ° C.

In fig.8 the electron microscopy investigation shows a composition image before test of NiCr/ $ZrO_2Y_2O_3$ before testing and in Fig.9 and 10 composition image after quick thermal shock test at temperatures of 900 ° C and 1100 ° C.

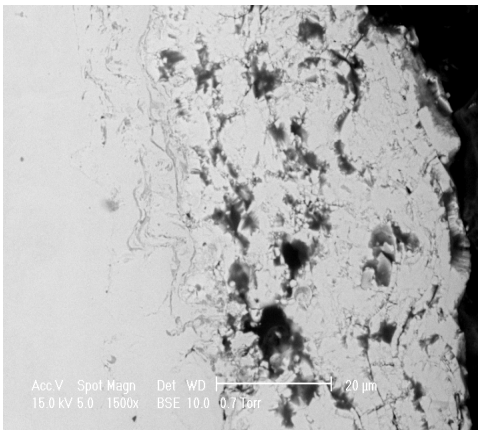

Fig. 8 image composition, N66 specimen before quick thermal shock test

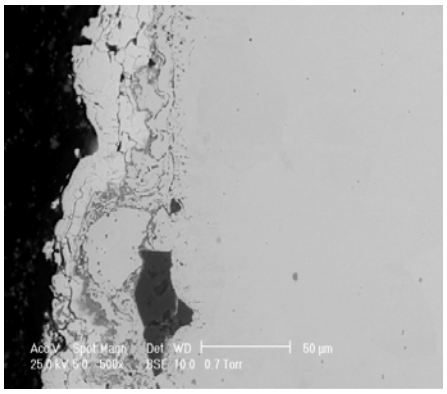

Fig.9. Imagie composition,N66 specimen after quick thermal shock test at 900°C

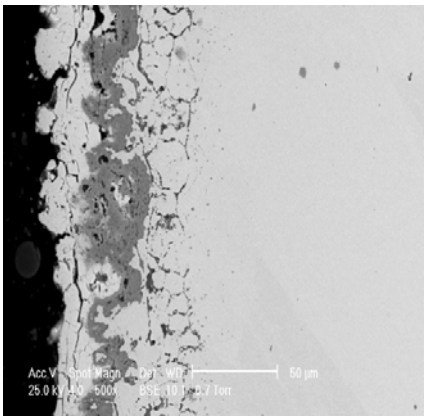

Fig.10. Image composition, specimen N66 after quick thermal shock test at 1100 ° C

Ceramic-based layer of ZrO_2,Y_2O_3 stabilized has a thickness of 40 ÷ 60µm.The bonding layer has a thickness of 5 ÷ 10µ formed from filament darker areas in a matrix of light color. The bonding layer is compact and has very good adhesion. (Fig. 8)

Due to similarities between the bonding layer and metallic layer can say that the bonding layer was mixed with the support material forming phases with elements in both directions. (Fig.9)

At temperature of 1100 ° C during the quick thermal shock test inter crystalline corrosion was an entire area of support. The deep that occurred up to this phenomenon is between 15 ÷ 45µm. (Fig.10)

TEST METHOD

A rectangular shaped specimen is moved from the environment inside an electric furnace, through the robot arms. The specimen is heated until the oven temperature is reached. The specimen is maintained in the oven a pre-determined time. The specimen is removed from the oven and is cooled on one or both sides with air jets, with different incidence angles. The temperature is recorded throughout the test specimen surface, both in the oven as well as in its exterior in the environment. Testing is performed at different temperatures and a number of tests are performed at the same temperature. After each test, the specimen is viewed in order to determine discoloration, cracking, exfoliations, etc. After each test temperature, the samples are obtained for optical and electronic microscopy analyses. When modifications occur the test is interrupted.

TEST FACILITY

Functional parameters of the installation for material testing in extreme heat conditions (Fig.11.), designed and built by the authors are given below:

- Allows testing materials up to 1500 ° C temperature

- Speed of heating, cooling -100 ° C / second

- Hand-cycle operation

- Operating in automatic cycle

- Monitoring functional parameters

- Continuous measurement of temperature specimen at heating and cooling

- Data acquisition system: permit the measurement of furnace heating temperature, specimen heating temperature, specimen cooling temperature, cooling fluid

pressure, cooling fluid temperature, oven heating time, specimen heating time, specimen cooling time

- View oven heating curve, heating curve cooling curve of specimen

Fig.11. Installation for material testing in extreme heat conditions

SPECIMEN GEOMETRY

Rectangular-shaped test specimens with dimensions L [mm] X L [mm] x h [mm] = (30 x 50 X 1÷2)

Specimens (Fig. 1.) are made of metal and nonmetallic materials.

Specimens can be monolayer or multilayered. The specimens are obtained by different deposition methods, on non-alloy steel, alloy or super alloy, with micron and nanometric sized powders.

Specimen dimensions were established taking into consideration the following:

- Allow removal of at least 6 samples for investigation by optical computer and microscopy

- Specimen thickness is close to the thickness of materials used for parts natural model
- Optical pyrometers can measure the temperature

TEST INSTALLATION ADJUSTMENTS

To achieve reproducible tests are needed on these calibrations, adjustments, etc..:

- Specimen holder position adjustment
- Control specimen clamping
- Optical pyrometers emissivity adjustment depending on the material that is tested
- Oven temperature control
- Oven heating curve control
- Air pressure coolant adjusting
- Establish the number and size of cooling nozzles
- Cooling nozzles position adjusting

TEST PROCEDURE

Installation checks are carried out before the test:

- Function oven

- Compressor operation

- Operating system and specimen clamping as well as the moving of the specimen inside the oven and vice versa

- Operating data acquisition system

Syntheses are shown further stages to be completed to achieve a quick thermal shock test.

Preheat oven to preset temperature.

Specimen is positioned on a support provided with a slot.

It starts compressor for filling the reservoir

It starts data acquisition system

Set installation for operation in automatic cycle

Specimen is inserted into an oven where it is maintained pre-determined time. Specimen surface temperature in the furnace is measured with an optical pyrometer. Oven temperature is controlled with two thermocouples and controller. After keeping the specimen in the oven time limit, it is removed from oven. The temperature of the specimen is measured continuously with two optical pyrometers during cooling. On leaving the oven specimen is caught with tweezers and moved into the cooling zone. Compressed air filtered and particle free water or oil pass through cooling nozzles and provide a cooling specimen one or both sides. After cooling, the specimen is inserted in oven again and cycle repeats until reaching the required number of tests. After each test, the specimen is inspected by view. In case of deterioration, the test is interrupted. Upon completion of pre-determined number of cycles for a temperature, a sample is drawn for electronic and optical microscopy investigations.

Restart testing at a new temperature.

RESULTS INTERPRETATION

Some test results, that the rate of heating and cooling rate of the specimen are recorded and presented graphically with Lab VIEW data acquisition systems of (Fig.12.)

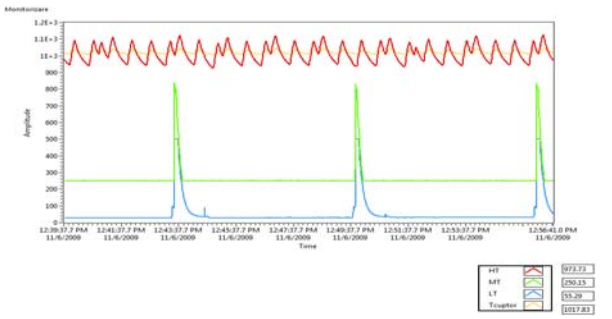

Fig.12. Thermal shock test specimen at 1000 ° C, N66 specimen

After computer analysis microscopy on samples before and after testing can determine structural modification of materials tested.

Corroborating the thermal shock tests, the test temperatures, the micro and macroscopic analysis allows the ranking of the materials at quick thermal shock test and selecting solutions based on which the material for natural model will be made.

CONCLUSIONS

- The thermal shock represents in comparison with the wear factors associated to the turbo engines- erosion at 2÷3 Mach speed, working temperature over 1000°C, corrosion, slide friction wear-the most perturbing parameter on the turbo engine "hot parts" materials life time.

- The quick thermal shock is associated to the turbo engine working in extreme conditions for short period of time (take off, emergency landing, start-stop engine, etc.) and corresponds to some high heating-cooling till 100°C/s.

- The QTS2 installation, conceived by INCAS, presents as against the known installations, the possibility to test thermally of the materials in a large domains of experimental parameters which corresponds to the functioning in the same time in current working conditions and extreme of the "hot parts" of turbo engines.

- The testing installation and the associated testing method provide technical-scientific data, necessary to the hierarchy and selection of the materials solutions, potential utilizable at the turbo engines, space shuttle, co generative systems, etc.

- The testing installation, versatile, functioning in semiautomatic and manual mode assures reproducible results for testing temperatures till 1500°C and maximum heating/cooling speed (100°C/s).

- The test results create the possibility to study of the protective coatings delaminating mechanism as well as the relation between the dynamic of the microstructure modifications induced by thermal shock in the coatings.

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CONTRIBUTIONS TO THE TESTS PERFORMED ON REINFORCED CONCRETE STRUCTURES WITH COMPOSITE MATERIALS REINFORCED WITH CARBON FIBER

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Abstract. *Studying the behavior of composite materials reinforced with carbon fibers and how they interact with the external environment is by means of specialized software, the results being used to optimize the technology of design, implementation and testing of products in which these materials are. Engineering construction materials in general is so specialized and composites reinforced with carbon fibers in particular so complex that it is difficult for one person or team to design such a product.*

Designers increasingly resorting to the use of computers and software applications, software is the catalyst that revolutionized the process.

The process has involved not only engineers can design and performance of composites reinforced with carbon fiber, but also in management systems capable of simulating their performance, resulting in so-called virtual prototyping.

Key words: *consolidation structures, composite materials, blades of carbon fiber.*

1. Principles and assumptions of modeling and simulation

In laboratory tests of composite materials reinforced with carbon fiber is used for calculating approximate models due to the modeling and simulation the following assumptions [3]:

- environmental situation continuously, homogeneous and isotropic;
- if small deformations with the magnitude of material;
- if the flat section of material subjected to bending (Bernoulli) and if the straight line perpendicular to the median surface of the material subjected to bending (KIRKHOFF);
- assumptions about the relative weights of the tensions that arise in a material subjected to the action of external loads;
- assumptions on the law of stress distribution in a certain section of material;
- if the linear relationship between stress and strain (Hooke's law), or a linear relationship for demands some form of elastic-plastic field and overlapping effects principle or principle of independence of action of forces;
- SAINT VENANT's hypothesis on the effect of tasks (concentrated or distributed) in a remote area of the zone of their action;
- ideal assumptions about the links that are used for modeling real links;
- assumptions about the types of tasks imposed on the material forces and couples concentrated forces and couples distributed (uniform, linear, parabolic, hyperbolic etc.) On a surface or a direction. These assumptions are reflected in the actual design load conditions.

For all the phenomenal that need to be studied for these composite materials and created analytical calculation model based

on modeling and simulation assumptions above, to write differential equations that characterize them, place the appropriate boundary conditions (constraints or bottlenecks imposed contact with the environment fixed or with other neighboring elements) and loading conditions. If problems are added depending on the time of the above initial conditions. Exact analytical model is also found in the literature as the virtual model.

Virtual model of a composite material reinforced with carbon fibers can be created in 2D or 3D virtual space using a computer modeling program. It can be analyzed in terms of his behavior under the action of external loads, for certain initial and boundary conditions, using a special program that uses different methods for analyzing and solving numeric equations. Finally numerical approximate solutions are provided. The program is able to optimize the solutions by obtaining a satisfactory accuracy in terms of the user: changing loading conditions, boundary conditions (where appropriate, initial conditions), their mode of application of the virtual model.

The need to address complex problems related to these materials subsequently led to a synthesis between analytical solution model and experiments about the actual models, resulting in numerical analysis. Numerical analysis allows the study of phenomena by varying test conditions particularly favorable economic conditions (especially for those phenomena that can not be reproduced in the laboratory) which requires not only design costs, computers and specialized software for numerical analysis [2, 9, 14]. The method used is finite element numerical analysis.

Finite element method uses a full mathematical model of composite material reinforced with carbon fiber, the method is based on local approximation of the variable field on subdomains (parts) of the studied material (called finite elements).

2. Experimental items and test methodology

Building on case study performed in 2007 was moved from the barracks where the work premises Gendarme Inspectorate Braila County in another location. It was built in 1966, has a ground floor with 3 rooms and a hall and is used by the institution concerned in 1992 bound for „deposits". Has built area of 57 m^2 and the following facilities in proper technical condition:

- indoor potable water plant;
- wiring;
- heating installation.

The main materials of the building is done are:

- foundation: concrete;
- walls: concrete;
- floor: reinforced concrete;
- parcel: tar paper.

During removal operations (lifting, putting on the trailer, circular road, setting the new location) the construction, although the distance was only about 3 km. Reinforced concrete structure was subjected to external applications (bending, tension, compression, torsion etc.), so the concrete tensile strength was offset by efforts to spread and cracks appeared in its structure. At that time did not exceed 0.4 mm. crack opening, so their influence of the corrosion rate of reinforcement was relatively low.

But over time the existence of these cracks contributed to ease the discharge of aggressive mass concrete, leading to corrosion of reinforcements. All they have contributed to environmental factors, intensity of wind, temperature and humidity outside and the intensity of solar radiation. Simultaneously, fittings and corrosion rust formation were a process of expansion, knowing that rust has a volume of about 8 times higher than the original steel.

In these circumstances the idea of building this building has emerged as a necessity, especially since the storage space deficit that we face our increasingly media. In late 2008 we prepared and submitted to Ministry of Interior conduct a feasibility study that proposes to strengthen the relevant

construction with composite materials reinforced with carbon fibers, the document was approved with a statement that, before the works themselves will perform an experiment focused on the possibility of composite material proposed by the beneficiary in reinforced concrete frame to a laboratory for testing construction materials locally, and, the conclusions with the results obtained will be necessary practical support and start conducting business.

To make building operations we used the following products [4, 5, 6, 7, 8]:

- woven carbon fiber oriented direction (MEGAWRAP 200);
- two component epoxy resin for impregnation (EPOMAX - LD);
- resin repair mortar, reinforced with dispersed fibers (MEGACRET - 40);
- Carbon fiber blades (MEGAPLATE)
- Two component epoxy paste for soldering (EPOMAX - PL).

Mechanical tests were conducted in the „Laboratory analysis and testing of construction materials" belonging to SC Concivia S.A. Braila.

Concrete structures used in these trials were 2600 mm in height., Width 1250 mm. and floor height of 650 mm. To avoid failure of these models due to loss of stability due to lack of floor and bulbs, was elected a wall thickness of 80 mm. Holes had dimensions of 250 x 500 mm. Walls that serve as experiments were embedded in the foundation blocks of height 400 mm., width 350 mm. and length of 1750 mm.

Structures were reinforced concrete construction reinforcement on prescriptions contained in the regulations in use to date of work [10, 13]. In order to ensure adhesion between concrete and reinforcing bars were used profiled PC 52 6 mm diameter. f_{sk} and characteristic strength = 355 N/mm^2. Around gaps were carcasses disposed of four reinforcement bars of diameter 6 mm., provided with the same diameter steel stirrups OB 37. Concrete compressive strength was used f_{am} = 50 N/mm^2 under the existing certificate in the technical quality of the construction.

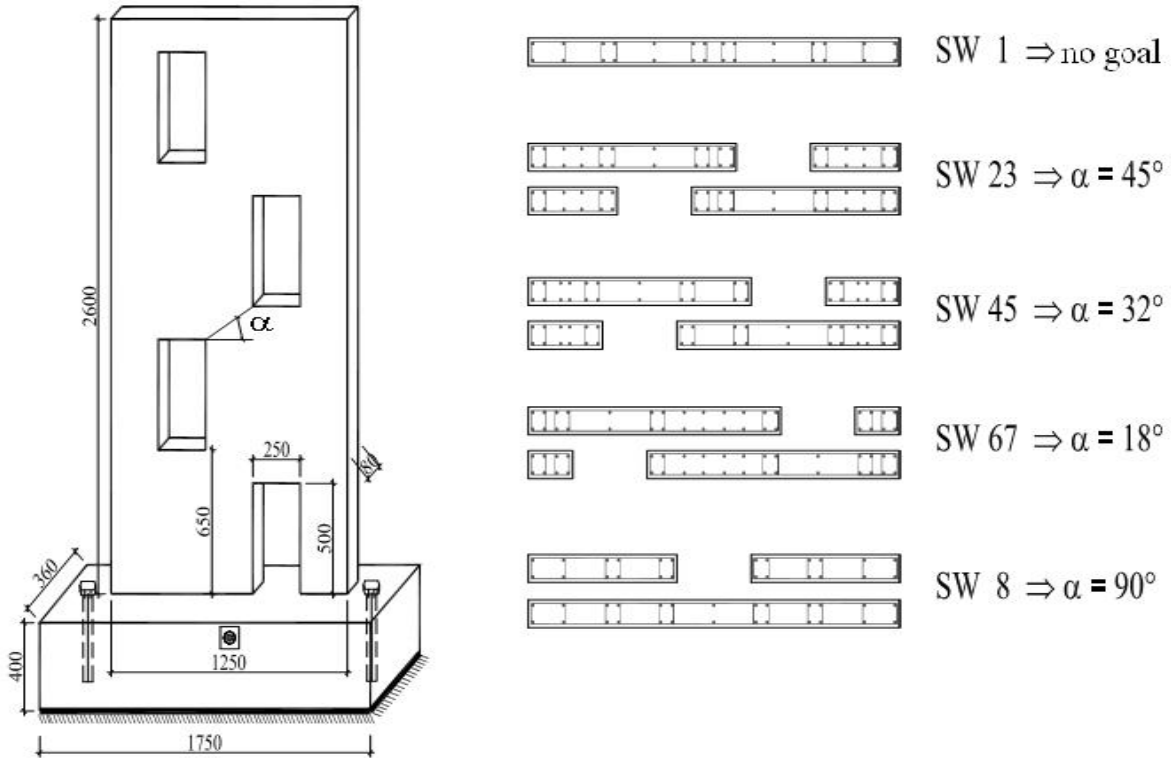

Figure 1 - Geometry and reinforcement of experimental evidence

The walls were loaded on top with a constant vertical force V = 50 kN. Horizontal load to full wall (no gaps) *SW1* consisted of a monotonous increasing force until failure and the other elements (the goals) of the cyclic alternating forces. The test was performed in the control of movement (horizontal movements of the upper experimental evidence).

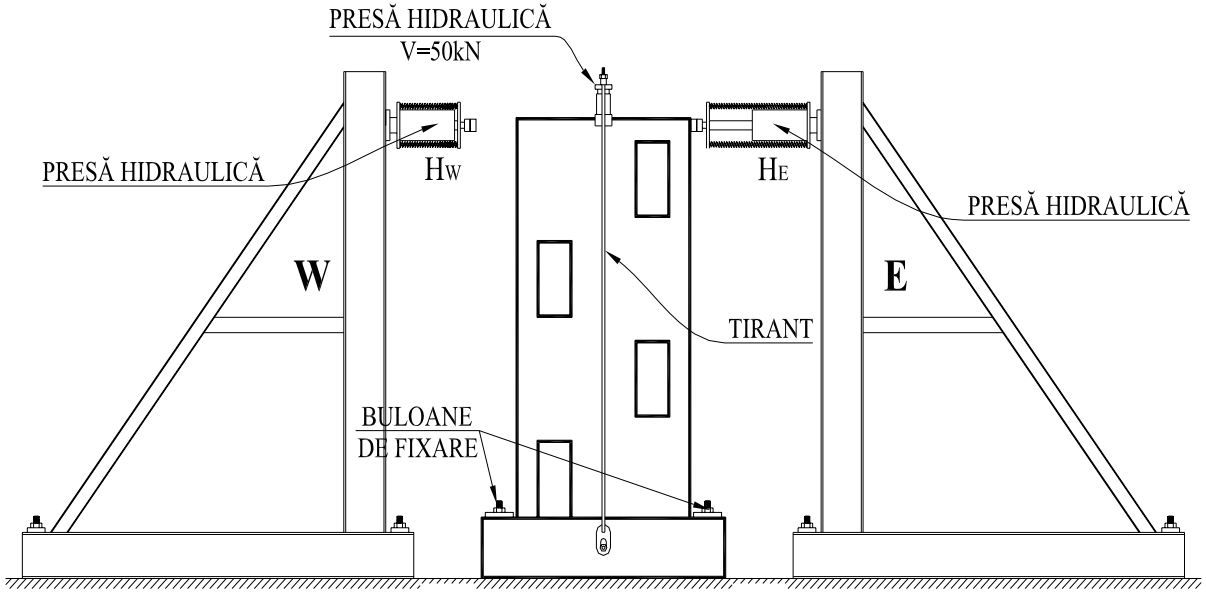

Figure 2 - Testing Methodology

Following tests carried out on reinforced concrete walls have resulted following observations:

- *SW1* wall (without holes) took a ductile failure in bending;
- to the wall of the central goals *SW8*, lease occurred by the appearance of joints in plastic rulers and then coupling to the pillars;
- hollow walls offset vertically *SW23*, *SW45* and *SW67* yielded by crushing of concrete in the small pillars, then having a large pillar-like behavior console.

Final conclusions in the first round of tests was that the walls of hollow structural lagged vertically arranged according to specific values of angle α, have a full structural behavior near the walls and therefore special measures are required reinforcement areas ductil plastic potential.

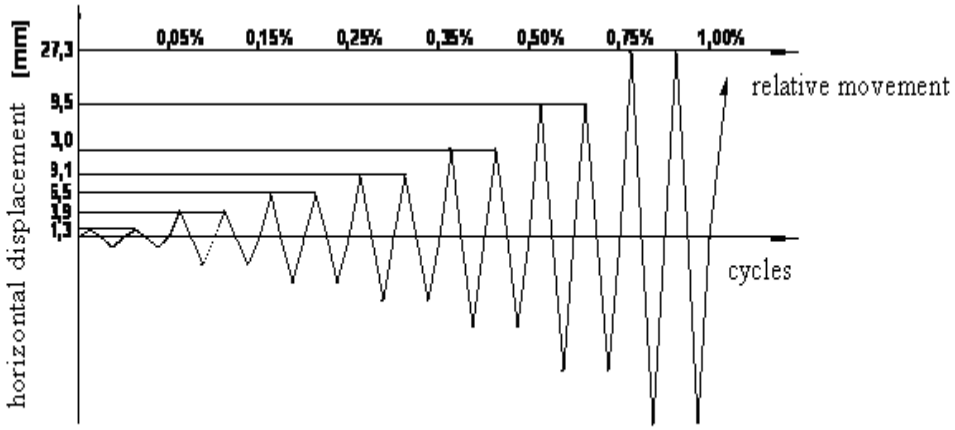

Figure 3 - Diagram of test

3. Description of retry

In the second phase of tests, test phases reinforced concrete walls were the following:

- preparation for strengthening the composite wall, strengthened by cleaning surfaces, filling existing cracks and repair broken concrete areas or exfoliated;
- preparation and execution of anchorage zone for composite;
- strengthening with carbon fiber fabric;
- processing and comparing the results obtained before and after consolidation.

The data recorded during tests were:

- peak horizontal load;
- horizontal movements;
- modes of failure of components;
- specific deformations of the composite.

Following this experiment could lead to composite material contribution to the acquisition effort bending and cutting, efficiency of the composite mode of settlement, that certain recommendations on the calculation of these consolidations.

4. The process of determining the rigidity, ductil and elastic-plastic curve equivalent

Loading H_{max} max was determined as the maximum load that resisted the wall and Δ_{max} was defined as the displacement (relative) corresponding to the maximum.

k_e elastic stiffness was defined as the secant stiffness, taken at 40 % capacity.

H_u breaking strength was determined as the highest load that was supported by the wall before significant reduction of resistance. Displacement at break Δ_u ultimate load was properly defined.

After each test the maximum envelope curves were drawn and stabilized. For each such reaction curve was defined curve equivalent elasto-plastic, used for comparison with test results. This artificial curve described as a wall would behave ideally elastic-perfectly plastic disipând an equivalent amount of energy as the test wall. Thus elasto-plastic curve equivalent was defined, that area under this curve is equal to the envelope area (force-displacement) [11, 15]. Equivalent elastic portion of the curve starts from the origin with slope equal to the elastic stiffness k_e.

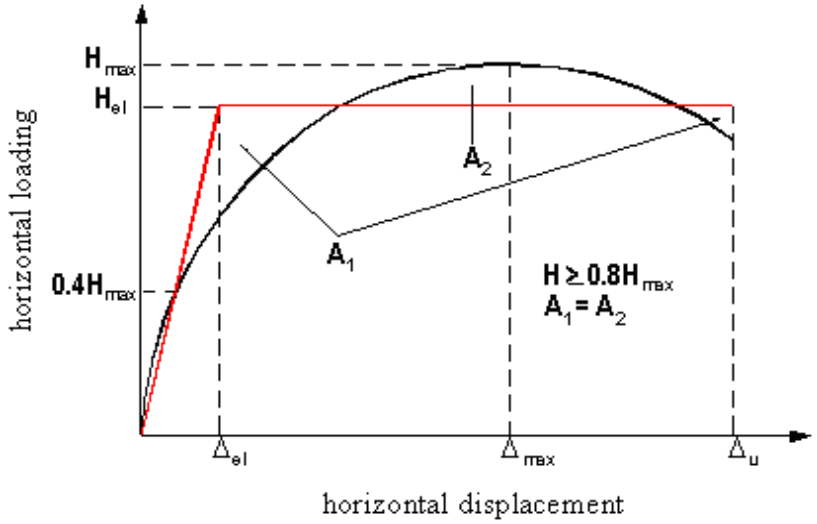

Figure 4 - Definition of elastic-plastic curve equivalent

Equivalent plastic portion of the curve is a horizontal line positioned so that areas equivalent curve and envelope curve is equal (eg A_1 and A_2 are equal) (Figure 4).

Δ_{el} elastic limit displacement respectively H_{el} elastic loading were set at the intersection of elastic and plastic parts, the equivalent curve respecting H_{el} be provided not less than 80 % of H_{max}.

From the above it follows that the more short carbon fibers with the lower portion of each fiber that actually stand the test in the composite material. At $l = l_c$ effective filling fraction fiber fraction is only half true. Maximum voltage is in the middle section carbon fiber and a plastic matrix, is given by 2:

$$\sigma_{\max} \pi r^2 = \tau 2\pi r \frac{1}{2} \quad (1)$$

$$\sigma_{\max} = \frac{2\tau l}{d} \quad (2)$$

Average voltage sent to a carbon fiber of length $l \leq l_c$ is equal to half the maximum voltage, as follows:

$$\sigma_f = \frac{1}{l}\int_0^l \sigma(x)dx = \frac{\tau l}{d} \quad (3)$$

Thus, strengthening provided by carbon fibers will be very short:

$$\sigma_c = \sigma_m v_m + \sigma_f v_f \quad (4)$$

Effort values $l \cong d$ passed to a filler particle is equal to the tension τ shear generated in the matrix.

5. Strengthening walls

Strengthening the wall trying to do with carbon fiber fabric oriented direction (MEGAWRAP 200), only one side. Fibers had an average tensile strength f_{frp} = 3900 N/mm^2, an elastic modulus E_{frp} = 231,000 N/mm^2 and a final specific strain of ε_{frp} = 1.7 %. Consolidation phases were:

- preparing walls for reinforcing composite materials (reinforced surfaces cleaning, filling existing cracks and repair broken concrete or peeling areas);
- preparation and execution of anchorage zone for the composite material (Figure 5);
- strengthen itself (the application of carbon fiber fabric).

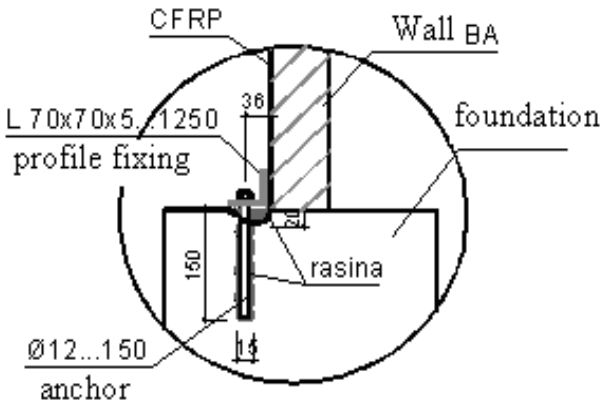

Figure 5 - The anchorage of carbon fibers

6. Strengthen walls retry

SW1 wall *RW1* was renamed after the consolidation, the consolidated component test carried out in the same conditions as the original [12]. As initially did not know how the item will be strengthened capacity, strengthening the wall was obtained using 4 strips of 150 mm. wide unidirectional carbon fiber fabric, placed on one side of the element in the vertical direction. Subsequently proved that this quantity has increased load capacity by approximately 35 % of the cornerstone. Therefore, the following was decided to use the walls 3 vertical strips of 150 mm., 4 respectively horizontal stripes also 150 mm. Vertical strips were placed at the ends of the walls and in the central and horizontal strips were placed on top of each level. To record the behavior of the material during the test at all the stamps were placed on the composite strain gauges in the most requested, directed along the carbon fibers.

7. Conclusions

Based on the results following conclusions can be drawn:

- The use of composite materials reinforced with carbon fibers for reinforcing concrete structural walls significantly increases their ultimate bearing capacity (basically, try bearing capacity of walls was negligible);
- specific strains of the composite material records demonstrating their contribution to bearing capacity of walls and strengthen cooperation with composite reinforced concrete element, the values recorded were within the range 0,54 ÷ 0,84 %;
- Consolidated disposal elements occurred by the gradual opening of existing cracks, the detachment of the material in the compressed, then the large pillars at the base, followed by stretching and sometimes tearing at its compression;
- maximum horizontal deformations of the walls were strengthen usually larger or at least identical to the walls witnesses;
- The results depend heavily on the initial state of enhanced item (number and opening cracks, the quantity entering the flow valve, the method and materials for rehabilitation) and the valuation method used. The method used to evaluate the mechanical characteristics were found that:
  - ✓ element stiffness decreased on average by 54 %;
  - ✓ elements ductility decreased on average by 61 %;
  - ✓ elastic limit the amount of force to the walls rose on average by 48 %;
  - ✓ maximum wall load increased on average by 46 %;
  - ✓ specific deformations of the composite material values were between 0.54 to 0.84 %;
  - ✓ anchorage system behaved excellently, without degradation or local failure.

Recent research in recent years led to a continuous improvement of technology for the composites reinforced with carbon fibers, thus a special contribution was the development of new technologies for treatment of carbon fibers used as reinforcement material (which led to an increase of 12-18 % of resistance to traction, bending and shock). These results were due to increased average molecular weight (doubling or tripling) of polypropylene dispersed in water carboxylate form of colloid and used as a coating material of carbon fibers.

Table 1 - Evolution of the mechanical properties of carbon fiber

Property	Unit of measurement	Type of treatment applied carbon fiber			
		Conventional	1984	2000	2009
Resistance of traction	MPa	70	80	90	115
Elongation module	GPa	5,6	5,8	6,1	7,4
Elongation	%	2,0	2,2	2,2	3,6
Inflection resistance	MPa	105	120	135	165
Flexural module	GPa	5,8	6,0	6,2	7,1
Impact resistance IZOD					
without noth	$kJ \cdot m^{-2}$	23	31	36	53
noth	$J \cdot m^{-1}$	70	80	94	118

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[5] Fişa tehnică – ,,Ră□ină epoxidică bicomponentă pentru impregnare (*EPOMAX - LD*)";

[6] Fişa tehnică – ,,Mortar cu ră□ină pentru repara□ii, armat cu fibre disperse (*MEGACRET - 40*)";

[7] Fişa tehnică – ,,Lamele din fibre de carbon (*MEGAPLATE*)";

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TOXIC ELEMENTS IN COAL AND FLY ASH FROM THERMAL POWER STATIONS

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Abstract: *Fly ash is a byproduct of coal burning at utility plants. As coal is burned, non-combustible mineral impurities in coal evaporate and condense into tiny particles of glass, almost totally spherical in shape. Coal is largely composed of organic matter, but it is the inorganic matter in coal—minerals and trace elements— that have been cited as possible causes of health, environmental, and technological problems associated with the use of coal. Some trace elements in coal are naturally radioactive.*

Keywords: *fly ash, radioactivity, toxic elements, etc.*

INTRODUCTION

Fly ash is one of the residues generated in the combustion of coal. Fly ash is generally captured from the chimneys of coal-fired power plants, whereas bottom ash is removed from the bottom of the furnace.

Fly ash is the finely divided residue that results from the combustion of pulverized coal and is transported from the combustion chamber by exhaust gases. Fly ash is produced by coal-fired electric and steam generating plants. Typically, coal is pulverized and blown with air into the boiler's combustion chamber where it immediately ignites, generating heat and producing a molten mineral residue. Boiler tubes extract heat from the boiler, cooling the flue gas and causing the molten mineral residue to harden and form ash. Coarse ash particles, referred to as bottom ash or slag, fall to the bottom of the combustion chamber, while the lighter fine ash particles, termed fly ash, remain suspended in the flue gas. Prior to exhausting the flue gas, fly ash is removed by particulate emission control devices, such as electrostatic precipitators or filter fabric bag houses.

Toxicity of coal fly ash

Coal fly ashes (CFA) are complex particles of a variable composition, which is mainly dependent on the combustion process, the source of coal and the precipitation technique. Toxic constituents in these particles are considered to be metals, polycyclic aromatic hydrocarbons and dioxins. Epidemiological studies in fly ash exposed working populations have found no evidence for effects commonly seen in coal workers (pneumoconiosis, emphysema) with the exception of airway obstruction at high exposure. In conclusion, the available data suggest that the hazard of coal fly ash is not to be assessed by merely adding the hazards of individual components. A closer investigation of 'matrix' effects on silica's toxicity in general seems an obligatory step in future risk assessment on fly ashes and other particles that incorporate silica as a component.

Polycyclic aromatic hydrocarbons in fly ash

Polycyclic aromatic hydrocarbons (PAHs) can result from the incomplete combustion of fuels such as wood, coal and oil. Metabolic transformations, by aquatic

and terrestrial organisms, result in carcinogenic substances. The most potent PAHs are benzofluoranthenes, benzo[a]pyrene, benz[a]anthracene and indenol[1,2,3-cd]pyrene. Although there has been a significant amount of work on PAHs arising from combustion of coal, most effort has focused on airborne particulate matter. PAHs will undergo photodegradation and are therefore thought to have a limited lifespan in the atmosphere. PAHs are only sparingly soluble in water, but their solubility decreases with increasing size of the molecule; e.g, naphthalene with two benzene rings has a solubility of 32mg/l whereas benzo[a]pyrene with five rings a solubility of $6x10^{-3}$ mg/l.

The major sources, apart from gasworks sites, were found to be coal-fired electricity generation (3140 tones per annum), domestic coal combustion (600 tones per annum), incinerators (56 tones per annum) and vehicles (80 tones per annum), with smaller amounts from oil and wood combustion and stubble burning. Although power generation consumes the largest proportion of coal, the emissions of PAHs are less per tone than for coal used for domestic consumption.

Another study detected no extractable trace organic in fly ash from large coal-fired power stations, in concentrations above 0,5μg/l.

Leaching tests on the fly ash in accordance with the Environment Agency extraction method have indicated level of the PAHs benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, benzo[ghi]perylene, fluoranthene and indenol[1,2,3-cd]pyrene to be <0,2μg/l for each species, confirming the above finding that the amount of available PAH from fly ash is negligible.

Dioxins in fly ash

Policlorinated dibenzo-p-dioxins (PCDDs) are family of chemicals based on the tricyclic molecule benzo-p-dioxin, which has two benzene rings linked by two oxygen atoms. PCDDs have some or all of the hydrogen on the benzene rings replaced by chlorine. There are often associated with polychlotinated dibenzofurans, which have only o single oxygen atom.

Dioxins and furan are considerated to be toxic to humans, although furans less so than dioxins. 2,3,7,8-tetraclorodibenzen-p-dioxin (TCDD) is considered to be the most toxic dioxin and therefore the studied.

Calculations indicate that, for people working at or the living near coal fired power station, the levels of dioxin exposure attributable to airborne dispersal of fly ash and stack-emitted are low. Exposure is negligible in relation to the background dioxin burden (between <0,1 per cent and 0,00004 per cent). Some 80% of the banckground dioxin burden is associated with the consumption of food (mainly animal facts).

The low chlorine content of coal combined with the high temperatures found furnaces of power station mean that dioxin are unlikely to from and only trace be expected in the resulting ash

Chromium VI in fly ash

Chromium is found in the environment in various forms, the most significant and stable being the trivalent form (Cr(III)) and the hexavalent form (Cr(VI)). Chromium (III) is essential for human health, the minimum daily requirement being estimated at between 30 and 130 nanograms per kilo bodyweight per day. Too much chromium can be harmful, however, since chromium (III) is fairly cytotoxic. Chromium (VI) is not only cytotoxic for the lungs and kidneys, but it is also a genotoxic carcinogen. When assessing the risks associated with chromium, two standards are therefore usually applied: one for chromium (V) and one for other chromium compounds, including chromium (III) compounds.

The status of chromium (VI) as a carcinogen derives mainly from its ability to cause lung cancer. Consequently, inhalation is the most significant exposure route. It is not easy to determine the concentration of chromium {VI} in the atmosphere or in solid

particulate material . Only in recent years have methods for doing so been developed, yielding a better picture of the presence of chromium (VI) in solid samples. The concentration of chromium (VI) in fly ash is low, averaging about 13 m grams per kilo.

CONCLUSIONS

The dioxins are present in fly ash , the levels are very low and similar to the background levels found in typical soils. Thus, fly ash is no more hazardous than soil.

The leachate from fly ash contains very small amounts PAHs. The concentration of effort on airborne emissions rather than waterborne PHAs indicates the relative significance of each. When fly ash is used as a fill, the amount that may become airborne is small, especially if dust suppression is effective, and transient, occurring only during construction. This means that this is not likely to be a major source of PHAs in the air.

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LIGHTWEIGHT AGGREGATES FROM FLY ASH FROM THERMAL POWER STATION

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Abstract: *Power plants generate a great amount of solid waste named ash during coal combustion. From this process two different kinds of ashes are extracted: fly ash (FA) and bottom ash (BA).There exist a considerable number of lightweight aggregate types. These range from naturally occurring materials from volcanic rocks, pumice, pozzolanas and volcanic slag, to material produced industrially, furnace bottom ash (FBA), expanded clay and sintered fly ash. Lightweight aggregates have been manufactured by sintering fly ash and crushing the product into suitable size.*

Keywords *:Fly ash, lightweight aggregates, bottom ash, etc.*

INTRODUCTION

Lightweight aggregates, under current rules are considered those who have an apparent density $\rho_g \leq 1000 kg/m^3$. Because of physical chemical characteristics (low density, thermal and ionic good stability in time) light aggregates have gotten in the past for an unprecedented development, being used to obtain different products.

There are many ways of producing artificial aggregates from fly ash. The chief distinctions between the various processes are in the methods used for agglomeration and hardening /B 50V.

Agglomeration techniques may be sub-classified into methods

- without external compacting forces (agitation, granulation)
- with external compacting forces (compaction).

Hardening methods may be differentiated according to the hardening temperature employed, for example:

- Sintering processes= 900 ℃
- Hydrothermal processes 100 - 250 ℃
- Cold-bonding processes10 -100 ℃

Given the same apparent density, mechanical properties such as strength, drying shrinkage and pellet creep will generally decrease across the hardening spectrum of sintering, hydrothermal and cold-bonding processes. The loss in strength and other properties can, however, be totally or partially compensated by increasing the density of the pellets through compaction agglomeration.

The lightweight materials were composed of 3 types, namely pumice, cellular lightweight aggregate and MTEC lightweight aggregate.

The tests for physical and mechanical properties of lightweight aggregate concretes (LWAC) were conducted in terms of workability, compressive strength, apparent density, abrasion resistance and absorption.

Characteristics of lightweight aggregates from fly ash

Main physical and mechanical characteristics of aggregates from fly ash are:

- Compressive strength: While most structural lightweight aggregates of

production concretes with compressive strengths in excess of 35 MPa, a limited number of lightweight aggregates can be used in concretes that develop cyclider strengths from 48 to 69 MPa.

The minimum specified compressive strength must be compatible with the density specified. As with any type of aggregate, the compressive strength of lightweight concrete may be limited by the strength of the aggregate.

- Grain appearance: round, brown, with smooth surface;

- Apparent density: in loose condition is dependent on the grain (Table 1).

Table 1.

Fraction [mm]	Apparent density [kg/m^3]
0-7	930
7-16	745
16-31	710

- Water absorption: depends on the size fraction (Table 2)

Table 2.

Fraction [mm]	Water absorption [%]
0-7	10,0
7-16	11,0
16-31	11,5

The absorption of lightweight aggregates is greater than the absorption of normal weight aggregates. The moisture content of lightweight aggregate prior to batching must be carefully monitored especially when the concrete is to be pumped.

- Granularity: has an essential role in obtaining concrete with superior technical performances. The research found that aggregates of fly ash not have some fine 0-0,2mm, 0,2-1mm and 1-3mm. These fractions can be substituted using the addition of ash, direct the manufacture of concrete, which improves on the fine granularity, having a dual role, both as a binder for the hydraulic effects as well as fine aggregate. Because this property can be used to obtain concrete trails.

Manufacture of lightweight aggregate (LWA) from fly ash

Lightweight aggregates have been manufactured by sintering fly ash and crushing the product into suitable sizes. These aggregates possess unique characteristics that make them suitable for high strength and high performance concrete. Concrete produced using these aggregates is around 22% lighter and at the same time 20% stronger than normal weight aggregate concrete. Drying shrinkage is around 33% less than that of normal weight concrete. Moreover, the aggregates possess high durability characteristics required in high performance structures. The importance of the new aggregates lies mostly in the fact that superior qualities are achieved without having to increase the cement content. Thus it is possible to reduce the amount of cement by as much as 20% without affecting the required strength. Weight reduction may reduce precast concrete transportation costs as well as provide slender and spacious construction. Utilising fly ash to produce quality aggregates should yield significant environmental benefits. The market for LWA represents one of the more attractive opportunities for commercial utilization of fly ash without seasonal problems, as LWA can be stored for an unlimited time in open air without losses, environmental problems or damage from the freeze-thaw cycle. To solved the ash disposal problem, emphasis must center on mass applications. Two billion tons of aggregate are produced annually.

The largest potential outlet for LWA manufactured from fly ash is in concrete, concrete products, block and masonry units. LWA offer better thermal and acoustical insulation, high fire resistance, easy cutting, drilling and nailability. The use of LWA offers architects and engineers greater freedom in designing longer spans, larger floor areas and added height. Still other applications for LWA are for example in horticulture, as a stone mulch and as a vehicle arrestor.

CONCLUSIONS

Lightweight aggregates are characterized by porous structure, dominated by coarse pores, low mechanical strength, high water absorption and permeability.

Fly ash lightweight aggregates is presented both as powdered material resulting from coal combustion as well as a product made by synthesizing.

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NUMERICAL SIMULATIONS OF THE COMBUSTION FOR SOLID ENERGETIC MATERIALS

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Abstract

This paper presents a numerical simulation of the combustion for a propellant component by using a detailed one-dimensional model. The temperature and species profiles in the flame are not preliminary specified but are calculated by the model. This approach allows analyzing accurately the flame structure and also validating some simplified concepts in the combustion modeling.The numerical code investigate the physical description of a steady AP (Ammonium Perchlorate) monopropellant flame using a detailed one-dimensional theory.

Key words: *Ammonium Perchlorat, combustion, temperature, pressure, interface, propellant, flame, chemistry.*

1. AN ACCURATE DESCRIPTION OF THE PROPELLANT COMPONENT IN COMBUSTION

AP is the most common component used in composite propellants and much works were carried out to describe the combustion mechanisms [1,2,3]. Even though several attempts were made to include the effects of condensed phase chemistry in these AP computations, no detailed reaction set based upon theory or experiment has been developed. In the absence of a rigorous condensed phase AP chemistry model, we employed continuation techniques to investigate the appropriate solid/gas interface in deflagrating AP flames. Continuation techniques [4] allow the determination of solution branches depending on a parameter, including turning points, and use phase-space, pseudo-arclength, reparameterization of solution branches, Euler predictors, Newton-like iterations and global adaptive rezoning. Continuations techniques are used to generate all possible solutions for varying pressure and the interface reaction parameter. The model takes into account detailed transport and complex chemistry in the gas phase as well as heat propagation in the solid phase. In the frame of the kinetic theory of dilute gas mixture, the transport coefficients in the species and energy equations are functions of the state of the mixture, i.e., of pressure, temperature and species mass fractions. The species diffusion velocities appearing in the equations can be expressed in terms of transport coefficients and macroscopic variable gradients. Regarding the reaction mechanism involving elementary chemical reactions, we have considered that each elementary reaction is estimated by a classical Arrhenius expression. The interface model is described by a surface reaction that includes direct dissociative sublimation of AP as well as gaseous products obtained through a liquid phase [1]. The surface reaction can be expressed with the following model:

$$Ap_s \rightarrow \alpha\,(NH_3+HClO_4)_{sub} + (1-\alpha)\,(7/2O_2+1/2N_2+5/2H_2O+1/2Cl_2+2/3HCl)_{equi} \quad (01)$$

where α is the parameter describing the relative proportion of moles processed through each chemical path. The mixture produced through the liquid phase is assumed to be an equilibrium mixture as suggested in Ref. [1].

The other important condition is the manner to evaluate the surface temperature at the interface. In a thick condensed phase zone, the temperature goes from the melting temperature at the solid-liquid interface up to a pressure and mixture dependent vaporizing temperature at the liquid gas interface. The condensed phase zone may also contain bubbles and the average temperature will also range between the melting temperature and a vaporizing temperature. When this condensed phase zone is shrinked into an interface, however, it is not clear how to define an interface temperature. A possible method, as in the simplified approach described above, could be use a semi empirical pyrolysis law relationship between the burning rate and the surface temperature:

$$V_i = A_i \exp(-E_i/RTs_i) \qquad (02)$$

Although it certainly yields more flexibility to the model, it has been observed [5] that the resulting surface temperatures are still around the melting temperature. As consequence, for the sake of simplicity, we have choosen to take the interface temperature equal to the melting temperature. So, we have:

$$T_s = T_{AP}^{\ melt} \qquad (03)$$

Even though the value of the α parameter is given in the literature as a constant at low pressure [6,7] numerical simulations by continuation techniques have been carried out in order to determine the value of α versus the pressure p. To do that, we have considered that the AP in combustion can be simulated following a chemical mechanism using 36 species and 215 reactions. Results can be expressed as solutions depending on two parameters: α and the pressure P (Fig. 1).

By intersecting numerical results in terms of burning rate with the experimental surface [8], corresponding to the green surface in Fig.1, we can obtained the α parameter versus the pressure. This value, $\alpha = 0.41$, is found to be pressure independent and very similar to the value obtained at low pressure in Ermolin's experiment [6].

Using this value of α, the burning rate of AP obtained at various pressures is in excellent agreement with experimental

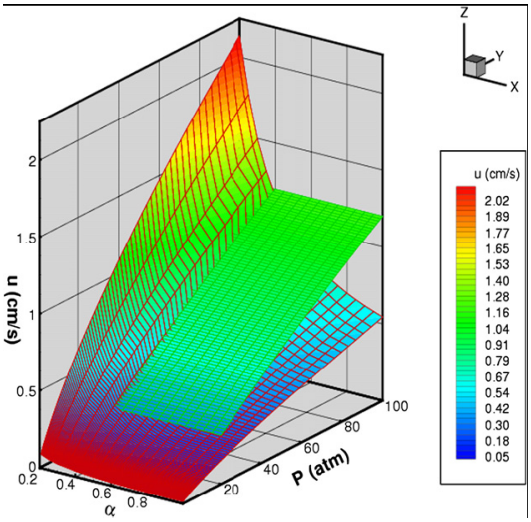


Fig. 1. Deflagation map of AP in combustion versus p and α, determination of α at high pressure.

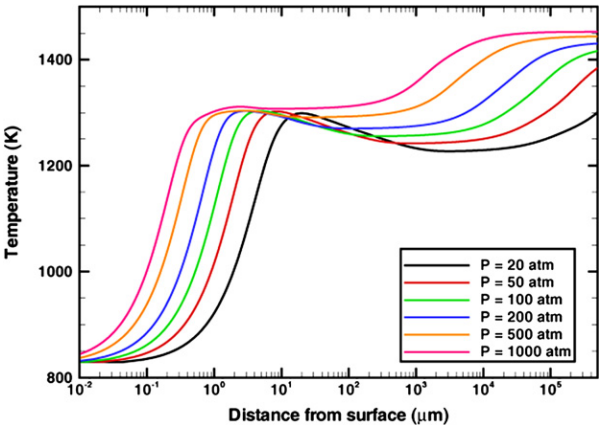


Fig. 2. Temperature profiles in the gas phase at different pressures for AP in combustion.

measurements. The temperature profiles are presented in Fig. 2, where the AP interface is the left boundary.

We note the multiscale nature of the flame structure, with a sharp temperature rise behind the interface, a plateau with a slight temperature decreasing due to an endothermic zone and finally a slow convergence to equilibrium. A detailed analysis reveals that endothermicity is mainly due to the reaction:

$$NH_3 + OH \rightarrow NH_2 + H_2O \qquad (04)$$

and that in this zone, NO_2 is transformed into NO. The other information given by this modeling of AP combustion concerns the pressure extinction limit. The pressure extinction limit can be investigated when

$\alpha = 1$, that is, in the absence of burned species coming from the liquid phase. In fact, the model can only describe qualitatively the pressure extinction limit since the multidimensional multiphase interface is not fully described.

However, it is an important property of the model to exhibit eventually turning points in the presence of heat losses. We first included conductive heat losses in all phases of the model by assuming that the AP sample was of cylindrical shape. By varying the cylinder radius r_0 of the sample, the heat loss rate can be varied and the extinction limit is accordingly shifted (Fig. 3).

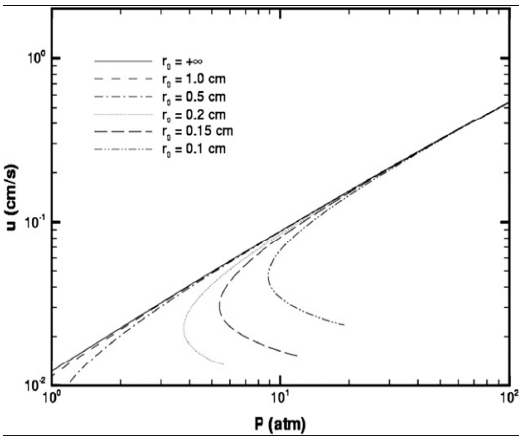


Fig. 3. Extinction curves depending on the radius of the AP sample.

For a representative value of $r_0 = 0.1$ cm, we obtain an extinction limit at $P = 9$ atm. We have also included surface radiative losses in the model and we observe an increase of the critical pressure by about one atmosphere when radiative losses are taken into account. In comparison with the experimental value of the pressure limit (i.e. $P \approx 22$ atm), this preliminary result is therefore qualitative because the multidimensional multiphase interface is not fully described.

2. MODELING HETEROGENEOUS PROPELLANT IN COMBUSTION [9]

Composite propellants based on AP and a fuel binder like HTPB are really heterogeneous because the oxidizer (AP) particles are embedded in the binder. The result is that the combustion is unsteady and three-dimensional at the flame scale. In comparison with the previous approaches given in this paper, this numerical approach for modeling the combustion of solid propellant is necessarily more complex and very different in terms of computational effort. So, it is evident that a full simulation with an accurate description (i.e. a detailed reactional mechanism) of gas phase and condensed phase is not possible at the present time. The other important point is that such numerical simulations are difficult due to the use of very fine grids and to the problem of surface tracking in order to couple the gas phase and condensed phase. This specific constraint comes from the density difference between the gas phase and condensed phase. In terms of timescales, the condensed phase timescale is much greater than the gas phase timescale. Following a three dimensional point of view of the problem, only few numerical simulations were carried out [10,11] and results have shown new insights in the combustion modeling for solid energetic materials. Because of complexity and heavy computational resources, only two-dimensional simulations were carried out in a first time. In order to study the heterogeneous propellant in combustion, the first thing is to define a strategy for representing the propellant morphology as randomly packed particles. With this in place, a fully coupled description of the gas phase, of the condensed phase and of the moving surface allow an examination of fundamental questions of propellant burning.

Real heterogeneous propellant has a complex solid phase, and it is well known that its geometrical structure can have an influence on its global burning rate. The packing generation method used here allows generating a 2D or 3D packing with desired characteristics: the particle diameters and the mass fraction of oxidizer. The main phases of the algorithm are:

• the random placement of the particles,
• the growing of particles for a spherical shape without any contact between them,
• a secondary growing phase with non-spherical shape,

• iteration to achieve the correct mass fraction of oxidizer.

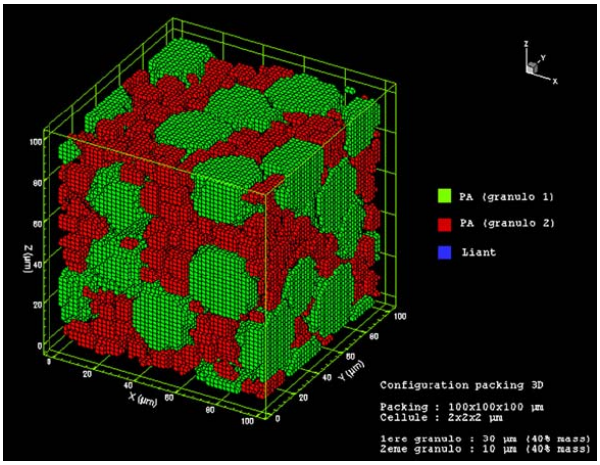


Fig. 4. Packing generation for a bimodal AP particles (50% of 30 µm and 50% of 10 µm).

Fig. 4 shows a typical result obtained for a packing of APHTPB propellant (100 µm × 100 µm × 100 µm) containing bimodal AP particles (50% of 30 µm and 50% of 10 µm).

In the condensed phase (oxidizer and binder), we solve the heat equation, where we have assumed, for simplicity, that the properties are constant. The surface temperature of the condensed phase is related to the regression rate of each component *i* (*i* for oxidizer or binder) by simple pyrolysis laws (Eq. (02)).

Gas-phase processes are described by the aerothermochemistry equations that express the conservation of mass, chemical species, momentum, and total energy. Oppositely with the previous numerical method based on a detailed transport and complex chemistry in the gas phase, we have used here a global kinetic scheme for modeling the combustion in order to avoid a large computation time. For the AP combustion (premixed flame) we have considered the following global reaction:

$$NH_3 + HClO_4 \rightarrow \alpha_1 Gas_{ox} + \beta_1 Gas_{comb} \quad (05)$$

Gas_{ox} has the role of the main oxidizer and Gas_{comb} defines the products coming from the AP premixed flame.

Regarding the diffusion flame, we assumed that the reaction is between the decomposition products of the binder Gas_b and the main oxidizer Gas_{ox}. So, the global reaction is:

$$\alpha_2 Gas_b + \beta_2 Gas_{ox} \rightarrow Gas_{comb} \quad (06)$$

Because chemical rates do not correspond to real reactions but are representative of a large set of them, the usual relations between the stoichiometric coefficients, the pressure exponents, and the exponents of the reacting species do not have to be satisfied. The activation energies of these two reactions come from mean values of the literature. These reactions are supposed to be second order.

Following the previous description, the interface model for the AP component is described by a surface reaction that includes direct dissociative sublimation as well as gaseous products obtained through a liquid phase [1]. The surface reaction can be expressed as:

$$AP_s \rightarrow \alpha(NH_3 + HClO_4)_{sub} + (1-\alpha)(\alpha_1 Gas_{ox} + \beta_1 Gas_{comb})_{equi} \quad (07)$$

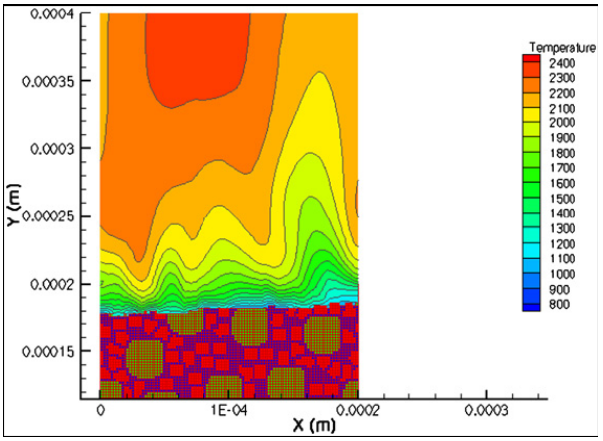
The overall process is exothermic. On the contrary, HTPB binder pyrolysis is endothermic and is supposed to release C_4H_6 only. With this simple decomposition model, we have:

$$Binder(s) \rightarrow Gas_b \approx C_4H_6 \quad (08)$$

To complete the interface model, we need to take into account a classical balance in terms of mass, global species and energy. The numerical method for fully coupled problem of propellant burning does not use a moving mesh based on a local burning rate. A simple tracking-surface method is used. The principle is to compute at each time-step the volume of each solid-cell of which, at least one face is located at the propellant surface. When a face of such cell undergoes a heat flux, the loss matter can be known through the pyrolysis law (Eq. (02)). When the volume of the solid is zero, the cell becomes a cell of gas for the mesh and the cell connectivity is updated.

Numerical simulations of two dimensional heterogeneous propellant combustion were carried out with two different packs for the

pressure of 6 MPa and initial temperature of 300 K. The first packing concerns 80% by mass fraction of AP with two particle sizes (50% of 10 µm and 50% of 30 µm) and the second packing has 80% in mass of AP with also two particle sizes (50% of 9 µm and 50% of 90 µm). For a given time, Fig. 5 (a, b) shows the nature of the combustion through the temperature contours. These results underline the unsteady behavior of the flame near the propellant surface. The structure of the flame is complex due to the multiple "flamelets" interaction. The other main information coming from these preliminary calculations is that the global propellant surface remains nearly flat. Further works need to be done in order to compare these first results with experimental data on burning rate and average surface temperature.



(a)

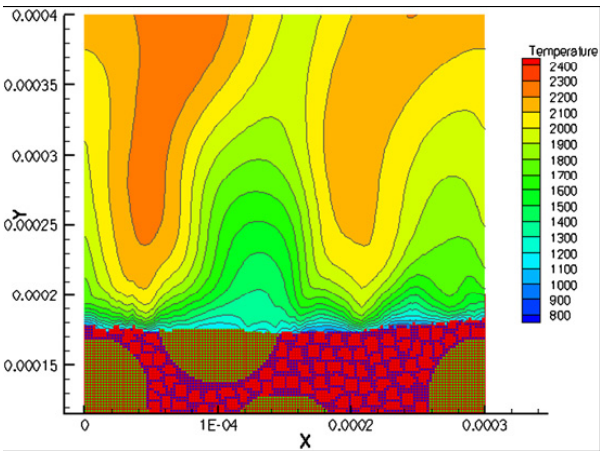


Fig. 5. Temperature iso-contours for two packs of propellant in combustion at P =6 MPa, T_0 = 298K. (a) 10 µm and 30 µm AP particle diameters; (b) 9µm and 90 µm AP particle diameters.

3. CONCLUSION

We have tried to show in this paper the combustion modeling of solid energetic materials. This short review has been mostly focused on the main physical description of the models developed instead of the mathematical formulations. The simplified approach used remains a powerful engineer tool to evaluate the burning rate of the propellant but its limitation is related to a poor description of the gas and condensed phases. The other point is that the simplified approach requires much experimental data for calculating the burning rate of the propellant.

With the increasing sophistication of the physical processes, the description of the propellant component in combustion based on numerical simulations of the entire flame structure taking into account a detailed kinetic theory transport is able to give access, with only one experimental result, to the burning rate. Calculations of qualitative pressure extinction limits are also possible with this approach. The only limitation arises from the geometrical description of the flame (i.e. one-dimensional).

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ASPECTS CONCERNING TO OBTAIN SOME COMPOSITES MATERIALS USED IN ARMOURED PROTECTION

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Abstract: *The theme propose to treat some aspects about the employment the plackage by explosion method in obtaining new special structures intended to assurance the armoured protection.*

Key words: *composites, materials, protection, armoure, vehicles*

1. HISTORICAL EVENTS IN THE DEVELOPING THE ARMOURED PROTECTION

Since Middle Age, a growth in threatening the collective protection of the warriors has been established, which brought the necessity of improvement of the methods to protect the warriors.

The rapid development of the technique since the beginning of the XIX-th century, the armed conflicts which marked the XX-th century since its first decades, determined the release and diversification of the collective protection, asserting substantially at the same time also the involvement of motor vehicles industry in supplying the military structures with battle vehicles, being suitable equipped to ensure the protection of warriors.

It must be noted that the main qualities of an armed battlefield vehicle, these qualities are not only defined by the level of mobility and the vehicle's capacity to move in any conditions, but also in the vehicle's protection against fire weapons.

To achieve protection of the armored vehicles, the vehicles must be equipped with relatively strong and light armature.

These two properties – the mobility and the protection through armature- seem initially contradictory, because in order to have a stronger resistance, the piece of armature must be thick; to be lighter, the piece has to be less dense. The solution is to build the armature from composite materials, which brings particular properties to the armature and brings it higher resistance at perforation after the impact with several types of ammunition [1].

Fig. 1 Types of armored battle vehicles

Studying the specialized publications, we bring the conclusion that the main efforts have been directed for the creation of new

types of intervention and modern fight vehicles (fig.1), being part of the fourth generation after World War II, and also the efforts have been directed for the modernization of some technologies to create the main components and sub-ensembles of vehicles [2].

Following, are exposed ways to improve the protection through armature, adopted by countries with a strong defense industry.

Israel:

The Blazer reactive-explosive armoure. The experience Israel encountered during the conflict from 1973 in the Middle East, has shown the need to increase the protection of the battle vehicles against the anti-tank methods.

To comply with this demand, the experts of RAFAEL company have built and developed the Blazer supplementary reactive-explosive armature, distinguished by linear protection, different configurations and calibers related to the requests concerning the protection, particular to every type of tank.

Spain:

The Santa Barbara reactive-explosive armoure. The Santa Barbara reactive-explosive armature has been implemented first on AMX-30 tanks, property of the Spanish army. This type of armature is similar to the Blazer reactive-explosive armature.

The Blazer reactive-explosive armature, but also the Santa Barbara reactive-explosive armature makes a protection of the armature with a reduction of 95% of the degree of penetration. Santa Barbara has developed several ways of dynamic protection according to the operational requests.

S.U.A:

USA has been the first country to use on an extended area the aluminium armature (type 5083), this armature being used in the construction in the armature vehicles M 113.

Through the use of the first generation of aluminium armature, the scientists obtained a reduction with 20% of the armature's weight, against the steel armature, without lowering the protection capacity compared to the steel armature.

It is necessary to mention that even since 1960 Alcan Plate company has developed a diverse range of alloy for the construction of armored vehicles. A related example is the new type of alloy, that cured, brings a good ballistic protection, but with a low resistance to corrosion.

Alcan Plate has improved this last type of alloy concerning the ballistic and anti-corrosion resistance, the new alloy being used for the construction of Scorpion, Fox, CET, BMR-600 armored vehicles, and lately for the construction of Warrior and Stormer carcasses' vehicles.

The development and the diversity of the types of ammunition, and also the variety of missions which must be accomplished in the country, and also in the theaters of operations, have determined the development of researches for improvement and the individual protection of the fighting personnel, without diminishing its mobility during exercising the missions.

2. CHOICES IN OBTAINING NEW PRODUCTS FOR COLLECTIVE PROTECTION

The appearance and development of different types of ammunition capable to neutralize the technique of the armored vehicles has thus determined the diversification of researches for making new types of armatures to reduce the effect of ammunition on target.

Throughout the multi-striated armature has been obtained an efficient protection against the perforated missiles, and also on the cumulative ones.

There are armatures of such types, where the non-metallic layer between the two layers of steel is "unmovable", like plastic reinforced with glass fiber or special rubber, but there are types where the middle layer is a foil of explosive.

The types of composite materials for the military use are some of the last-generation products of American Technology Applications Knowledge (ATAK) Incorporated, for example: ATAK-MAT-1,

ATAK-MAT-2, ATAK-MAT-3, ATAK-BLAST-1 and ATAK-BLAST-2 [3].

So, the ATAK-MAT-1 product is a composite material with polymeric matrix reinforced with fibers, resistant to corrosion and fire, being built especially for applications where the resistance to breaking, perforation and also the high reliability are particularities simultaneously required, being much superior to the conditions imposed under the MIL-L-46197 standard (fig.2) [3].

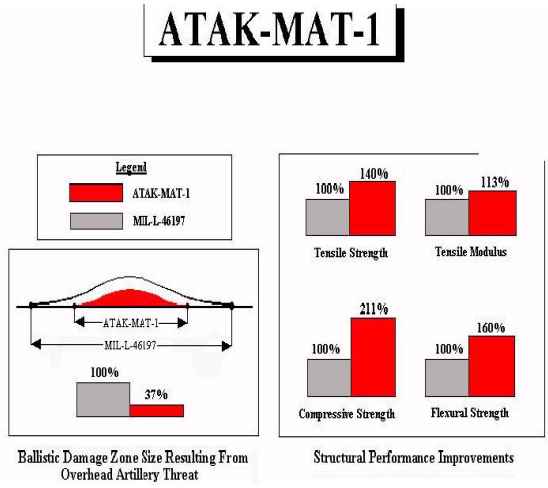


Fig. 2 Features of the ATAK-MAT-1 composite armature [3]

The ATAK-MAT-2 composite is superior in some ways to the properties of the ATAK-MAT-1 composite concerning the resistance, rigidity, the resistance to cyclic efforts of striking. And ATAK-MAT-1 is much superior to the conditions imposed by the MIL-L-46197 standard (fig.3) [3].

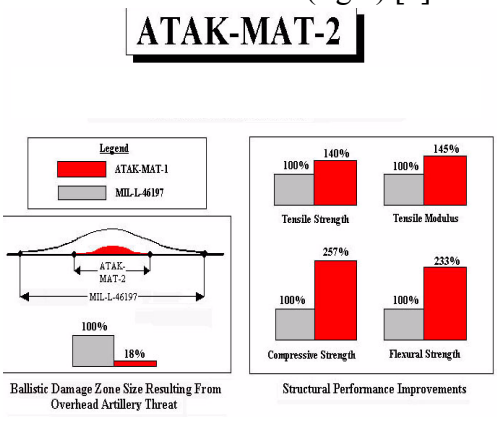


Fig. 3 Features of the ATAK-MAT-2 composite armature [4]

ATAK-BLAST-1 is a superior composite to those mentioned above, produced also by ATAK company. This composite material with polymeric matrix reinforced with fibers, together with the high tolerance to shocks has been specially designed for the armature of the armored vehicles' boarding. Concomitant with the high tolerance to shocks, this composite has been created to resist the fragmentation of mines with effect through blister and fragments (fig.4) [3].

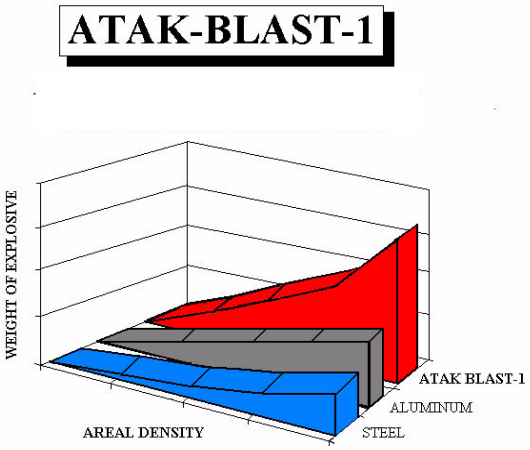


Fig. 4 Comparative graphic of the materials used at the armored battle vehicles construction [3]

3. OBTAINING LAYERED MATERIALS USING WELDING THROUGH EXPLOSION

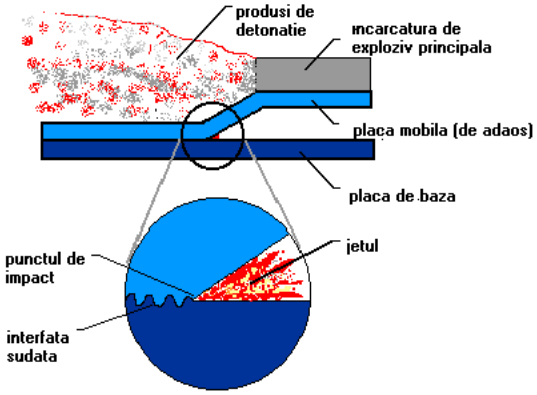
At the end of the first decade of the XXth century, the scientific research has been used on the explosives for technologic purposes, at the procedures treating medals. Thus, have been drafted more new technologies, among the method lining and welding through explosion.

The method of welding and lining and welding through explosion (containing welding through explosion of small metallic layers) [4], has a series of incontestable advantages: the possibility of welding of metallic combinations "incompatible" through another procedure, fastness in execution, (so that the possibility to obtain a high

productivity), but also the possibility to create the necessary explosives inside the country, this way assuring an independence related to any installation of source of conventional energy.

Because of the short period of welding procedure, the structural modifications inside the deposited layer are removed, this method being an economic method and can be applied on large proportions.

Fig. 5 Main and schematic representation of the welding through explosion procedure



At the welding through explosion there is a transversal impact between tow components that need to be welded, resulting a hydrodynamic action of the metals into the contact area.

After the skewed collision often results a high speed jet; this jet is made up from material elements deposited on the superficial layers of the two components [5].

The jet produces a cleaning of the interface area, followed by a strong push, which results in welding.

An ensemble image of the numeric simulation of the method of lining through explosion for several periods of time t [μs], from the moment of generation of rapping is presented in fig.6 [6].

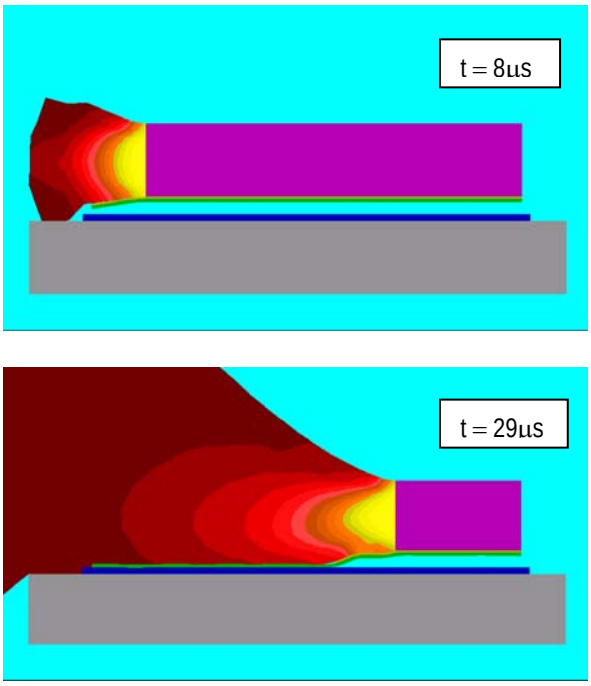


Fig. 6 Sequential phases of lining through explosion procedure, of time t [μs], [6]

Rapid transit phenomena, like the ones particular on lining through explosion, are affordable and can be treated sequentially to numerical simulation (fig.6) and represented as an effect of simulation, without drawing on sophisticated means of record, like ultra-fast cinematography, photocopying by x-rays are costly methods.

4. CONCLUSIONS

Among the issues mentioned above, the conclusion is that the tendencies in research in this domain consists in finding new light materials to ensure a high mobility of the armored vehicles, but the material's tasks concerning the resistance on the impact have to be superior to those materials used now, being defined by a superior protection at a larger area of means of perforation.

The types of materials describes, also the ones obtained by using the process of lining through explosion emphasizes once again that the laminated materials are the ones which, through its properties, can mostly satisfy the demands required by purchasers

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VELOCITY DETERMINATION USING LASER SYSTEMS

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Abstract: *In this paper are presented the experimental results obtained for the velocities determination around an aerodynamic profile consisting of a biplane configuration. The experimental results are obtain through laser Doppler method, the results consisting from the flow velocities around the profile and the determination errors.*
The laser Doppler method is a non-intrusive one (the phenomenon is not influenced by the measures) and its precision is at the order of the laser wavelength used.

Key words*: laser, Laser Doppler Method, biplane.*

1. Laser Doppler Method

The laser Doppler method uses a source the monochromatic laser light. The intersection of two laser beams reflected on the detector where they are forming a fringe net. The information regarding the velocities of the diffraction centers are contained in the diffraction field through the laser Doppler effect. The laser Doppler method is an indirect measuring method.

The basic principle of the laser Doppler method is presented in the figure bellow. The laser Doppler effect appears twice, once when the laser beam is incident on the moving particle, beam characterized by the wavelength λ_b and the frequency f_b and one when the reflected beam, with the frequency f_p, is received by a stationary detector having the frequency f_r.

$$f_r = f_p \frac{1}{1-\frac{e_{pr}\cdot v_p}{c}} = f_p \frac{\frac{e_b \cdot v_p}{c}}{1-\frac{e_{pr}\cdot v_p}{c}}$$

$$\approx f_b + f_b \frac{v_p(e_{pr}-e_b)}{c} = f_b + \frac{v_p(e_{pr}-e_b)}{\lambda_b}$$

$$(|v_p| << c, \mathrm{c} = \mathrm{f_b}\lambda_b) \qquad (1)$$

c is the sped of light in the specific environment.

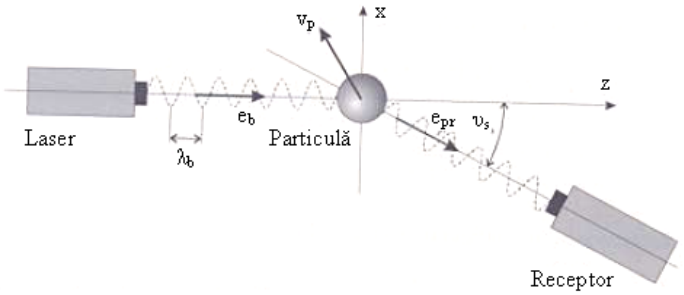
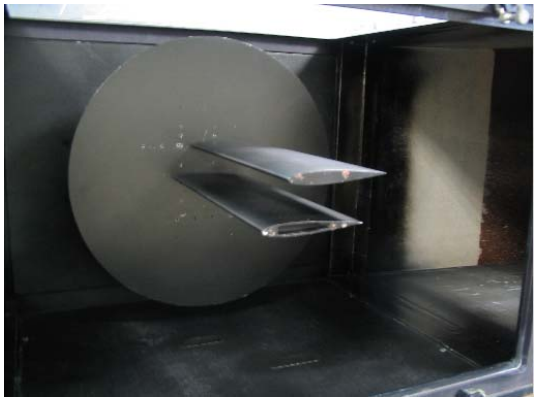


Fig. 1 – Laser Doppler effect

2. The configuration



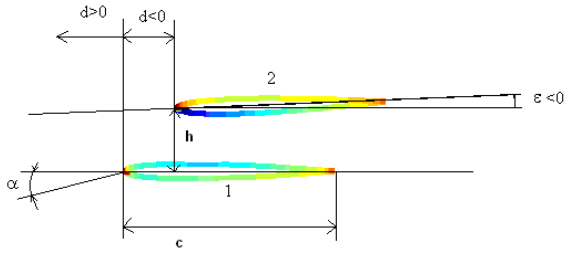


Fig. 2 – The measuring configuration

Notations:

- c – the profile chord
- d – the horizontal distance between the front of the two wings
- h – the vertical distance between the front of the two wings
- ε - the angle between the two wings
- α – the incidence angle (measured form the wing 1)

The configuration is made form two identical and rectangular wings, naca0012 profile, in biplane configuration.

The two wings were put in configuration by the help of a disc, resulting a bidirectional flow. An assembly between walls was chosen.

3. The measuring system

The measurements were made to determine one component of the velocity (horizontal). To determine two components of the velocity, two pairs of laser beams are necessary. For every component a different wavelength is used.

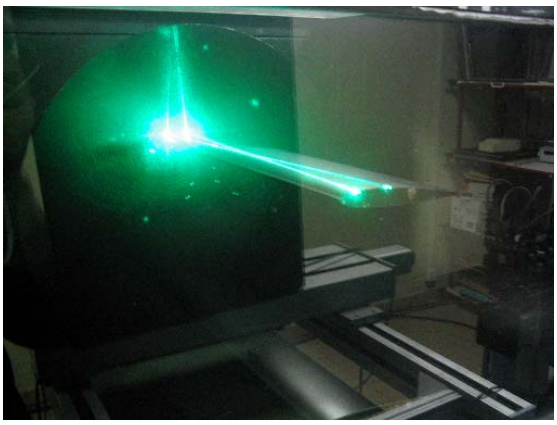


Fig. 3 – The measuring system

The measurements were made for different configurations and for two incidence angles 0 and 5^o.

These configurations are:

1) h/c=1.5, d/c=0 and ε=0
2) h/c=0.5, d/c=0 and ε=0
3) h/c=0.5, d/c=0.5 and ε=-3.

The measurements were made in an cross plane at the half of wings length. For the measurements, a net of measuring points was defined.

4. Results for the velocities measurements

1) h/c=1.5, d/c=0, ε=0, zero incidence configuration

In the image form bellow is presented the velocities distributions around a biplane configuration. The velocities configuration is the same as for a monoplane. The flow around the two wings is the same and it is symmetrical in rapport of the profile chord. The results are similar from the one in aerodynamics. The stopping phenomenon can be seen in fort and in the back part of the wing. Also, it can be seen that the velocity increases between the two wings because of the decreasing of the cross section.

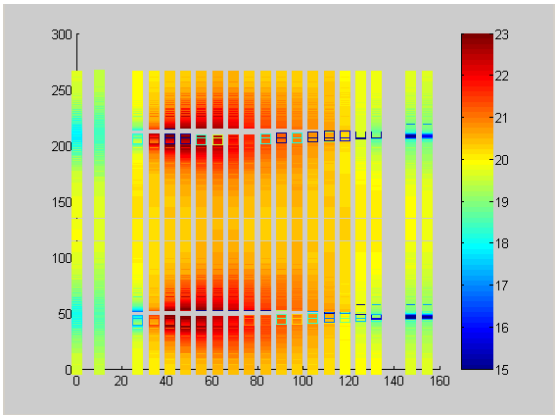


Fig. 4 – Flow field for h/c=1.5 d/c=0 and ε=0

2) h/c=1.5, d/c=0, ε=0, 5 degree incidence configuration

As in the image above, the flow field is similar with the aerodynamics theory. The interaction of the two wings can be seen. The

low is no longer symmetrical. In this configuration the stopping phenomenon can be seen more easily, especially for the wing bellow. It can be seen that the velocities in the above part of the wings are greater then the ones bellow, resulting in a lifting force. The difference between the velocities from the above and the bellow part of the wings is higher for the wing above.

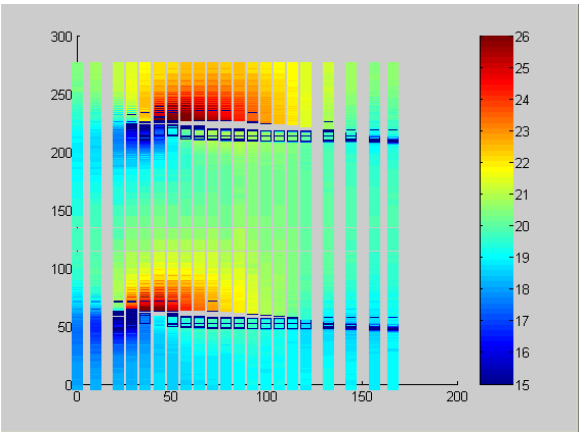


Fig. 5 – Flow field for h/c=1.5, d/c=0, ε=0, α=5

3) h/c=0.5, d/c=0, ε=0, zero incidence configuration

In the image bellow it can be seen that the velocities between the two wings is greater than the firs configuration, so the influence of the wings on each other is greater. The maximum velocity in the first configuration is 23 m/s, while in this configuration the maximum velocity is 26 m/s. The flow is no longer symmetrical in rapport of the profiles chord, but is symmetrical in rapport of a line between the two wings. The lower wing has a positive lift force and the higher wing has a negative lift force.

In this configuration the interaction of the two wings is more pronounced. The difference between the lower and the higher part of each wing being 3,5 – 4 m/s.

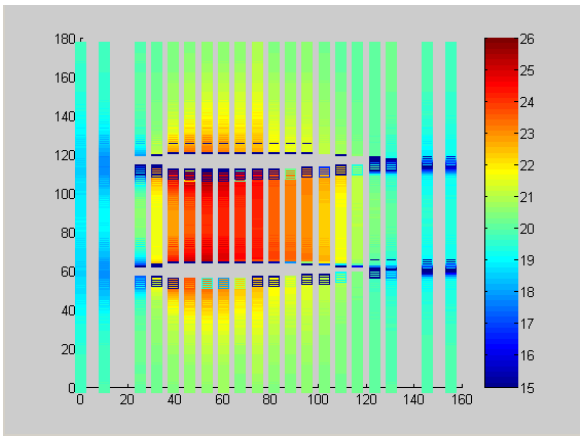


Fig. 6 – Flow field for h/c=0.5, d/c=0, ε=0, α=0

4) h/c=0.5, d/c=0, ε=0, 5 degree incidence configuration

In this configuration both wings have a positive lift force, but the one of the lower wing is greater. The velocities difference for the two parts of the lower wing is 7 m/s. In this configuration the velocities between the two wings increases.

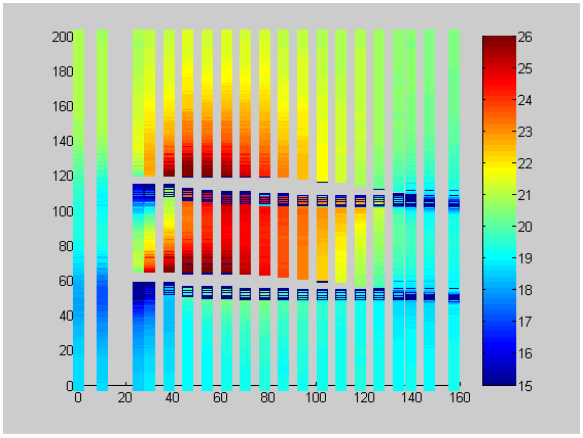


Fig. 7 – Flow field for h/c=0.5, d/c=0, ε=0, α=5

5) h/c=0.5, d/c=0,5, ε=3°, zero incidence configuration

In this configuration the higher wing is in front of the lower wing with a half of the chord and it is rotated with 3° form horizontal. In this case the stopping phenomenon is more pronounced for the higher wing. The velocities difference is grater for the higher wing. This configuration has a negative lift

force although the lower wing has a positive lift force.

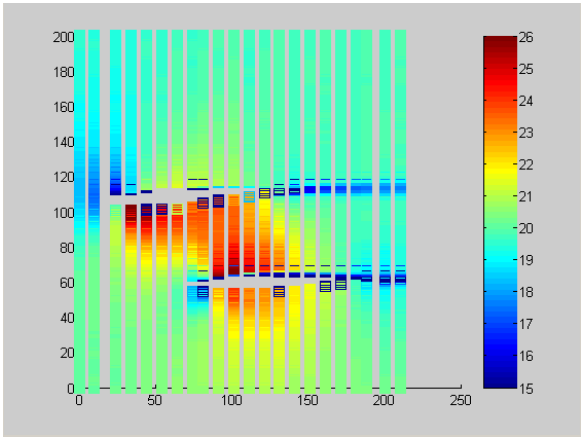


Fig. 8 – Flow field for h/c=0.5, d/c=0.5, ε=-3, α=0

6) h/c=0.5, d/c=0.5, ε=-3°, 5 degree incidence configuration

In this configuration the stopping phenomenon is more pronounced for the lower wing. The velocities differences is higher for the lower wing, which is the same as in reality.

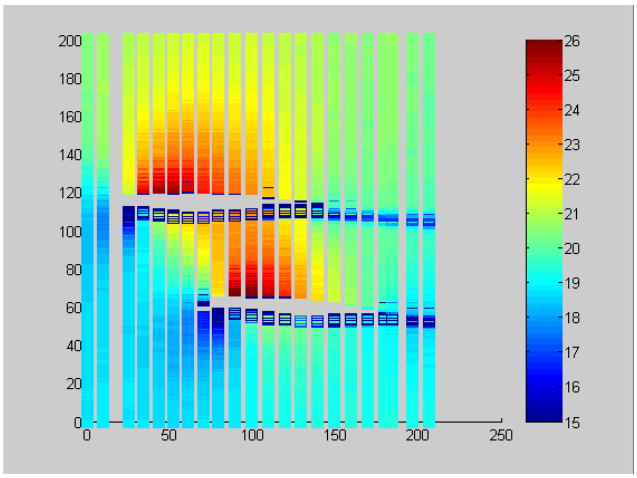


Fig. 9 – Flow field for h/c=0.5, d/c=0.5, ε=-3, α=5

5. Measuring errors

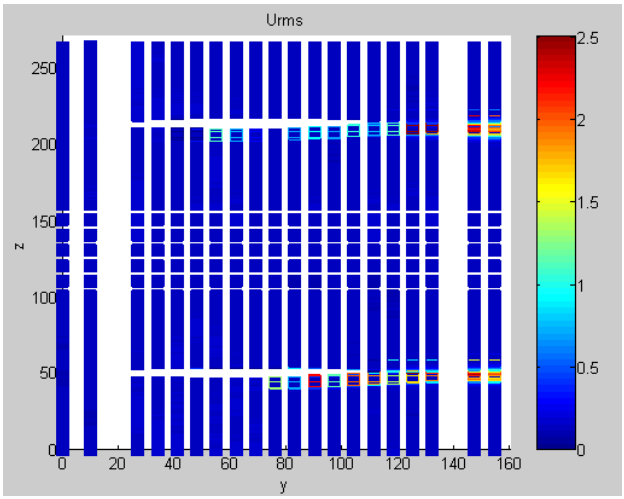


Fig. 10 – h/c=1.5 d/c=0 and ε=0 configuration

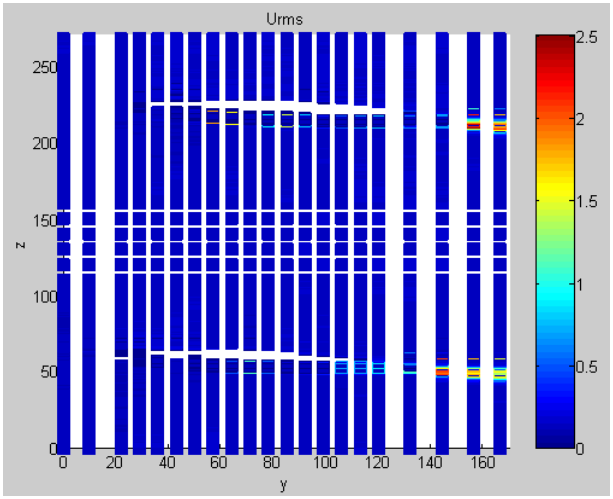


Fig. 11 – h/c=1.5, d/c=0, ε=0, α=5 configuration

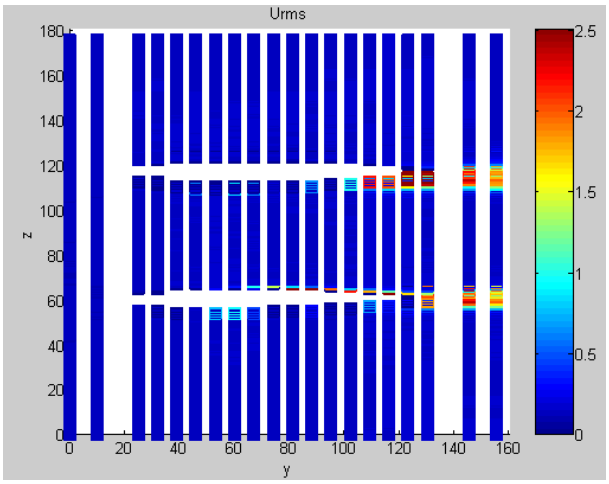


Fig. 12 – h/c=0.5, d/c=0, ε=0, α=0 configuration

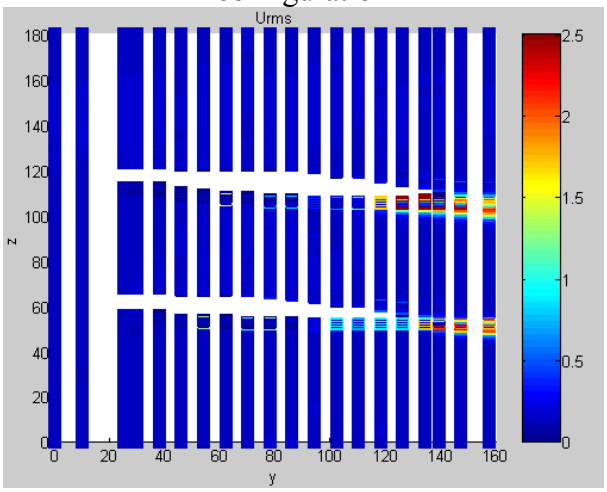


Fig. 13 – h/c=0.5, d/c=0, ε=0, α=5 configuration

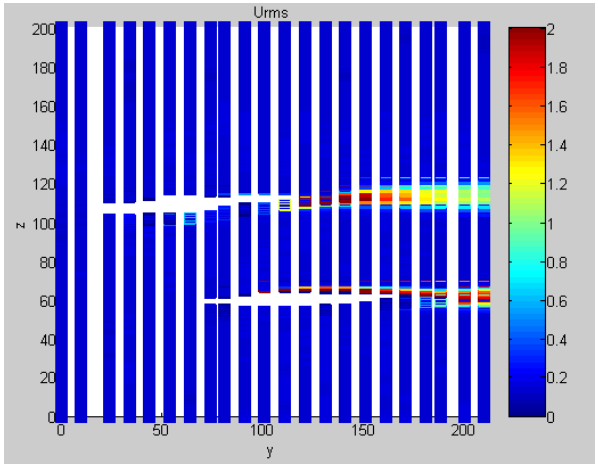


Fig. 14 – h/c=0.5, d/c=0.5, ε=-3, α=0 configuration

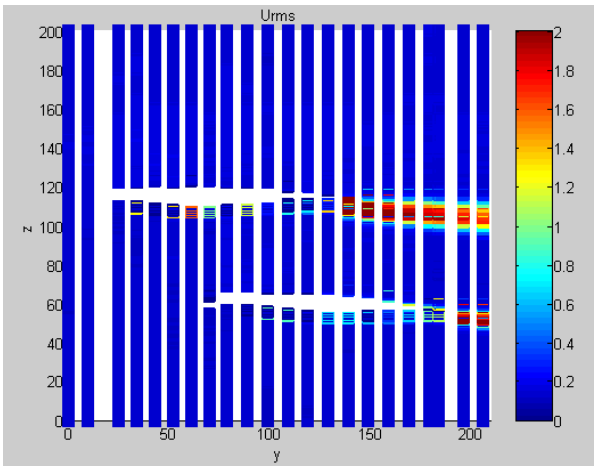


Fig. 15 – h/c=0.5, d/c=0.5, ε=-3, α=5 configuration

6. Conclusions

The chosen system configuration was a biplane for which the relative positions of the wings were modified. This modification were made in such a way to study as much cases as possible (a total of 6 configurations were studied), each with its own particularities.

For each point velocity measurement, a total of 1024 measurements have been made. The resulting velocity was an average of these 1024 results.

According to these multiple measurements for each configuration, the measurement errors were determined, the errors being negligible in rapport of the velocity measured (environ 0,1-0,2 m/s for velocities of 20 – 24 m/s). Higher values for the measurement errors appeared in points in which the system configuration influenced the measurements. Because of the system vibrations due to the flow around the profiles, close to the wings, the lasers beams were interrupted, resulting higher measurements errors.

The laser Doppler method is a non-intrusive one (the phenomenon is not influenced by the measures) and its precision is at the order of the laser wavelength used.

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AUTOMATIC VISUAL INSPECTION OF SPECULAR SURFACES

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Abstract: *In this article we wanted to see how specular highlights otherwise the glossy surfaces. Illumination was done from a single point and with different degrees of light with CCD camera software. First of all the specular surface was analyzed using a digital microscope, there have been several captures of image and the structure was then analyzed with a program for the micro-and nano image processing.*

Key words: *specular surface, BRDF, quality control, reflection.*

1. INTRODUCTION

Quality control is one of the most important aspects of competitiveness industrial. The high costs of human inspection done to promote and develop systems able to solve the tasks automatically. One of the greatest difficulties in inspection is the monitoring of the visual appearance. This is responsible in most times, human inspectors. The human visual system is suitable for operating in a world of variety and change, while the inspection process industrial visual, require the observation of a scene repeated so that they can abnormalities. The accuracy of human vision gets worse with work repetitive and monotonous. The inspection result is a slow, expensive and erratic. Inspection automated visual is obviously an alternative to human inspectors, freeing them from so alienating work. Among the possible scenarios of Automated Visual Inspection Systems, this paper has focused on visual inspection of ball bearings surfaces. The reasons for these restrictions are given by the complexities of designing these systems in general. In fact, over recent years, many architectures have been developed to detect visual defects and homogeneous flat surfaces such as textiles, wood, steel, aluminum, plastics, paper pulp and a host of industrial products, showing great interest to industry as well as applied research.

Various models have been used reflecting the concept of machine vision and graphics. Horn used diffuse reflectance Lambertian model and double-delta model to develop algorithms "shading shape (shape-from-shading) [HORN]. Phong proposed a parametric continuous function to represent reflection and speculation has used this model to produce synthesized images of objects [B Phong]. Woodham Lambertian model used to determine the shape of objects through stereo photometry [R. J. Woodham]. Ikeuchi specular model used „double-delta" to determine surface shape stereo speculation photometrically [K. Ikeuchi]. Pentland developed a local form of the algorithm "shape-from-shading" which involves reflecting Lambertiana [A. P. Pentland]. Coleman and Jain have proposed four-source photometric stereo speculation that removes reflections and diffuse reflections using Lambertian model to determine the form [E N. Coleman and R. Jain]. Sanderson, Weiss, and Nayar have used specular double-delta model to determine the surface speculation by means of highlighting the structure [A. C. Sanderson, L. E. Weiss, and S. K. Nayar]. Recently, Nayar, Ikeuchi, and Kanade developed photometric sampling method using a reflection model hybrid model containing both

Lambertian and specular how to highlight form and Lambertian reflection, speculation and complex surfaces [S. K. Nayar, K. Ikeuchi, T. Kanade].

2. SURFACE REFLECTANCE

How light reflects from a surface depends, among other factors of surface microscopic features.A smooth surface, for example, can reflect incident light in one direction, while a rough surface will tend to scatter light in different directions. To accurately predict the incidence light reflection, we must have knowledge about the microscopic irregularities of the surface order, in other words, we need a model surface. Surfaces can be divided into two categories: areas with known profiles and areas with irregular surfaces. Profile can be accurately determined by measuring the height of each point on the surface with a sensor, such as profilometers. This method, however, is rather cumbersome and also inapplicable in many practical situations [Shree K. Nayar].

3.BIDIRECTIONAL REFLECTANCE FUNCTION

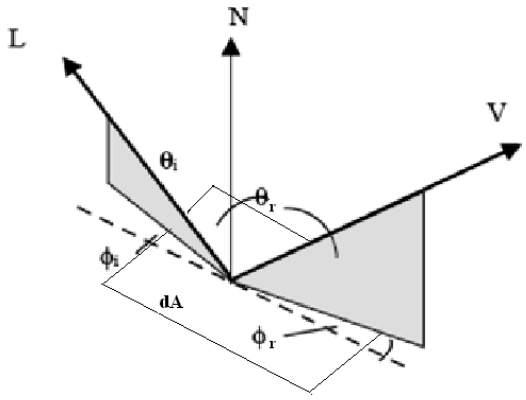


Fig. 1. Bidirectional Reflectance Concept

Reflection is fully described by the bidirectional reflectance function (BRDF). The image synthesis is seeking more efficient modeling and complete this mode of interaction of light with objects. Intensity and wavelength light reflected from a surface of an object depends on several factors: length wavelength of incident light, angle of incidence, nature area and its properties Electrical: permittivity, permeability and conductance. Precise model of interaction is extremely complex and it can be approximated by the reflection function bidirectional (bidirectional reflectivity function - BDRF), which allows an assessment quantitative suggestive enough to illuminate objects in the graphics rendering computer.

Bidirectional reflectance function is the relationship between light intensity reflected in the direction ($\varphi_r\theta_r$) and light energy received from the direction ($\varphi_i\theta_i$):

$$R_{bd}(\lambda,\varphi_i, \theta_i,\varphi_v,\theta_v) = \frac{Iv((\lambda, \varphi i, \theta i, \varphi v, \theta v))}{(E\downarrow i(\varphi i, \theta i))} \quad (01)$$

$$q(\theta_i,\varphi_i,\theta_r,\varphi_r) = \frac{L_r(\theta_r, \varphi_r)}{dE_i} = \frac{L_r(\theta_r, \varphi_r)}{L_i(\theta_i, \varphi_i)\cos\theta i\, d\omega_i} \quad (02)$$

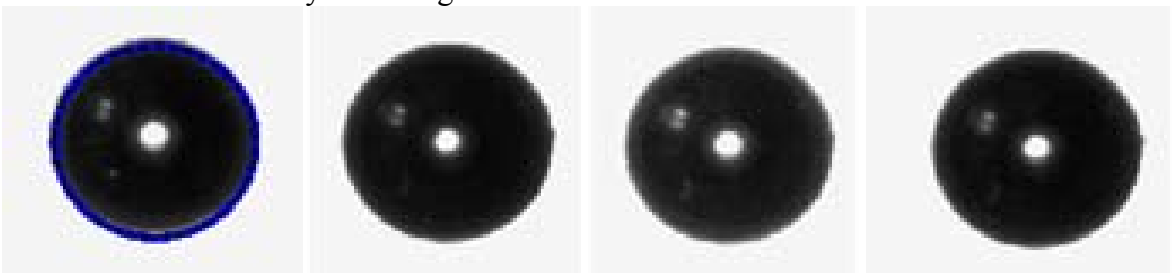
Two-dimensional reflectance function value is determined by surface type (type of material, method of surface processing), while measuring the surface state (oxidation, roughness) and, indirectly, the surface temperature. Relationship between incident light energy corresponding to a solid angle ω_i and intensity I_i is:

$$E(\phi_i, \theta_i) = I_i(\phi_i, \theta_i)\cos\theta_i d\omega_i \quad (03)$$

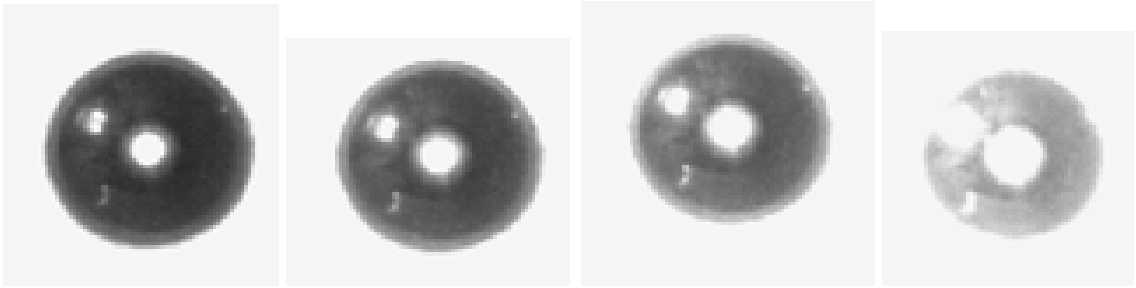
For computer graphics can be considered in a simplified manner that reflected intensity is composed of three components: component reflecting directional (specular) component directed and diffuse reflection component Ideal diffuse reflection. The first two components are due to reflection of primordial and ideal diffuse reflection component due to multiple reflections of subsurface reflections.

Component values depend on the roughness reflected intensities surface and the wavelength of light. If the mirror surface would be perfect then the only component of reflected light would be directed component (Specular). For real surfaces, with a degree of roughness component specular reflected $\phi_v = \phi_i$, $\theta_v = \theta_i$. The intensity of this component depends surface roughness: the surface is

smooth, the specular component is higher. Directed diffusion component also depends on the initial reflections order. Directions are scattered hemispherical reflectance centered in point incidence, but there preferințială direction that is towards reflection speculation for surfaces with low roughness. Ideal diffusion component reflects light in all directions within a semisfere centered point of incidence, due to scattering caused by subsurface components. Bidirectional reflectance function by breaking into three components can develop an analytical model based on physical, optical and geometric, which allow simulation of illumination and reflection in computer graphics. Reflectance model Phong is the most popular model in computer graphics, which takes a representation empirical and phenomenological, the formula for calculating simple imitation of behavior theoretical reflectivity of light, described above.



(a) =1500 (b)=5500 (c)=10000 (d) =15000



(e)= 20000 (f)=25000 (g)=40000 (h)=70000

Fig. 2. DVT Camera image of a specular surface where it was varied the degree of illumination

4. DVT camera

DVT configuration is based on a CCD sensor in close connection with a microprocessor. During this inspection system two important phenomena occur: image acquisition by CCD (digital) and transferred directly to the microprocessor memory of the place of analysis and image processing. Finally, inspection results are stored by other devices. Processing and image acquisition can take place simultaneously. However those tasks are carried out with two intermediate memories are intended for storage (acquisition and analysis). Each buffer can store only one image, regardless of the size of acquisition window. Therefore, a new image can not be acquired unless gained last image was moved to the memory of inspection.

5. CONCLUSION

Surface imaged texture depends on the lighting conditions which affect the analysed surface. A reduction or an increase in the light intensity may affesct the resultant imaged texture. Changes in the direction of the light combined with the surface relief may also modify texture perception. Properties like spectral distribution of the incident light also contribute to the image formation process. if the object contains concave regions, either on a meso scale (three-dimensional surface corrugations or roughness), or on a macro scale (concave shapes) reflexes will occur. In this article was presented only concave surface.

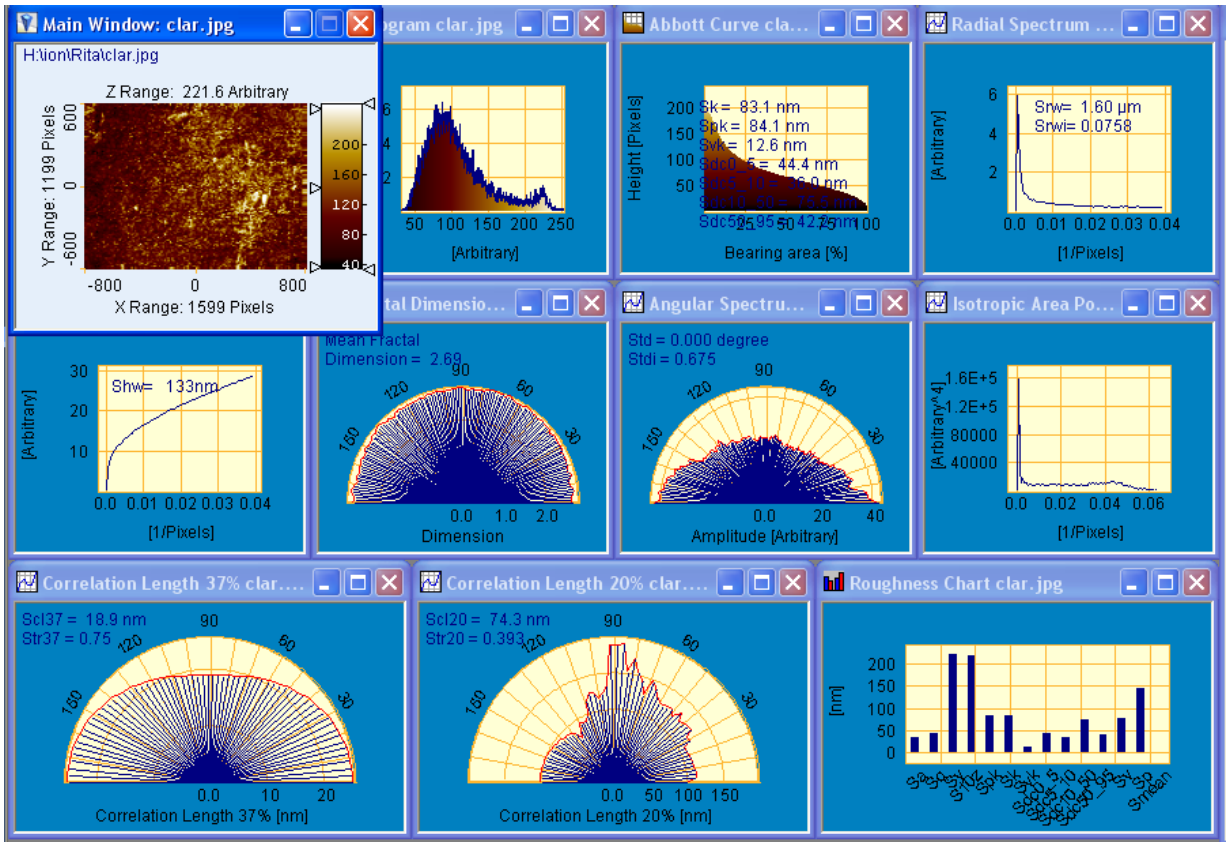


Fig. 3. *Specular Surface* Parameters

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AUTOMATIC VISUAL INSPECTION OF MATTE SURFACES

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Abstract: *In this article we wanted to see how specular highlights otherwise the matte surfaces. Illumination was done from a single point and with different degrees of light with CCD camera software. First of all the matte surface was analyzed using a digital microscope, there have been several captures of image and the structure was then analyzed with a program for the micro-and nano image processing.*

Key words: *matte surfaces, CCD camera, optical inspection, surface roughness*

1. INTRODUCTION

Measuring tasks in the field of visual inspection require high quality image data. The necessary quality is often achieved by applying image fusion methods across sensors, also called multimodal analysis. With one camera only it is often impossible to achieve a representation of sufficient visual quality. The reason for this is the manifold interaction between the illumination, the object and the observation optics on one hand, and the limited sensing capabilities of common 2D intensity sensors to measure the information-bearing light field on the other hand. Image optimization can be achieved by a multimodal analysis, i.e. fusing images of the same scene acquired by different sensors or taken with different illumination and/or observation parameters (e.g. illumination direction, structured illumination, camera position and orientation, spectral response, focus, etc.) If the image acquisition is done with the same sensor, but with at least one varied acquisition parameter the sensors are also called ‘‘virtual’’ sensors.

2. SURFACE MODEL

Reflection from a roughened surface is assumed to be composed of two components: specular reflection from mirror-like surface facets and a diffuse component. The diffuse component may originate either from multiple reflections among the facets or from internal scattering, while the specular component is subject to mutual shadowing and masking by adjacent facets.
The reflected flux is thus pictured as being composed of a uniformly scattered component plus a perturbation due to the mirror-like facets. This model of reflection is in general accord with measurements of the state of polarization of light reflected from rough surfaces.

3. SURFACE ROUGHNESS

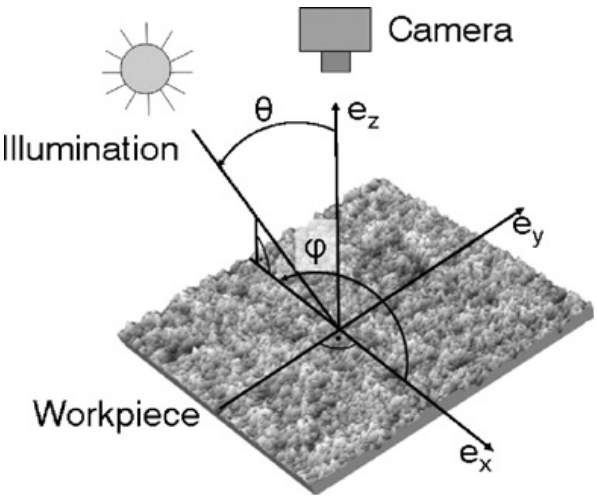

Fig. 1. Surface model

Surface texture often consists of different scales of variation, denoted as roughness and waviness which are illustrated in Fig. 3. Roughness consists of small scale variation

whereas waviness refers to larger scale variation. In the paper industry surface roughness is classified into three different classes:

- Optical roughness at length scales smaller than 1 μm,
- Micro roughness at 1 μm -100 μm,
- Macro roughness at 0.1 *mm* - 1 *mm*.

Optical roughness is connected to the surface properties of individual pigment particles and pulp fibers. Micro roughness consists of the shapes and positions of fibers and fines in the paper surface. Macro roughness results from variation in the paper basis weight. All these three roughness classes affect paper gloss, and micro and macro roughness also affect paper uniformity. The roughness surface can be characterized by statistical analysis and time series analysis in the spatial or frequency domain. In statistical analysis, the roughness is characterized from the height distribution of the roughness surface. The traditional roughness values for profiles from surfaces are root-mean-square roughness *Rq* and average roughness *Ra*.

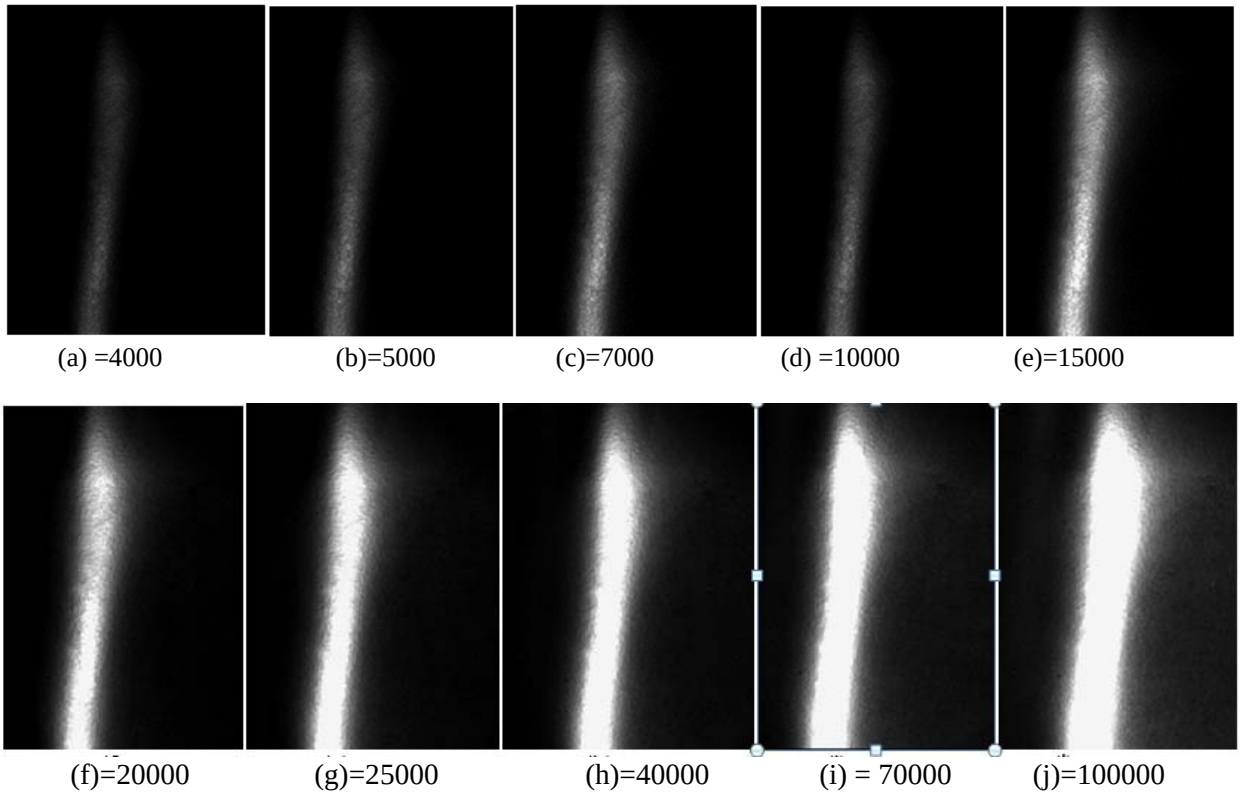

Fig. 2. DVT Camera image of a matte surface where it was varied the degree of illumination

The 2D counterparts are denoted as *Sq* and *Sa*. The root-mean-square roughness, *Sq*, corresponds to the standard deviation of the roughness surface and is defined as

$$S_q = \sqrt{\frac{1}{MN}\sum_{k=0}^{M-1}\sum_{l=0}^{N-1}[z(x_k,y_l)]^2} \qquad (01)$$

where *M* and *N* are the number of data points in the *x*- and *y*-directions and $r(x, y)$ is the height value of the roughness surface at point (x, y).

The average roughness, *Sa*, is the absolute height deviation of the roughness surface and is given as

$$S_a = \frac{1}{MN}\sum_{k=0}^{M-1}\sum_{l=0}^{N-1} f\left|z(x_k,y_l)\right| \qquad (02)$$

The Surface Skewness, *Ssk*, describes the asymmetry of the height distribution histogram, and is defined as:

$$S_{sk} = \frac{1}{MNS_q^3} \sum_{k=0}^{M-1} \sum_{l=0}^{N-1} [z(x_k, y_l)]^3 \quad (03)$$

If *Ssk* = 0, a symmetric height distributions is indicated, for example, a Gaussian like. If *Ssk* < 0, it can be a bearing surface with holes and if *Ssk* > 0 it can be a flat surface with peaks. Values numerically greater than 1.0 may indicate extreme holes or peaks on the surface.

The Surface Kurtosis, *Sku*, describes the "peakedness" of the surface topography, and is defined as:

$$S_{ku} = \frac{1}{MNS_q^4} \sum_{k=0}^{M-1} \sum_{l=0}^{N-1} [z(x_k, y_l)]^4 \quad (04)$$

For Gaussian height distributions S_{ku} approaches 3.0 when increasing the number of pixels. Smaller values indicate broader height distributions and *visa versa* for values greater than 3.0.

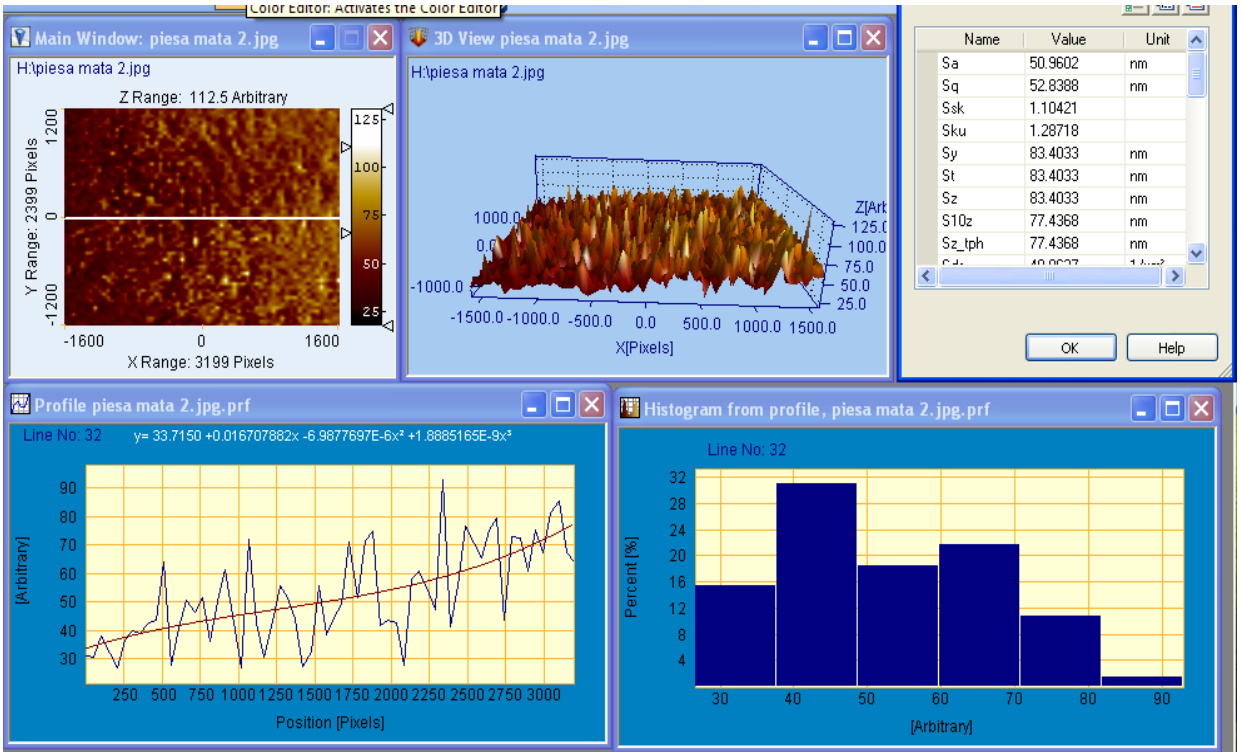

Fig. 3. *Roughness Average* Parameters

The Peak-Peak Height, are denoted by three parameter names, Sz, St, Sy, according to ISO, ASME. They are defined as the height difference between the highest and lowest pixel in the image.

$$S_z = S_{t-} = S_y = z_{max} - z_{min} \quad (05)$$

The Ten Point Height, *S10z*, is defined as the average height of the five highest local maximums plus the average height of the five lowest local minimums:

$$S_{10z} = \frac{\sum_{i=1}^{5} |z_{pi}| + \sum_{i=1}^{5} |z_{vi}|}{5} \quad (06)$$

4 . DVT CAMERA

DVT configuration is based on a CCD sensor in close connection with a microprocessor. During this inspection system two important phenomena occur: image acquisition by CCD (digital) and transferred directly to the microprocessor memory of the place of analysis and image processing. Finally, inspection results are stored by other devices. Processing and image acquisition can take place simultaneously. However those tasks are carried out with two intermediate memories are intended for storage (acquisition and

analysis). Each buffer can store only one image, regardless of the size of acquisition window. Therefore, a new image can not be acquired unless gained last image was moved to the memory of inspection. Similarly, an image can not be moved to the inspection buffer except the last image has been completely processed.

Advanced illumination is a lighting solutions company, primarily serving the Machine Vision Industry. Advanced illumination manufacture a wide array of solid state, Light Emitting Diode (LED) lighting products as well as supporting drive and control electronics. Since Ai's inception in 1993, their mission has been to simplify and improve the implementation of machine vision systems through the use of their proprietary lighting technologies.

Once the system has completed its inspection of a part, it must be able to communicate with the "outside world" to control the manufacturing process, communicate PASS/FAIL information to a database, or both. Usually, a digital I/O interface board and/or network card make up the interfacing through which the machine vision system communicates with the outside systems and databases.

CONCLUSIONS

The diffuse model is lighter on the right and darker on the left due to the effects of vignetting, shadowing, and interreflections and the surface attitude effect; the specular model shows clearly the first, second, and third and even higher order reflections (although the outermost circles in the patterns are merged from about the sixth order due to the resolution of the images); the glossy model displays a pattern that is intermediate between that of the diffuse and the specular models.

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STUDY OF MECHANICAL CHARACTERISTICS AND SURFACE OF GRAY IRON PARTS COATED WITH TITANIUM ELECTRODE USING IMPULSE DISCHARGE METHOD

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Abstract: *The paper presents a study of the characteristics of thin layers obtained by deposition using the material added titanium electrode and the material base of grey cast iron. The depositions were obtained using impulse discharge method, thus resulting hard layers, with micrometers thickness. Surface quality was analyzed using optical microscope and scanning electronic microscope and hardness determination was made by using Vickers micro-hardness.*

Keywords: *impulse discharge method, deposition, scanning electronic microscope, micro-hardness*

1. INTRODUCTION

Imposed functional characteristics of the machines on the consumer market (higher power, improved efficiency, bigger lifetime etc.) require the use of special surface proprieties materials (defined as interface between material and environment). To obtain these materials is a continuous challenge for the research and industry.

The paper fits in the vanguard domain of the actual researches, in the metallurgical domain, such as surfaces micro alloying using the properties of the achieved thin layers.

This method is a hybrid between welding and metallic coating. Nowadays, products achievement supposes the use of new materials, artificially created, with high hardness, high corrosion resistance, refractoriness, wear resistance [3].

Deposited layers with vibrating electrode, according to the predominant play the piece has, can have different purposes such as wear resistance, special physical chemical properties, corrosion resistance etc. Electrode type chooses according to the purpose of the deposition.

Vibrating electrode method is used for coating components of the installation that works in hard abrasive were conditions in wet and dry environment. In wet environment beside the mechanical stress, the material must resist to chemical corrosion also.

Electric sparking alloying of the metallic surfaces is bases on the polarized erosive effect and on the transfer of the anode material (electrode) on cathode (piece) at the impulse electric discharge in gaseous fluid.

2. METHODOLOGY

To process the materials using electric sparking having as objective removing a part from the material (cutting, drilling, polishing, etc.) direct polarity is used, part being the anode, in case of coating the part plays the cathode (layer coating).

Processing can take place in the air, gaseous protective environment or liquid environment.

Comparring with others methods used for metal surface coating, deposition and alloying method of metallic surfaces by electric sparking reveals a series of advantages [1]:

- Ensures a high adherence with the base material;
- No special surface finish is required;
- High melting point materials can be deposited; (Mo, W, Ti);

- Pollution effect is reduced to minimum and excludes totally some non-metallic toxic compounds, like cyanides from coating;
- Alloying can be supplemented from the elements from surrounding discharge environment (nitrogen, carbon, boor);
- Quenching of coated material from liquid stage is produced.

So, coating principle by electric sparking creates a layer with special proprieties depending on the electrode and discharge environment. A important request of the method consists in discharged energy between electrode and part, process starts by closing the electrode to the part, when at a certain distance the space is penetrated, and electric spark is produced, that continues until the contact from the electrode and part.

Owing to sparking energy, the electrode surface develop some electric erosion cracks due to melting and vaporising, and the material is deposited on the part surface under the hydrodynamic action of the plasma flow.

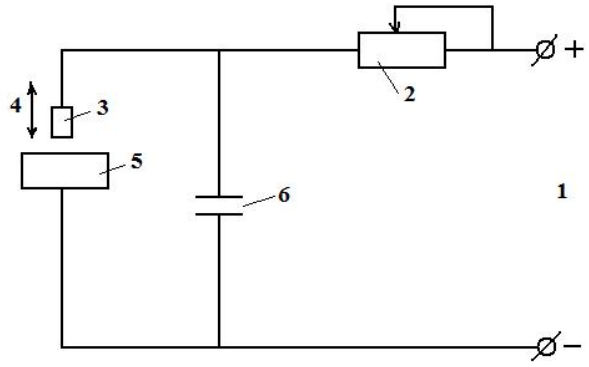

Fig. 1 Electric sparking coating method principle; 1 – current source, 2 – electric resistance, 3 - electrode, 4 – Electrode vibrator, 5 – coated part, 6 – Condenser.

The process course is with a certain electrode vibration frequency and certain amplitude, resulting by vibrating electrode sparking chemical composition and mechanical proprieties modification. In comparison with other methods of coating, electric sparking coating base is using simple installations and some easy to build technologies. Installation consists in a continuous current table and an electric spark discharge circuit (fig. 1). The electrode is vibrated with a frequency of 50 ÷ 200 Hz.

3. RESULTS AND DISCUSSION

Ferrite-pearlite cast-iron used for the experiment and chemical composition is presented in table 1. The chemical composition determined by means of Foundry Master Spectrometer. Tests were made with the apparatus type Elitron 22A [5]. The electrode used for coating is Ti. Ti electrode coatings with one layer were made.

Impulse discharge hardening can be used with benefit on desalinisation water pumps, which are working in high wear conditions, to increase their lifetime [2].

Table 1 Chemical composition of the base material, %

C	Si	Mn	S	Cr	Ni	Cu
3.97	2.87	0.25	0.07	0.28	0.126	0.17

3.1. One-way deposition using Ti electrode

One layer Ti coating microstructure is presented in figure 2. The picture was made at 400X zoom.

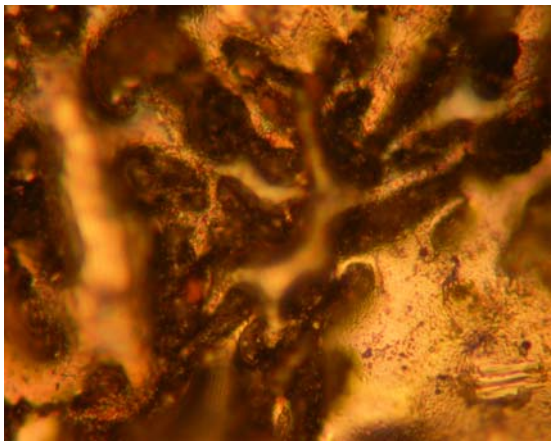

Fig. 2 Ti coating microstructure.

In one way deposition, the deposits with Ti electrode (fig. 3) are compact, due to the atomic number of Ti (22), which is closer to Fe (26), meaning that the difference of atomic radius is very small. This makes titanium transfer easily from interface to substrate. The exterior layer of the ferrite-pearlitic iron stands a partial melting, which made possible titanium micro alloying.

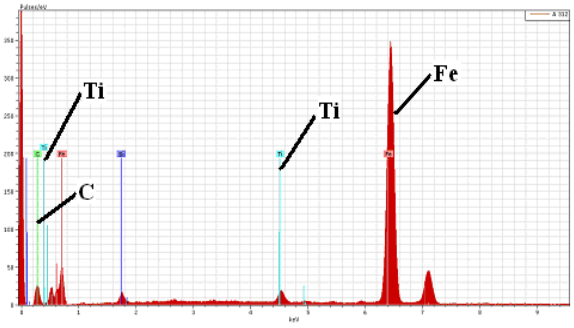

Fig. 3 Ti simple layer coating spectrum.

It achieved a thin layer with discontinuous micro zones, without material withdrawals. Titanium has good coating qualities when base material is ferrite-pearlitic iron.
The photos and the chemical composition of the layer achieved by means of electronic scanning microscope.

Table 2 Chemical composition of Ti single layer coating, %

Element	Fe	C	Ti	Si
%	88.32	7.258	2.417	1.995

In table two, it is given the chemical composition of the deposit layer with Ti electrode, one-way deposition.

From the pictures made to analyse the layer thickness (fig. 4), with element distribution we observe Ti and Fe presence at the surface and a slightly interpenetration, this is due to alloying of the two elements in micro-baths corresponding to melted drops. Good to highlight in the fact that the graphite remains not dissolved in the bath, graphite lamellas maintaining the same shape, even if it crosses one melted drop.

Ti layer thickness vary between 24,75 ÷ 30,63 µm.

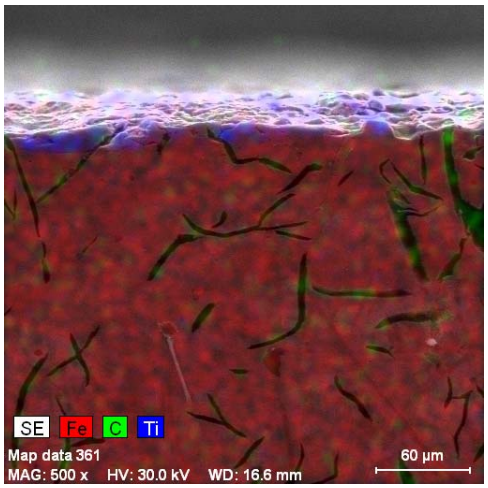

Fig. 4 Ti Layer thickness.

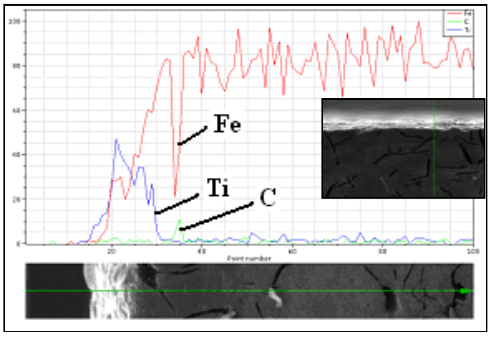

Fig. 5 In line layer thickness.

From the inline analysis (fig. 5) we can see the compact layer graphite alloyed with Fe; the layer area presenting a Ti structure between 20 – 48 % and Fe between 30 – 60 %, C keeping in percentage under 1 % and it is compact in carbon lamellas area.

3.2. Hardness of the Ti coating layer

To measure the micro-hardness PMT 3 micro-hardness tester was used. Wickers Hardness was used as a method. The weight of the penetrator was 50g (HV50). When you choose the micro-hardness testing method of different coatings structure and proprieties of the layer must be taken in account [4].

Table 3 Micro-hardness variation HV 50

Base material	Ti single layer
400	729.96

Micro-hardness measurements values can be observed in figure 6. After coating

samples were polished, on the section and chemical attacked.

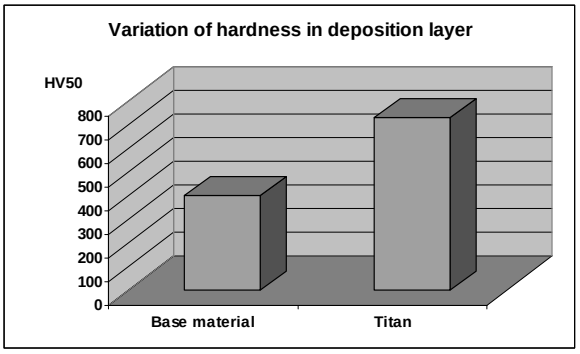

Fig. 6 Ti layer hardness value.

Micro-hardness measurements were made because of the small layer thickness (tens of microns). The penetrator was used on the section and not on the coating surface so the values will represent only the layer hardness not influenced by the base layer hardness.

4. CONCLUSIONS

1) The method has practical applicability, not only for the reconditioning of the parts but also for increasing the hard conditions functioning life of grey cast-iron parts.

2) For Ti electrode coating, one layer, we can see that the exterior layer of the sample part is relative compact, with small number and fine cracks.

3) Ti layer thickness vary between 24,75 - 30,63 μm, this indicates a good coating uniformity with very small surface flatness deviations and small roughness.

4) Comparing the results from the micro-hardness we can see the Ti coating has a bigger value that the base material (base material 400 HV_{50}, and coating layer 729,96 HV_{50}).

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MATERIALS MANAGEMENT

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Abstract: *Both manufacturing industries and in those with large investment per unit of product, material function is primarily a service operation, its main role is to serve other functions directly lucrative, such as production or operations. Therefore, the objectives of "material" should be closely aligned to the goals of these functions and general objectives of the enterprise.*

Key words: *materials management , material handling , materials planning.*

1. INTRODUCTION

By "materials management" I mean all those functions involved in the process of budgeting and logistics, from initial identification to final end user or consumer reception.

Normally, some of these functions are not subordinated to the materials manager, but rather the financial department, engineering or production, but by my opinion, it is necessary to include:

- technical conditions;
- supply, purchase and shipment;
- inventory control;
- storage and materials handling;
- ensuring, testing and monitoring of quality;
- internal and external distribution.

Although all these functions exist in manufacturing industry, their relative importance and approaching mode of any functions are very different in each industry with large investment per product unit.

2. MATERIALS DEFINITION

The traditional US Army and Air Force spelling of material is:

"All items necessary to equip, operate, maintain, and support military activities without distinction as to its application for administrative or combat purposes. This includes ships, tanks, weapons, aircraft, and related spares, repair parts, and support equipment, but excluding real property, installations, and utilities".

Defense Materials Management Processes include materials requirements, materials planning systems, materials acquisition and sustainability (figure 1)

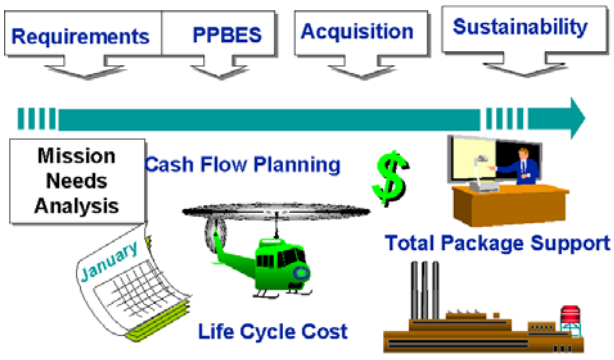

Figure 1. Defense Materials Management Processes

Increased reliability and maintainability, purchases directly from the manufacturer, and on-the-spot manufacturing are the pricipal characteristics of this process.

Materials management requirements are:

1. Advanced miniaturization;
2. Communication systems;

3.Computer Aided Design and Computer Aided Manufacturing;

4. Recycling concepts deliver requirements (figure 2)

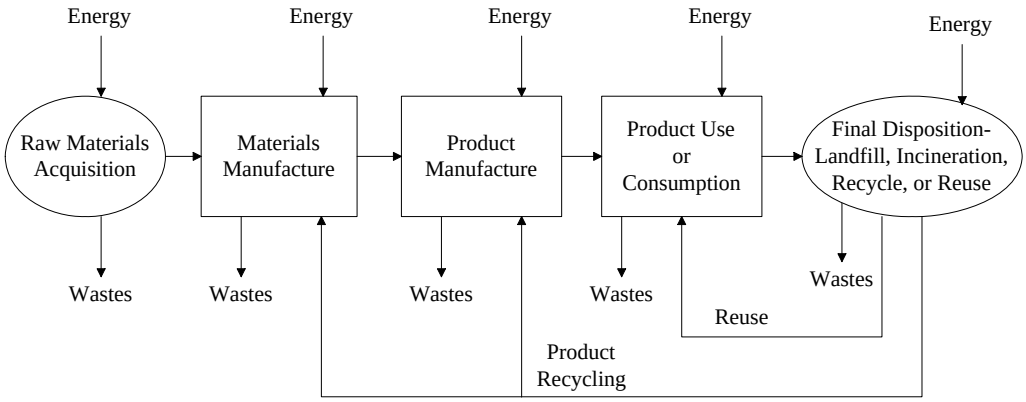

Figure 2. General materials flow diagram for a product life cycle (Boguski 1996).

A primary consideration in the logistics system of the future will be that of increased reliability of replacement parts. Improvements in reliability, maintainability and deployability are indeed challenges to traditional logistics concepts.

A magnitude of increased reliability would result in a decreased need for inventory parts, storage costs, time, and effort expended in testing for defective components and replacing critical parts. Greater reliability of equipment and parts would also result in greater ease of monitoring safety levels of stock.

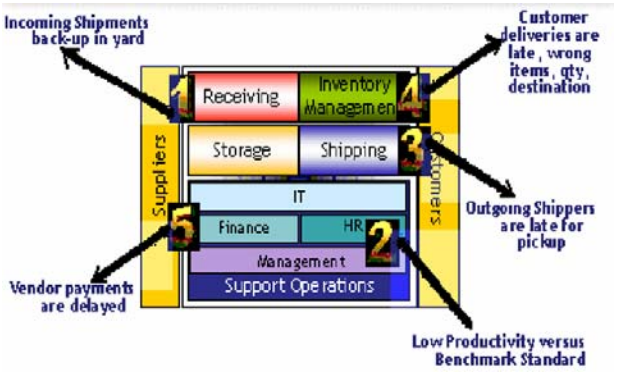

Figure 3. Supply depot operating circumstances

3. MATERIALS HANDLING

Material handling refers to the handling, storage, control, and flow of materials throughout a facility. A material handling system (figure 4) provides efficient flow paths, coordinates supply and demand, minimizes damaged goods, and maximizes storage space. Pre-assembling the parts can also help reduce material movement costs. The successful operation of any enterprise depends to a great extent on an efficient and effective system.

Material handling can be categorized into four areas:

(1) Shop material handling (the shops rely on forklift trucks, conveyors, and cranes to move material);

(2) Weapon systems block material handling (the weapon system is assembled by using special transporters and cranes);

(3) Weapon systems movement (Navy ship systems are moved by using dry docks, tugboats, or pontoon launchers with translation rail systems);

(4) Movement of small parts and tools in on-board and on-block environments (personnel travel from the work site to another location to obtain these items).

Figure 4. Special crane used in ship block material handling

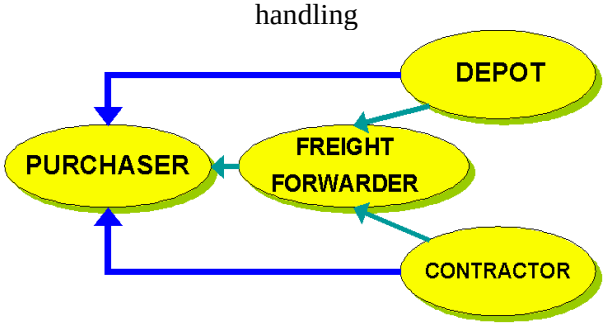

Figure 5. Materials Movement

4. MATERIALS PLANNING

It is in this area that a huge variety of techniques have been invented. The techniques fall into two themes:

1."Push" systems (triggered by interpretation of the expected demand and scheduling of supply to meet that demand)

2."Pull" systems (replenishment systems triggered by the usage or depletion of stock)

Dealing with the Pull systems first, they are a group of techniques that aim to ensure that when stock is used, it is replenished. In it's simplest form there is "Replacement", which simply replaces used items. This technique is commonly used for maintenance spares and grocery restocking and my partner. This is also the underlying principle of "Kanban" systems. "Reorder-point" systems invented by operational researchers sophisticated this process in the Second World War by taking into account:

- The variability of supply and demand (introducing safety stock);
- Lead-time to replenish, which ordered replacements at a point (the reorder-point) where allowing for the lead-time and forecast demand they would be available before using the safety stock.
- Later smoothing algorithms (exponential smoothing) were introduced to take more account of recent demand. At the same time a technique was introduced to deliver to the next stage in the process all the parts required for the next period's work.

This technique ("Period Batch Control" by Burbidge) synchronized the arrival of components for sub-assembly and sub assemblies for final assembly by allowing a period for the production of all the parts required for the next stage.

Using a weekly period as an example:
Week 1: Order parts from supplier
Week 2: Deliver to the component manufacturing process by the end of the week.
Week 3: Make components by the end of the week
Week 4: Make sub assemblies by the end of the week
Week 5: Make final assemblies and deliver to customer by the end of the week

In this example the lead-time is fixed and is 5 weeks.

The technique was a huge step forward in coordinating the supply of parts for "A", and "X" type products. It required a Bill of material (parts-list), to drive the schedule for the preceding stage. In the automotive industry computer based scheduling based on multiplying demand by exploded Bills of Material was starting to be used to produce forward fixed weekly schedules for suppliers by the mid 1970's, using commercially available computers.

These fixed cycle schedules are still the most common method of communicating demand to suppliers in the automotive industry today.

5. CONCLUSION

Sales and purchasing departments continue to use consignment stocks as a bargaining chip and a way of losing stock from the inventory respectively. Depending if the accountant

belongs to the customer or supplier, they will argue: "a way of reducing stock and deferring payment" or "increased administration" respectively. In a lean organization and to the inventory planner the arguments are irrelevant, the stock is still there and it should be minimized to improve the whole supply chain. A logical extension of this concept is that the major retail outlets become property owners rather than retailers with their aisles owned by the supplier!

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MATERIALS REQUIREMENTS PLANNING - MRP

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Abstract: *Chronologically Materials Requirements Planning (MRP1) came next initially with fixed period lead-times ("bucketed" systems). This is the scheduling engine required for Period Batch Control, which utilized the Bill of Material within it and the scheduling rules (periods) to produce a schedule for the preceding stages, using the example above, five weeks in advance. At this time computers began to be used commercially to generate these schedules. Later variable lead times and safety stocks were accommodated.*

Key words: *MRP, materials, JIT, Kanban*

1. INTRODUCTION

MRP is software based production planning and inventory control system used to manage manufacturing processes.
MRP Objectives:

- Ensure materials and products are available for production and delivery to customers.
- Maintain the lowest possible level of inventory.
- Plan manufacturing activities, delivery schedules and purchasing activities

MRP Roles:
The questions it provides answers for are:

- WHAT items are required?
- HOW MANY are required?
- WHEN are they required by?

2. MRP DECISION PRINCIPLES

MRP decision principles are:
1. TIMING - when to order; we always ordered *as late as possible*, but never planned a stockout. This is a driving principle in MRP, never order before you need to, never plan to stockout.

2. QUANTITY - how much to order we always ordered as little as possible, i.e. just enough to avoid a stockout.

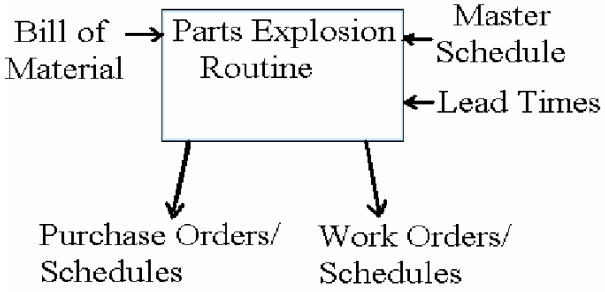

Figure1. Material Requirements Planning MRP 1

The difference between gross& net requirements is the inclusion of stock in the parts explosion routine to produce requirements net of stock. With gross requirements this calculation is done manually later.

The Bill of Material (BOM) or Parts List is exploded into its constituent parts and multiplied by the requirements for these parts

from the Master Production Schedule (MPS) (order book or forecast).

Stock is deducted (net requirements) and the lead-times allowed for, to give start dates for the works and purchase orders / schedules. Further provisions can be made for scrap allowances and batching rules. This acts as the demand for the next level (in the BOM) constituent parts.

Requirements are aggregated at each level from all sources to create a total requirement at that level. This calculation is then performed and the result passed down to the next level (in the BOM) where it is added to other requirements for that item and the process repeated until the bottom level of the BOM is reached.

MRP outputs are "Recommended Production Schedule" and "Recommended Purchasing Schedule".

This was followed by Manufacturing Resources Planning (MRP 2) which combined MRP1 and capacity planning together with a control system.

3. MANUFACTURING RESOURCES PLANNING (MRP 2)

MRP 2 is MRP but with more added:

- cost information,
- management reports
- easy "what-if" analysis
- *capacity requirements planning* (essentially try and automatically include capacity restrictions in the planning process).

Whilst widely implemented the faulty implementation of MRP systems became a scandal with little regard for data accuracy, ownership, and accompanying management processes. One of the major criticisms of MRP is the concept of a staged Bill of Material, which represented the stages of manufacture and also enshrined that into a sequential process, which ignored the potential for parallel working. Work by Burbidge, showed that by flattening the Bill of Material, and parallel working not only simplified the administration of production but also reduced lead-times. However this created tension between the engineering view of the product and the logistics view of the product which "phantom bills of material" did not resolve and which also complicated the issue of bill of material ownership.

However the MRP is still the dominant technique used by most computer "ERP" software commercially available today. Whilst the concept of MRP 2 is sound, the advent of "Just in Time" (JIT) and it's control system "Kanban" created an attractive and significantly simpler mechanism.

Table 1. MRP versus JIT

MRP versus JIT	
MRP	JIT
• a “Push” system	• a “Pull” system
• a system based on fulfilling *predicted* usage in a set time period	• a system based on *actual* usage
• is more appropriate when lead times are long.	• is a dynamic linked system and can be used when lead times are short

This for a while in the early 1980's seemed to provide an alternative to the concept of MRP, to an extent where the leading gurus of the time predicted the demise of MRP, in favour of the more pragmatic approach.

This was unfounded and in fact ignored the requirement to plan "A" and "X" type product production in advance from both a materials and capacity point of view which JIT did not provide. Even "I" and "T" and "V" type product production require a forward view to provide a planning ability. This led the computer software suppliers to attempt to integrate the two approaches with so called "Electronic Kanbans" (a replenishment signalling mechanism sent electronically). Although rarely needed for internal company signalling this mechanism has found later usage in the inter-company replenishment signalling involved with "agile" communications. Unfortunately this ignores the inherent weakness of computers in that it is

notoriously difficult to change computer programs quickly and reliably in the event that the requirements change and the lack of visibility of the process.

This led to the expansion of parameters held within the computer system that could be changed to reflect the changed situation. This has now led to a process of "configuration" where the software can be "configured" to reflect different circumstances. Unfortunately the process of reconfiguring can often be difficult presently. Another trap that the software suppliers have fallen into in the race to provide increased functionality is to add complexity to the configuration process. This has resulted in many horror stories of incorrect configuration, and a demand for highly skilled "configurers" which outstripped supply. These factors have combined to constrain sales of the software. Unfortunately this misses the point which is that the manufacturing plant was simply trying to plan materials and capacity simply.

MRP and JIT have now resolved into split roles. In a mixed MRP/JIT environment MRP is primarily used for long term capacity planning and forward ordering of indicative material requirements with JIT pulling the next job when the previous one is finished. In the absence of JIT, MRP schedules may be treated as firm. This poses the question in what circumstances is an approach valid? In this case the choice is primarily determined by the mix and manufacturing strategy.

In mixed mode operation MRP (figure 2) can provide firm schedules in parts of the supply chain not covered by JIT replenishment signals, and indicative schedules in parts of the supply chain where JIT replenishments are used as shown below.

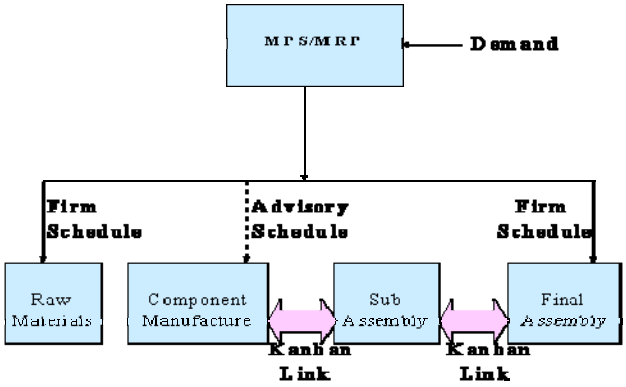

Figure 2. MRP mixed mode operation

In 1986 it was recognized by a European conference of leading MRP guru's that the logical solution to the problem of Manufacturing Planning and Control was an appropriate use of techniques to match the circumstances. Unfortunately there are a number of inhibiting factors here:

- Any one business has an array of circumstances
- No one except us has yet catalogued the control systems available in a logical way such that the strengths and weakness of the techniques are apparent and can be used in a mix and match way to solve an individual problem.
- Each new technique is viewed as universally applicable and better than the last
- The situation will change with product life cycles, product mix and volume changes, and process changes
- There are a number of vested interests and significant sunken investment
- It is easier to blame the system rather than the implementation and move on to the latest fad. The success rate of MRP implementations is very poor, such that it may be replaced when it could be corrected.
- It is not a simple task to change the technique.

4. MATERIALS CONTROL

There have been 5 significant developments in material control in this period:

- JIT and it's accompanying Kanban control system
- The use of bar code reading in stock movement
- Electronic Data Interchange (EDI)
- The use of "Backflushing" techniques in MRP systems
- The growth of consignment stocks

5. BAR CODING

Stock recording and stock movement recording has been greatly simplified and improved by the automation of the data entry by bar coding. If used as a common identifier between sales outlet and first tier manufacturer this becomes a significant element of "Agile" manufacturing. However this may be distracting us from the simplification of stock control which can be achieved by visible control systems, and Kanban replenishment systems.

6. ELECTRONIC DATA INTERCHANGE

The use of computers to communicate demands between organizations has grown significantly from the introduction of faxes which were used to send schedules then Kanbans to the use of electronic buying via the Internet and electronic payment settlement towards e-commerce.

7. VIRTUAL MATERIALS MANAGER

Visualization technology for the logistician will "permit human-centered aspects of system operation and maintenance to be simulated and fully verified before hardware is produced.

The keys to this virtual world are digitization of product and supply data along with more low-cost computing power. This technology will allow certain aspects of logistics to be modeled with much greater realism and larger consequence than ever before.

An example might be the movement of military material through aerial ports that could :

1. simulate graphically to identify bottlenecks;
2. optimize warehouse space and resource utilization;
3. manage air and ground transportation functions.

This modeling could also allow logisticians to have real time pictures of the status of critical cargo items in transit, port and depot operations, and airlifter/ sealifter locations across the globe.

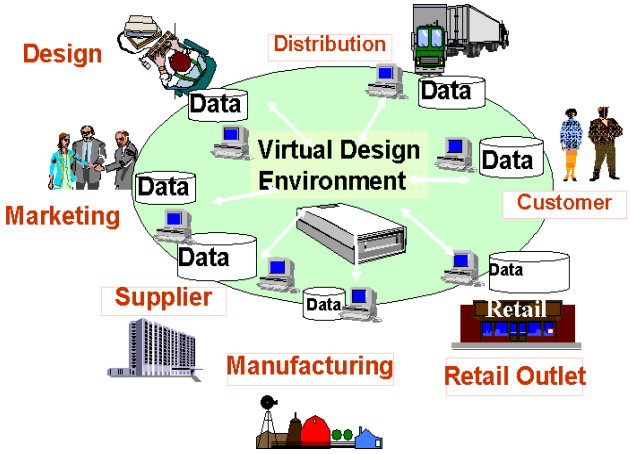

Figure 3. Global optimization of design, manufacturing, supplier, distribution, planning decisions in a distributed environment

8. BACKFLUSHING

The computer technique of deducting components parts from stock based on the arrival of a sub assembly at some key measurement point has been developed in response to the need to automate the stock issuing process in conjunction with the introduction of JIT techniques. This has also been used as a basis for paying suppliers. By doing this, a situation has been created where the Bill of Material accuracy for these inexpensive parts must be totally accurate. Often these parts' usage is probabilistic anyway rather than deterministic (with shims for example), with average usage entered into the Bills of Material making the usage approximate. This seems to miss the point that these parts require minimum administration and supplier top up or two bin systems are usually more appropriate than issuing MRP schedules for these parts which are notoriously unreliable.

9. CONCLUSIONS

The output of an MRP system consists of action messages highlighting exception conditions caused by changes and data errors. Firstly these messages need to be handled in a sequence, and secondly these need to be managed and particularly at implementation need to be controlled.

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HOW TO CHOISE THE MATERIALS AND TECHNOLOGY TO HAVE AN COMPETITIVENESS DIE FORGING PRODUCTION SYSTEMS

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Abstract: *Because are acting on a globalized market in a continuous growing, any production systems have to take every possibility to operate and succeed in the market. In production systems that produce forging dies, one of the characteristics that might influence the competitiveness of the production systems is how the materials and technologies are chosen. Forging dies material must be chosen so that finally the molds need to have the characteristics required by the customers on the lowest cost with the maximum benefit for the manufacturer. Selected technologies have a decisive role in the competitiveness of die forging systems, meaning that depending what kind of materials are chosen, certain steps must be made, that ultimately lead to the expected results.*

Key words: *production system, die forging, competitiveness, heat treatment, die forging materials, die forging element.*

1. INTRODUCTION

It is important for systems that produce forging dies how to choose the right material. The most expensive and the best quality material shouldn`t be the main features, because of that the system might not be competitive on the market using expensive products.

A production system that produces forging dies operate in a market with fierce competitors from tractors, automotive, electrical and electrochemical industry, fine mechanics industry, aircraft industry - aircraft and interplanetary vehicles, arms industry and even FMCG industry.

2. FORGING AND DIE FORGING

Forging is used to produce large quantities of identical parts by applying force. Forging changes size and shape, but not volume of parts that are used in manufacturing, automobiles, aerospace parts, military equipments etc.

Forging metals has been practiced since Bronze Age. Forging is divided into three main methods - hammer forging, press forging and rolled forging.

Die forging is widely used forging process in forging industry. Die forging forges metal in plastic deformation under external force and is full of forging mold. Die forging needs a mold that determines size, shape and quality of products.

Equipments used in die forging are die forging hammer, hot forging press, flat forging press, friction forging press etc. Die forging can be divided into open die forging and closed die forging.

3. ELEMENTS AND CHARACHTERISTICS OF DIE FORGING

Constructive parts for a die forging are presented on the figure 1.

1. lower die;
2. pluging guide;
3. throw rod;
4. steady lozenge;
5. mobile lozenge;
6. upper die.

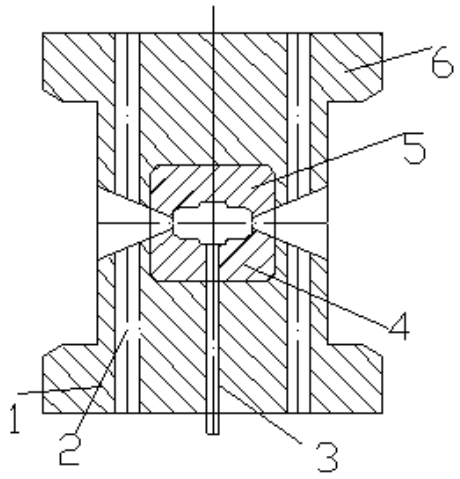

Fig. 1 Constructive elements for a die forging

Characteristics of die forging [h SCR]:

- Merits:
  - ❖ optimal microstructure;
  - ❖ grain flow (fiber structure) made to suit;
  - ❖ complicated forms;
  - ❖ low amount of machining;
  - ❖ efficient use of material;
- Problems:
  - ❖ tool costs;
  - ❖ for large production series;
  - ❖ highest demands on strength - toughness;
- Applications:
  - ❖ safety parts;
- Alloys:
  - ❖ mainly medium to high-strength materials.

4. DIE FORGING MATERIALS AND TEHNOLOGY

Choosing the materials which will used to create the dies, from the beginning is the first questions which have to be solved.

The active parts are the most under stressed parts of a mold. The edges and working surfaces are under dynamic stress.

Because of that the active parts will be made by materials having the following conditions [1, 2]:

- ❖ the Hardness and the high strength compared to the processed material;
- ❖ high tenacity and high strength on usage;
- ❖ to maintain the dimensions and the properties on temperatures during processing.

The Tooling and materials are considered aspects of materials in the forging process, including the materials used in production equipment (die blocks, etc.), new materials to be forged, and the impact of these materials on the forging process. In particular, it's very hard to improve the performance and reduce the cost of die systems and improve overall material utilization [3].

The highest priority research for die making and materials is the development of a multi-attribute, heterogeneous die that eliminates the need for lubricants. This would be an engineered die that would have different material characteristics in various parts of the die to match the specific performance requirements of that area. This would provide greater wear resistance in areas that have a lot of material movement across them and would minimize friction and lubrication needs. Development of such a die could be possible within ten years if supported by a government-industry R&D partnership.

Among the most critical barriers is the lack of effective lubrication methods between the die and the forged material. More precisely, there is a lack of technologies innovative die materials, coatings, equipment, and processes that would eliminate the need for lubricants altogether. Material-surface coatings are needed that provide very low heat transfer and can handle variability in the coefficient of friction. There is also inefficient use of lubricants because they are not applied locally to the portion of the tooling or under specific conditions that require lubrication [3].

Other key barriers include the need for better measurement and testing in the forging process leading to the accumulation of forging process data for evaluation; limitations in die materials such as the ability to effectively determine material composition and select appropriate die materials; and limitations in die making such as the need for high speed machining of the die cavity and surface hardening technology (figure 2).

Measurement and Testing	Real-time non-destructive testing; Lack of use of passive sensors; Limit forging load; Need for cost-effective process monitoring; Accurate non-contact dimensional measurement; Consistent bar billet temperature; We do not know when the die is dead; Accumulating forging process data for evaluation;
Material Property Understanding	Common descriptor for die steels; Accurate material database to drive simulations: - flow stress vs. temperature data as a function of strain rate for models; Design alloy for forging process; Determine the effect of residual stress on the forging process; Steel which is very ductile at 700°F, but still good when cooled to right temperature; What is: 1. net shape 2. mindraft 3. hog-out vs.
Die Materials and Die Making	Die material composition and selection; Composite die materials; Surface engineering, thermal heating, and local engineering of surface; Alloys with material properties needed for extended die life are costly to machine; Obtaining a die support material that is stiff enough; High-speed machining of die cavity size and finish; Net shape cavity by forging, casting, semi-solid, and powder; Cutting tool life; Surface hardening technology
Lubrication	Lack of novel die materials, coatings, and equipment processes that will eliminate lubrication; The lack of condition-specific, targeted lubrication; Lack of material-surface coatings with: 1. very low heat transfer 2. variability of coefficient of friction Better understanding of interface and coating
Process Control of Product Materials	Maintaining consistent die temperature; Operator training; Raw material, control: size, volume, and surface; Lack of first part - good part. No trial and error; Lack of inexpensive and efficient die heating system for isothermal forging; Lack of integrated, instantaneous process control

Fig. 2 Major Technology Barriers to Achieving Targets in Tooling and Materials [3]

To ensure a good behavior in operation is required not just a good choice of material, but also a proper heat treatment to apply.

5. DIE FORGIND AND HEAT TREATMENTS

In forging-die production there is a considerable range of forging dies which are promising for a changeover into advanced heat treatment involving bulk temper hardening and surface hardening using induction heating. The heat treatment suggested provides a saving of material resources as a result of improving the life of forging dies by a factor of 1.5–3 depending on the grade of die steel. As a result of induction hardening of forging dies, after temper hardening close to the boundary of the hardened layer a zone of reduced hardness forms whose unfavorable effect may be reduced by using before induction surface hardening bulk warming in a furnace or deep induction heating with a reduced energy concentration in the heating zone to the tempering temperature in the temper hardening cycle. In order to improve the uniformity of induction surface hardening for dies with a complex working shape it is desirable to use heating at reduced power with an increase in heating time [4].

The heat treatment of forgings plays an important role in developing the desired properties such as the relieving of internal stresses, the refinement of grain structure, and the attainment of improved mechanical and physical properties.

The heat treatments apply to die forging are [4]:

- Full Annealing forgings restores the softness of the metal. The forging is heated to a specific temperature then cooled in a furnace according to specific time intervals for uniform softness through the entire forging.
- Normalizing involves heating the forging to a specific temperature and then allowing the forging to cool in still air. The result is the restoration of ductility. Normalized forgings are less expensive than full annealed forgings because full annealing relies on furnace-controlled cooling.
- Normalizing and Tempering first normalizes the metal forging then heats it again to a temperature between 400 and 600°C. Tempering establishes the correct balance of strength and ductility within the forging.
- Process Annealing is used for low carbon steel forgings. The forging is heated to a temperature lower than those used in full annealing or normalizing and then is allowed to cool in still air. This alters the grain size and flow of the forging.
- Spheroidizing is used for high-carbon steel forgings as well as tool steel and alloy steel forgings. The process forms spheroids throughout the structure of the forging which results in improved machinability.

http://www.philadelphiaforgings.com/value-added/heat-treatment.html

Is recommended to treat the active surfaces, this process will bring the hardness to higher points and to reduce stresses which cause deformations.

It also have to take into account a recommendation that the die should not be used before the final heat treatment, because

after processing it size will not match the right dimensions of parts needed to obtained. However, there is a solution to use the die with a special resin which has the same shrinkage with the alloy which will be poured.

Depending on processing stage the following heat treatments are used [5, 6]:

- Tempering at 8500C – before roughing, drilling, milling and cavity processing;
- Second annealing at 8500C- before finalizing the cavity, centering pins and bushings processing;
- Hardening and annealing – is applied after final processing and finishing.

6. ELEMENTS, TECHNOLOGY, HEAT TREATMENT FOR AN MINING KNIFE

Take for example a mold used in the manufacture of forged knives for mining. The materials used for forging mold components are presented in table 1.

Table 1 Materials used for forging mold components:

No. crt.	The name of the component mold	Materials
1.	lower die	XC 45
2.	pluging guide	XC 15
3.	throw rod	XC 45
4.	steady lozenge	30 VCrW 82 (W85) or W300
5.	mobile lozenge	30 VCrW 82 (W85) or W300
6.	upper die	XC 45

To ensure good behavior in operation is required in addition a proper choice of material, and to apply the appropriate heat treatment.

Blocks which run mold parts, in an annealed state are subject to the planing operation on the 6 faces. Then are drilled the centering pins, milled the fixture and the outlet channel distributor. Cavities are processed (slots form) by classical methods (turning, milling, drilling) and electro erosion, or by printing the form (leave fingerprints by cold pressing) [7].

The forms active parts and the core parts are finished to reduce roughness, easily release parts, avoiding creating exfoliation, and eliminating roughness, cracks appearances.

In figure 3 are presented the casting mold components, production processes and equipment that are in processes.

No crt	The mame of the compon ent mold	Materials	Machines	Process
1.	Lower die	XC 45	Milling machine, CNC drilling maschine, grinding machine, CNC grinding machine	roughing milling, roughing grinding, steering holes in columns, column holes grinding;
2.	Pluging guide	XC 15	Turning machine SN 400, grinding machine	outside turning, external grinding;
3.	Throw rod	XC 45	Turning machine SN 400, grinding machine	outside turning, external grinding;
4.	Steady lozenge	30 VCrW 82 (W85)	Milling machine, CNC drilling machine, grinding machine, CNC grinding machine, processing machines, electro erosion massive electrode (graphite or copper electrode);	roughing milling, roughing grinding, steering holes in columns, execution of extractor hole, grinding extractor holes,cavity execution by electroerosion execution of solid electrode (graphite or copper electrode);
5.	Mobile lozenge	30 VCrW 82 (W85)	Milling machine, CNC drilling maschine, grinding machine , CNC grinding machine , processing machines, electro erosion massive electrode (graphite or copper electrode)	roughing milling, roughing grinding, steering holes in columns, execution of extractor hole, grinding extractor holes,cavity execution by electroerosion execution of solid electrode (graphite or copper electrode)
6.	Upper die	XC 45	Milling machine, CNC drilling maschine grinding machine , CNC grinding	roughing milling, roughing grinding, steering holes in columns, column holes

Fig. 3 Forging mold components, production processes and equipment that are processed.

Heat treatment applied to the mold elements in question is found in figure 4.

No. crt.	The mame of the componen t mold	Materials	Heat tre tm ent	Machine for heat treatment
1.	Lower die	XC 45	Hardening, annealing Călire, revenire 30-35RHN	Controlled atmosphere annealing furnace, oil cooling tank, annealing oven;
2.	Pluging guide	XC 15	Cementing, hardening, annealing 30-35RHN	Face hardening oven, controlled atmosphere annealing furnace, oil cooling, annealing oven;
3.	Throw rod	XC 45	Hardening, annealing 30-35RHN	Controlled atmosphere annealing furnace, oil cooling tank, annealing oven
4.	Steady lozenge	30 VCrW 82 (W85)	Hardening, annealing nitrification 50-55RHN	Controlled atmosphere annealing furnace, oil cooling tank, annealing oven, nitriding oven in nitrogen atmosphere
5.	Mobile lozenge	30 VCrW 82 (W85)	Hardening, annealing, nitrification 50-55RHN	Controlled atmosphere annealing furnace, oil cooling tank, annealing oven, nitriding oven in nitrogen atmosphere
6.	Upper die	XC 45	Hardening, annealing 30-35RHN	Controlled atmosphere annealing furnace, oil cooling tank, annealing oven;

Fig. 4 Forging mold components, their materials, and heat treatment furnaces which it applies

7. CONCLUSIONS

The materials used on forging dies are chosen according to the series of pieces that will be forged and the type of alloy that will be forged. Materials used to achieve the active parts are selected according to the main steps leading to degradation of the mold active parts.

Is recommended to use softer materials to less used components and harsh materials required only on active parties. This will lead to lower cost mold, so they lower final price, which implies more competitive production system.

This will decrease the cost of the mold, so the final price will be lower, which implies more competitive production system. Materials used for forging molds are divided into hard materials with high properties, materials like VCrW 30 82 (W85) 30 VCrW 100 (W100), 30 VCrW 300 (W300) for fixed and mobile pill and softer materials from XC to lower die, pluging guide, rod throw and upper die.

It is advisable to use a material on mold manufacturing which is suitable for the product realized by a molding process. If an inappropriate material is used, it`s a possibility to have a very expensive mold or a mold that can`t fulfill the role for which it was made.

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COMPARATIVE STUDY ON VENEERS DISCOLORATION

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Abstract: *Whether finished or unfinished, wood changes its colour over time. Some species darken, while others lighten, some colour change is to be expected for all species and a drastic change can be expected for some. The objective of the present research work resided in establishing the sunlight influence upon the colour changes of black alder (Alnus glutinosa) and cherry (Prunus avium) veneers, exposed under indoor conditions for 1 and 3 months. A Chroma Meter Konika Minolta CR-410 device was used for colour measurement. The colour coordinates L*, a* and b* were recorded according to Standard ISO 7724-2. The sunlight mostly influenced the colour changes, in the case of cherry veneer especially, which recorded significant colour differences of about 10.87 just right after the first month of exposure, while for alder veneer, the maximum colour difference of about 8.67 hardly appeared after three months of exposure.*

Key words: *colour, veneer, sunlight exposure, discoloration.*

1. INTRODUCTION

Wood has been used for centuries and today we still depend on wood to provide our shelter; colour is used to create harmony and equilibrium inside it.

The colour of wood is an important aesthetic matter for customers of wood products. Whether finished or unfinished, wood changes its colour over time.

Because of its "personality", wood should be treated with understanding and a certain amount of care.

Weathering is the general term used to define the slow degradation of materials exposed to the weather. The degradation mechanism depends on the type of material, but the cause is a combination of factors found in nature: moisture, sunlight, heat, cold, chemicals, abrasion by windblow materials and biological agents [1].

The degradation of wood surfaces on exposure to UV light is mainly due to breakdown of the lignin component, which discolors [2].

Wood exposed outdoors will undergo a rapid color change in addition to the UV induced degradation of lignin.

The appearance of unprotected wood exposed outdoors changes markedly in a few months; then the wood remains almost unaltered for years [3].

Very little radiation can penetrate common window glass. The colour change that occurs to wood when exposed indoors is caused by visible light that has sufficient energy to degrade the extractives which confer colour to wood: organic compounds of various types that may contain halogens, sulphur and nitrogen.

UV light penetrates approximately 75μm and visible light about 200μm into wood [4].

All wood species change their colour under visible light influence. Veneers made of light-coloured wood species (alder, cherry, birch and maple) darken, while the colour of others becomes significantly darker (sapele veneer) or a light discoloration may be produced (jarrah veneer) [5].

The objective of the present paper resided in establishing the sunlight influence upon the colour of veneers made of alder *(Alnus glutinosa)* and cherry *(Prunus avium),* exposed to sunlight under natural indoor conditions, behind a window glass, for 1 and 3 months, respectively.

2. MATERIAL AND METHOD

Wood material

Veneers made of two wood species, namely: black alder (*Alnus glutinosa*) and cherry (*Prunus avium*) were used as materials.

These two wood species were selected for colour measurements in the present comparative study due to their similar appearance, highlighted in Fig.1. Black alder presents pale pinkish-brown colour, darkening somewhat when exposed to light; when suitable stained and finished it is almost indistinguishable from cherry.

a b

Fig.1 Alder (a) and cherry (b) – pale reddish colour

The veneers were cut at LOSAN Company from logs after performing their thermal treatment at the temperature of 60-70ºC for 10-12 hours.

Alder veneers were cut by half-round slicing method and cherry veneers were cut by flat slicing method.

The veneer sheets were dried at temperatures of 90-100 ºC and the dimensions of the veneer samples used for this study were: 250 mm x 150 mm x 0.55 mm. Five veneer samples for each wood species were used; they were exposed to sunlight under indoor conditions.

Fig. 2 Experimental trial stand for sunlight exposure

Indoor exposure of veneer surfaces

Exposure conditions (temperature and air-relative humidity) were daily recorded during 1 and 3 months in summer: June, June-July-August respectively (Fig. 3).

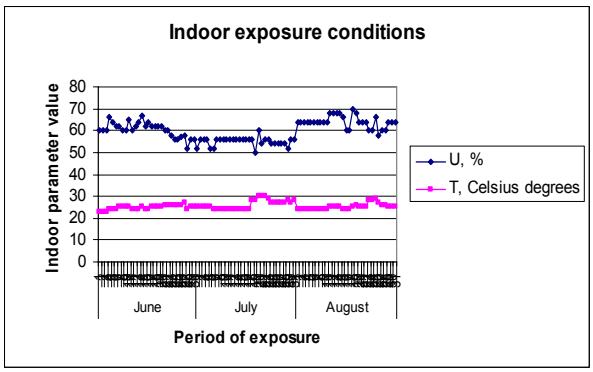

Fig.3 Indoor exposure conditions

Colour measurement

CIE L*a*b* system is derived from CIE (International Commission on Illumination) Standard Colour Table by transforming the original *X*, *Y* and *Z* colorimetric coordinates (colour values) into three new reference values of *L**, *a** and *b**. The objective of this transformation is a colour-space to aid in the numerical classification of colour differences. Each colour in the CIE L*a*b* colour-space has a unique location (see Fig. 4) defined by its cartesian coordinates with respect to the axes *L**, *a** and *b**, where *L** is the degree of lightness, ranging from white (100) to black (0) along a grey scale, *a** is the degree of redness and greenness and *b** is the degree of yellowness and blueness [6].

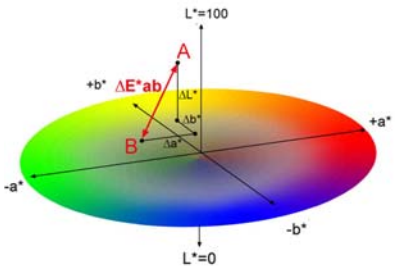

Fig.4 CIE *L** *a** *b** colour space

In the present study, a Chroma Meter Konika Minolta CR-410 was used for colour measurement (Fig.5).

The colour measurements were performed at LOSAN Company from Brasov.

All the veneer samples were grouped depending on wood species and indoor conditions of exposure as presented in Table 1.

Table 1 Test groups based on veneer wood species and indoor conditions

Veneer wood species	Control groups	Exposed groups (months)	
		One month	Three months
	Sunlight exposure	Sunlight exposure	Sunlight exposure
Alder	As	AsE1	AsE3
Cherry	Cs	CsE1	CsE3

Colour measurements according to *ISO 7724-2* [7] were performed on 5 veneer sheets of each wood species under study. On each veneer sheet there were defined 5 distinct circular areas (50 mm) in order to record the colour parameters (Fig.5).

Fig.5 Chroma Meter Konika Minolta CR-410

*L**, *a** and *b** colour coordinates for each sample group were determined before and after the sunlight exposure under indoor conditions, for 1 and 3 months, respecting the same circular areas.

These colour-space values were used to calculate the total colour change ΔE^* as a function of treatments applied to veneers according to the following relations:

$$\Delta L^* = L^*_E - L^*_i \quad (01)$$

$$\Delta a^* = a^*_E - a^*_i \quad (02)$$

$$\Delta b^* = b^*_E - b^*_i \quad (03)$$

$$\Delta E^* = \sqrt{\left((\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2\right)} \quad (04)$$

where the subscripts *E* and *i* indicate the values for the exposed samples and control references, respectively.

A colour difference ΔE^* of 1-3 units is the smallest difference that can be discerned by the human eye [6].

*L**, *a** and *b** values contribute to the total colour change. In each case, a low value corresponds to a low colour change or a stable colour [8].

3. RESULTS

The colour changes occurred in the case of the two veneer species, after 1 and 3 months of indoor exposure, compared to the references values, are presented in Fig.6.

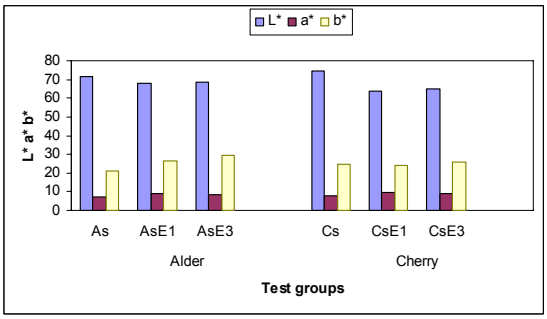

Fig. 6 Colour changes occurred on veneers (alder, cherry) after sunlight exposure for 1 and 3 months, under indoor conditions

The total colour differences resulted after the two periods of indoor exposure, under sunlight influence, are highlighted in Fig.7. The colour difference describes the size of a colour difference but not the direction in the colour space.

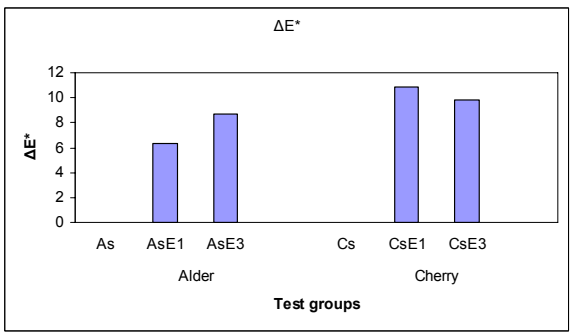

Fig. 7 Colour differences ΔE* determined on veneers (alder, cherry) after sunlight exposure for 1 and 3 months, under indoor conditions

4. DISCUSSIONS

In this study, the colour of veneer surfaces due to indoor exposure, under sunlight influence, was different than that one of the control groups.

Colour changes appeared for both studied wood species.

The obtained results may be resumed as follows:

- A decrease of L^* colour values indicates the surface brownish, while their increase is specific to some lighter surfaces. The study results show that both veneer species presented a decrease of lightness with the exposure period, this being significantly pronounced for cherry veneer (L^*= 63.71), after 1 month of sunlight exposure when compared to alder veneer.
- A decrease of a^* colour values means a passing tendency through the greenish tinge, while their increase corresponds to a reddish intensification. As resulted from the presented data, a^* values lightly and almost linearly increase with the exposure period, for both species, under sunlight influence. The surfaces of all veneers suffered a colour darkening with a reddish tendency, this transformation being more pronounced for cherry veneer which recorded a maximum value of about 9.41 after 1 month of sunlight exposure.
- A decrease of b^* colour values shows the relation with a mauve tinge within the colour-space and their increase suggests a colour darkening. This colour coordinate increased with the exposure period but the increase was suddenly occurred in the case of alder veneer exposed to sunlight, being established a maximum value of about 29.31 after 3 months of exposure.
- Thus, under sunlight influence, cherry veneer reacted powerfully within the colour-space than the alder one did, recording total maximum colour differences of about 10.87 after 1 month of sunlight exposure.
- Therefore, under the same conditions and exposure periods, the two veneer species reacted differently: under sunlight influence, cherry veneer darkened itself much more than alder did.

5. CONCLUSIONS

The results of the present study are very useful in furniture industry; the two wood species can be replaced one by another when the situation requests it.

It is noticed that the veneers exposed to sunlight under indoor conditions suffer a colour change, highlighted, generally, as a colour darkening and a tinge changing phenomenon. Because of its biological nature and sensitivity to light, unprotected wood is susceptible to weathering and photo-oxidative degradation.

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REVIEW OVER HAND-CRAFTED WOOD

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***Abstract**: Nowadays man is focused on some eco-friendly ideas. The greenies push for public awareness and the legislation about saving the planet are in top as well. All folk-ethno-eco aspects seem to revive and to define again the culture, history and language of any people. The paper presents a review over some hand-crafted aspects of alder wood from Romania and abroad. Less-known traditional skills were pointed out. Some of them are very old and they were forgotten unfortunately. The paper offers an unconventional approach with a view to capture the interest on this wood species, neglected and considered a secondary resource only.*

***Key words:** black alder, traditional material, crafts.*

1. INTRODUCTION

Wood species with restricted distribution area, such as alders, are less or not studied yet, being set on the position of diverse wood species and used for fire especially. The insufficient knowledge of raw material properties has restricted the use of alder wood and lowered its value in our country and abroad as well. The best possible ways to process alder wood have been forgotten for many decades just because of the small utilization rate of the wood material. But this can be changed when the interest of specialists will increase and alder rehabilitation will be done.

This is the reason why the present paper highlighted some hand-crafted aspects of alder wood. Crafts in wood are kept and respected by peasants and artisans in Romania and abroad as well.

The paper offers an unconventional approach with a view to capture the interest on this wood species, neglected and considered a secondary resource only.

2. FORESTRY ASPECTS

Vegetation was kept the same in its diversity as the one between the ice age periods. Alder has gained since then its actual repartition area.

The indigenous tree species belonging to Alnus Mill Genus are: *Alnus glutinosa* (L.) Gaertn., *Alnus incana* (L.) Moench and *Alnus viridis* (D.C.) Chaix. Any of about 30 species of ornamental shrubs and trees in the Genus Alnus, of the Birch Family, are located throughout the Northern Hemisphere and western South America on cool, wet sites [1].

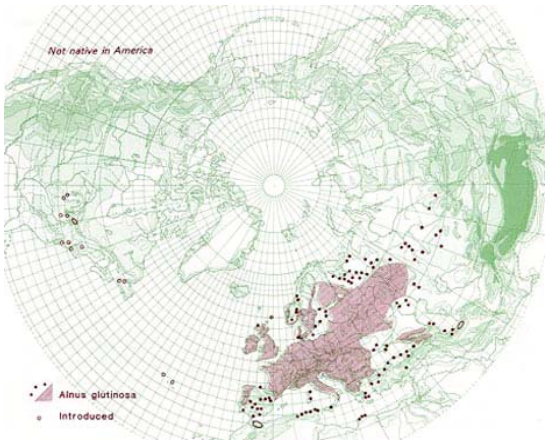

Fig.1 Natural distribution of *Alnus glutinosa*

The leaves of the Alder are broadly ovate, stalked and usually smooth. It produces catkins that are formed in the autumn, the fruiting ones having scales rather like tiny fir cones. The flowers appear in early spring before the leaves are fully out and its woody nearly globular female catkins are its so-called berries [1].

Alder trees are usually small in stature but can reach heights of 70 ft (21 meters) in perfect conditions. The tree is mature when reaching 30 years, capable of producing a full crop of seeds. After this, it can live on to reach an age of about 150 years. It is also the only broadleaved tree to produce cones.

Fig.2 Black alder *Alnus glutinosa* (L.) Gaertn. – Biological features

3. GENERAL PRESENTATION OF ALDER WOOD

Alder is almost white when freshly cut but quickly changes on exposure to air, becoming light brown with a yellow or reddish tinge. The wood is fairly straight grained with a uniform texture.

Alder is a relatively soft hardwood of medium density that has low bending strength, shock resistance and stiffness.

Its main industrial uses are: furniture, kitchen cabinets, doors, mouldings, turnings, carvings, veneers, chipboards and constructions.

Alder wood presents a good response to the following machining operations (see Table 1).

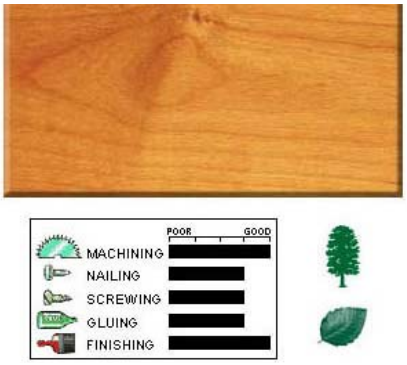

Fig.3 Rating of alder wood machining [2]

Table 1 Relative working properties [2]

Operation	**Alder wood reaction**
Turning	Alder is reported to turn very well despite its softness.
Moulding	Moulding or shaping is reported to require sharp tools and non-excessive feed rates for best results.
Carving	Alder is reported to respond well to carving, either with hand or machine tools.
Boring	Boring properties are rated as fairly good, the mortising ones as well.
Gluing	The wood has excellent gluing properties and is reported to be well known for its bonding qualities. It requires only moderately controlled conditions for the best results.
Nailing	Resistance to splitting in nailing operations is reported to be very good, but nail-holding qualities are not particularly good.
Screwing	Screwing properties are reported to be very good, but the wood does not hold screws very well.
Sanding	The wood is very easy to sand.
Finishing	Finishing is typically quite easy, if the wood is dry enough and if the MC is equal in the wood. Some problems are caused by the color changes that usually appear into the wood during drying.
Polishing	The wood can be polished very easily. No grain filling is required.
Staining	The uniform, small pore structure and color consistency of alder are reported to allow it to accept a variety of commercially available stains.
Response to hand tools	The wood responds well to hand tools.

4. TRADITIONAL CRAFTS RELATED TO ALDER WOOD

Traditional crafts and skills related to alder wood are classified as follows:

- Underwater structures
- Clogs craft
- Spinning wheels
- Kitchen utensils
- Twig furniture
- Traditional dyeing
- Traditional medicine
- Folk and ritual aspects

The wood of alder tree has many uses. When young it is brittle and very easily worked but the more mature of its wood is tinted and veined. Due to the Alders resistance to water, in times gone by it was used in the construction of bridges, particularly the long heavy piles driven into the ground or sometimes under water to support it. This quality for long endurance under water also made it valuable for pumps, troughs and sluices for which purposes it is said to have been used in the sixteenth-century in Venice, as well as in France and Holland [3].

Fig.4 Venice - Rialto Bridge

The roots and knots of alder furnished good material for cabinet-makers. These were used for making the clogs of old Lancashire mill-towns, however demand exceeded supply and birch had to be used in its stead.

The clog-making craft has almost completely disappeared from the rural district of England. The origins of this simply constructed piece of footwear are lost in the mists of antiquity, but clogs were certainly worn by rich and poor alike.

The Dutch have been wearing wooden shoes, or clogs, or "Klompen" since medieval times. Originally, they were made with a wooden sole and a leather top or strap tacked to the wood. Eventually, the shoes began to be made entirely from wood to protect the whole foot. Originally, alder, willow and poplar woods were used. The first guild of clog makers dates back to around 1570 in Holland [4].

The older the picture (Fig.5), the older the craft is. Nowadays new, modern, decorated and coloured clogs are manufactured. They make an excellent souvenir, they are great for garden and home decoration. Wooden shoes are warm in winter and cool in summer.

Fig.5 Old clog maker

Alder wood was also used for spinning wheels, bowls, spoons, wooden heels and herring-barrel staves. The earliest clear illustrations of the spinning wheel come from Baghdad (1237), China (1270) and Europe (1280) [5].

Fig.6 Irish Spinning Wheel

Decorative objects such as bowls are made of alder wood. All of them are created today by craftsmen. Each item is hand made with great care and many hours of work. Spoons present simple or complex shapes. However they are made nowadays by young and devoted folk-artists with original shape, design and story (Fig.7). All these objects demand a soft and elastic wood, ready to be shaped, carved and scratched, properties specific to alder wood as well.

Fig.7 Original spoons with stories

Two spoons with stories are depicted [6]:

Luck spoon: In Romanian folk tradition they used to say that when a stork makes her nest on a house she protects it from fire, water and thieves.

Power spoon: The snake is a power symbol but in the same time known as the protector spirit of the house, or "the one who defends the citadel gates". Also the flag of the Dacian people used to be represented by a snake (or dragon). Its head was made with iron, and the rest was made of leather. This way, when the wind was blowing in the dragon's mouth, it would sound like a wolf howling. That would discourage the enemy, and scare the horses that weren't used to the sound.

The twig work is an important genre of folk art. Twigs have been used for centuries to make furniture, since someone figured out they needed a place to sit and a table to work upon. This genre of rustic furniture is referred to by names such as: *twig, willow, stick, bentwood and wicker.* Twig furniture inherits its personality and magic directly from nature. Artists do not need special tools to make most of the twig furniture pieces, but they require imagination to create such inventive designs as shown in Fig. 8 [7]. The huge advantage of twig furniture is that it is made from plants (alder and willow as examples) growing year around and they are generally found besides streams and marshes.

Fig.8 Twig furniture

All the products of alder tree were used by peasants for centuries: in dyeing, medicine and rituals.

In dyeing, the bark of alder is used as a foundation for blacks with the addition of copperas. Alone it dyes woolens with a reddish colour (Aldine Red). The young shoots of alder dye yellow; with a little copper is obtained a yellowish-grey colour useful in the half-tints and shadows of tapestry. The shoots cut in March will dye cinnamon, and if dried and powdered they produce a tawny shade. The fresh wood yields a pinkish-fawn dye and the catkins a green. The leaves have been used in tanning leather. They are clammy and if spread in a room are said to catch fleas on their sticky glutinous surface [8].

Fig.9 Traditional dyeing

Alder presents tonic and astringent medicinal properties. A decoction of bark is useful to bathe swellings and inflammations of the throat especially and has been known to cure ague. Peasants were reported to be cured of rheumatism by being covered with bags full of the heated leaves. Placing alder leaves in your shoes will ease weary feet, being useful for walkers and hikers [9].

Therapy of trees is a curative method of healing with the help of trees. It has been used since antiquity but was hardly admitted as scientific method only in 1927, nowadays belonging to the balneary-climatic therapy. The fresh air from woodlands contains negative ions of oxygen, considered to be true air vitamins. Shamans of Native American and Europe believed that trees also possess curative powers. Different trees are said to have particular medicinal properties. Each tree has its own activity and tempo. It has its own personality, a mystery, a story as well. Alder grows in wetlands, remaining in repose only between 0.30 and 3.00 a.m. Its energy is negative. We must not uphold this tree. Liver can be cured when pressing a piece of alder wood on it. The soul is soft and anger no longer appears [10].

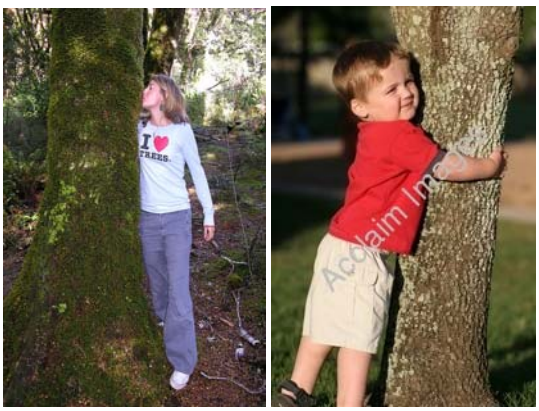

Fig.10 Hugging a tree

In Celtic folklore alder is associated with the fairies and it was believed that doorways to the fairy realm were concealed within its trunk. The Alder was sacred to the god 'Bran' who carried a branch of it with him during the 'Battle of the Trees' saga. Ritual pipes and whistles were often made from alder wood, many in the shape of the Raven.

In some Irish legends the first man was formed from the Alder while the first woman came from the Rowan [11].

Fig.11 Ritual whistle made of alder

Witches used to mix the sap from alder tree with that of the madder plant, a Eurasian plant (Rubia tinctorum of the family Rubiaceae) to produce red dyes. These were then used to colour ribbons, cords and sashes used in rituals.

Also in Italy the alder wood was used to light the fires for the spring festival.

A folk ritual used in Fagaras region said that after a good river bath, cold is removed when leaves of alder tree are put behind each ear while one turns its head to the left and to the right and exclaims: “Maică, taică, frunză de arine, ieşi apă din mine!” [12].

5. CONCLUSIONS

All the folk-ethno-eco aspects presented within this paper try to adjust the status of alder wood and contribute to its rehabilitation. Besides traditions, the eco-friendly ideas and attitude offer original support.

Alder wood presents good and special uses, the tree parts are very useful for people. They can be used in medicine, in dyeing and diverse range of skills.

Alder has magic power, it positively influence people and their attitude in front of destiny, myths and legends are created around it.

All these aspects involving its traditional uses in Romania and abroad, show that alder is a special wood species, not only from the industrial point of view, but also it has a real and constructive influence upon all the energetic models of nature.

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RESEARCHES ON ISSUES RELATING TO SURFACES OBTAINED BY LOADING WELDING

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Abstract: *Current requirements to increase efficiency in the production of materials in industrial practice have required implementation of new economic concepts of design and manufacturing of parts. Loading is one of the welding processes commonly used in this direction, because it gives multiple advantages. Efficient execution of parts loaded is conditional inter alia on the recognition and judicious use of specific characteristics of all components used to obtain all of the base metal and the addition.*

Keywords: *welding, loading welding, reconditioning .*

INTRODUCTION

Current requirements to increase efficiency in the production area required the implementation in practice of new concepts of industrial design and economical manufacture of parts. Loading welding is one of these processes commonly used in this direction, because the multiple benefits which gives. It extends both in the production of new parts, the number or unique activities as well as in manufacturing or reworking of defects occurs in service.

Achieving efficient loaded parts is conditioned among others by knowing and judicious use of specific characteristics of all components used to obtain all of the material and the addition.

Welding load advantages are:

- increase durability of the parts loaded into operation
- reducing the use of special steels, up to 85% by replacing them with carbon steel or low alloy steels
- reduce energy consumption by up to 65% by eliminating the traditional process of specific processing operations
- increase security of operation and reduce the risk of damage to the parts loaded as a result of improved quality standards
- lower cost.

These advantages enable the optimization of manufacturing of parts charged by welding in order to obtain outstanding performance for a particular area of operation.

CONSIDERATIONS FOR CHOOSING A METHOD OF LOADING

Election processes and welding materials loading is a major problem. At this stage must ensure the possibility of obtaining a piece loaded with as high efficiency in terms of execution, operational safety, the specific consumption and costs. The two sides of the election process and selection processes of loading materials are interrelated and depend on technical and economic factors.

Choosing the welding process of loading is influenced mainly by three groups of decision makers: technical, economic and human.

Technical factors are the volume of deposits, deposit mix, determined, by dilution with the base metal, items that can be loaded with that process, metals and alloys that can be charged with that process.

Technical factors define the potential execution of bimetallic parts quality requirements imposed by the design.

Economic factors are: productivity, as expressed by the quality of metal deposited per unit time, investments denominated in

expenditure required to equip with the equipment and production facilities, production costs, expressed as welding materials costs, energy and labor. These costs are variable in time and depend on economic situation of the market.

Human factors are difficult to define quantitatively, are variable in time and therefore more difficult to control. However, it should be given special attention because they depend on the quality level of products.

In the manufacture and reconditioning by welding load, one of the basic conditions is the use of technology in making optimal loading of materials, in terms of the goal, mostly economic, chosen on the basis reasonable criteria**.**

Starting from the fact that the loading of layers with special properties, is not only a means of manufacturing the parts but also a process of welding of at least two matters, which often are different and difficult weld able, can appreciate that the choice of welding material loading has at least two issues are interrelated, namely:

• technological aspect, which refers to compatibility with the base metal and weld load parameters influence on the characteristics of the piece obtained;

• economic aspect, which considers the effects obtained by loading.

The loading of materials with special properties and its outcome is highly influenced by specific characteristics and materials placed in it. Therefore, for a rational selection of materials is necessary to know in detail added both operational requirements and the physical-chemical, technological and economic characteristics of the materials used and the correlation between them. Study items listed should only correlated with two custom lines of business practice loading namely welding;

• reshuffle defects - manufacturing or service parts,

• implementation of new songs uploaded by welding.

Usually, the correct choice of materials to be completed loading the following steps:

• determining the type of wear and stresses to which is subject to Part;

• establishing the technical conditions imposed minimum quality piece;

• Construction design load by welding;

• determining the characteristics for MB and MA,

• Check the compatibility of the welding MA MB;

• verification of the operational behavior of the part load;

• analysis of economic issues.

FILLER MATERIALS FOR WELDING LOADING

The loading process welding meet two categories of materials:

• MB which is the basic material support that is submitted to wear and coating;

• Ma added material (alloy steel) which is carried coating and / or buffer layer.

Basic materials and filler materials are defined by their personality characteristics: chemical composition, metallographic structure and geometry (diameter, thickness, etc..), Which must comply with both in terms of performance and strength of technological skills welding.

Added for loading materials can be divided into 5 main categories as follows: rods (rods) coated electrodes, wires, fluxes and dust.

When selecting an alloy material or a named type of wear should be considered those characteristics and properties of alloys which are dominant in their behavior.

FEATURES OF SURFACES OBTAINED BY LOADING

Performance materials are determined by the nature and composition of the dispersion phase, the quantity and size distribution and structural constituents and crystalline grain size. Loading surface parts fabricated by welding is heterogeneous in terms of physicochemical characteristics.

Chemical heterogeneity loaded parts are generated by the welding process. It

is caused by differences between chemical compositions of MB and MA for their thermophysical properties, time deposit and thermal power source used

CONCLUSIONS

Loading welding is one of these processes commonly used in this direction, because the multiple benefits which gives. I

Choice of welding procedures for loading is influenced mainly by three groups of decision makers: technical, economic and human.

In the manufacture and reconditioning by welding load, one of the basic conditions is the use of technology in making optimal loading of materials, in terms of the goal, mostly economic, chosen on the basis reasonable criteria**.**

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DEFORMATIONS UNEVENNESS FOR PROCESSING BY PLASTIC DEFORMATION

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Abstract: *In the process of hot plastic deformation of metals and alloys needed tools as performance, to ensure the greatest possible operating period without too many interventions and maintenance costs are as low. Metals and alloys deformability characterized their ability to deform permanently without breaking internal ties. The size of the degree of deformation possible to apply to material without cracking or breaking it occur during deformation, in conditions of temperature and deformation rate, is generally considered his deformability.*

Keywords: *plastic deformation, parts reconditioning, welding, etc..*

The processes of deformation and deformation state of tension is what causes uneven flow of heterogeneous material. The uniformity of plastic deformation means the difference between maximum and minimum value of local plastic deformation along an axis. The presence of defects in processed products, such as internal cracks, duplication of material changes shape, etc.., Are closely related to how the flow of processed material. Main reasons causing uneven deformation are:

- Friction contact surface between tool and semi, which constitute a major cause uneven deformation of the material.

The friction forces are greater, the greater uniformity and distortion. Size-dependent friction forces roughness and quality tools used lubricant.

A cylindrical body subjected to deformation by upsetting the presence of friction forces leads to 3 distinct zones, as shown in Figure 1.

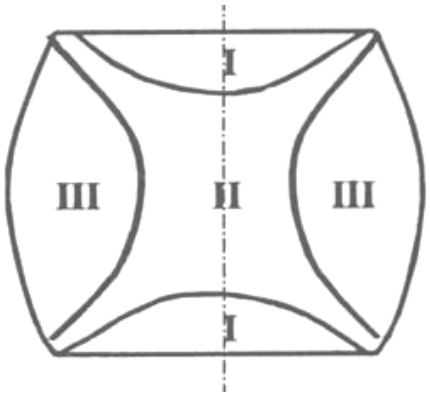

Figure 1. Deformation zones are cylindrical repression of a half-finished:
Zone I is the area with minimal deformation due to the presence of friction forces,
Zone II is the area of maximum deformation and deformation zone III is the area with average.

- Physico-chemical and structural inhomogeneity of the material under deformation, the material affects the deformation of grains by the coexistence of areas with homogeneous and inhomogeneous deformation.
- Blank thermal inhomogeneity occurs when heat processing and heat transfer is faster due to the semi deformation tools, so close to the contact surfaces of rolling deformation resistance increase due to more intense cooling.

As a result of this process, deformation zones at the contact surface

will be hindered emphasizing the uniformity of deformation caused by friction forces.

- Geometric shape tools, greatly influence a unevenness deformity.

Figure 2. is given an example.

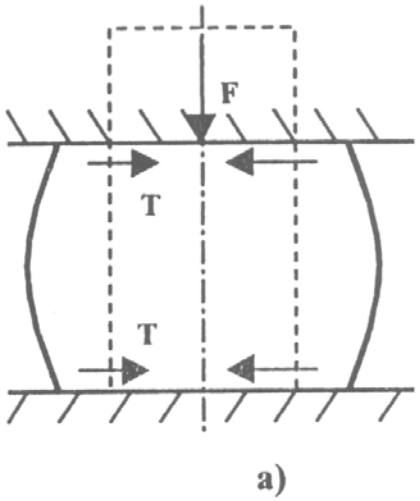

Figure 2. Influence the shape deformation tool to repression unevenness a semi-cylindrical
strain a. between plane-parallel tool b. between conical tools

To highlight the uniformity strain used several methods.

- Rectangular network method, which consists of cutting a body before deformation axially and draw a rectangular network flat surfaces on one result.

- Hardness measurement method is based on the dependence of the degree of deformation and intensity of cold hardening. The method applies only to plastic deformation.

Ways of reducing distortion unevenness

To reduce friction forces surfaces of the tools necessary to be processed by processes to reduce the surface roughness of their assets. It is recommended that tool surfaces to be lubricated with grease. To reduce the chemical and structural unevenness can apply heat treatment (annealing to homogenize).

Thermal inhomogeneity can be reduced by tool heating to reduce the transfer of semi. Tool heating temperature is limited by the mechanical properties of steel are made and the danger of rolling adhesions formation.

Also in order to reduce thermal homogeneity can be applied to other methods: the use of lubricants that have surface coating and insulation properties or assets of resistant paint tools.

Some research has shown that a reduction in the unevenness strain can be obtained by optimizing the shape and geometric tools.

Wrought processing

Processing procedures by plastic deformation of metallic materials can be classified as:

• The temperature at which deformation occurs: cold and hot;
• The strain rate: with low rates of deformation $v < 10m / s$ and deformation speeds $v > 10m / s$;
• The surface quality achieved: perform pressing, finishing
• The complexity of processes used: intrinsic, complex.

Intrinsic processes by plastic deformation processing

• Metal;
• Drawing;
• Extrusion;
• Drop
• Forging;
• Sharp-edged cutting;
• Working plate

Lamination is the method of processing wrought - hot or cold - at which material is forced to pass through two rotating cylinders.

The drawing is the process of plastic deformation of material under a force of thrust F produced in order to obtain bar, wire, pipes, etc..

Extrusion processing is the process by which plastic deformation is forced to pull the material due to compressive forces. The mold has an opening shaped section and smaller than film material.

Bending deformation is the operation which changes the orientation

axis workpiece without affecting its length. Bending process takes place with a punch that deforms it blank by pressing the appropriate media profile.

Tablets are having a semi in size (thickness) less than the other two. Wrought processing ensures an complex parts with close to final form and with great economy of material. Bending and stamping are two of the processing methods with applications in electronic plate.

Cutting is the process through deformation processing technology by which a plan to get a piece semi-hollow with or without changing the thickness of material.

CONCLUSIONS

Processes covered by a plastic deformation process analysis that takes into account the temperature is still to be introduced and additional field data related to temperature.

An important step in the analysis of processes of plastic deformation by finite element simulation is the interpretation of results. After they both conclusions can be drawn that can lead to optimization of plastic deformation, as well as conclusions about the accuracy of simulation.

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USING ADVANCED METHOD TO DETERMINE THE ACOUSTICAL PARAMETER OF LIGNOCELLULOSE COMPOSITE MATERIALS

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Abstract: *The paper presents results of experimental research on acoustic testing of various lignocelluloses composite materials used in environmental architecture, such as solid wood (oak, beech, maple, spruce, and yew), chipboard, composite panel, fibreboard. To determine the acoustic parameters such as normal frequency, resonance frequency, normal modes, Bruel &Kjaer equipment was used. The influence of wood species, moisture content, thickness, materials structure of samples on their acoustic characteristics was the main objective of this research. The method for measuring the coefficient of the sample is described in the paper and the results are presented in numerous charts.*

Key words: *composite materials, frequency characteristics, lignocelluloses*

1. INTRODUCTION

One of the main objectives of sustainable development is based on using and recycling waste. Lignocelluloses composite materials from different structures (plates, beam, solid) are made from sawdust, fibers, wood chips with different sizes, all being residues resulted from primary and secondary wood processing.

Mixture of the resin and matrix leads to obtain materials with new properties and with different statically and dynamical behavior. The acoustic qualities of a mechanical structure are intrinsically linked to the material they are made of and also linked to own elastically properties.

The wood's behavior under the acoustic waves depends on the one hand on the sound energy which makes contact with it and on the other hand it depends on the nature and the state of the wooden material, respectively on the macro and microscopic structure of the wood – the structure of the cellular membrane, the fibers' dimensions and cohesion, the presence of some own chemicals, the wood's humidity, the temperature of the wood, the elastically properties, and it also depends on the structure's layout in proportion to the sound source (longitudinal, transversal, radial, tangential, complex).

Depending on moisture content, microscopic structure, sized (thickness), section, wood and lignocelluloses materials can be used in applications that are designed to isolate noise and vibrations (sound absorbing panels in civil, social, cultural, industrial, automotive, paving, etc.) or the construction of musical instruments.

2. OBJECTIVES OF PAPER

This paper presents results of theoretical and experimental investigations on the dynamic behavior of lignocelluloses plates in terms of natural frequency and damping coefficient.

The objectives of this research are: presentation of the equipment and the procedures of impact hammer method, determination of: logarithmic decrement, damping ratio and natural frequency of composite plates, comparison between the theoretical results obtained with FEM and experimental ones.

3. METHOD AND MATERIALS

The method used consisted of hitting plate (structure) at central points of plate with a *hammer impact* for light structures. The response of structure to vibrations has been captured by means of four accelerometers (measuring on z direction) located in symmetrically points of the plate.

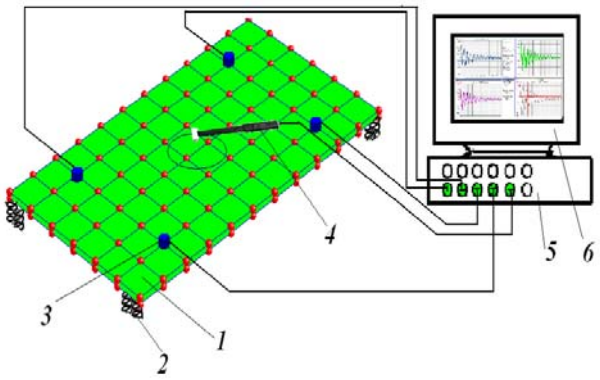

Fig. 1 The experimental set-up
(1- studied sample, 2 - yielding seat, 3 - accelerometer (s), 4 - impact hammer, 5 - Pulse hardware, 6- Pulse software)

The captured signal was displayed with Pulse soft and the primary data were processed with ME' Scope VES 4.0 software. The experimental stand was built as it can be seen in Fig. 1. Each plate (1) was freely supported on a foam device (2) and hit with impact hammer type B & K 8204 (4) in central point of plate. The vibrations of plate were captured with four accelerometers type B&K 8320 (3) and transmitted to Pulse hardware and displayed with Pulse soft. A work program in Pulse soft was developed to capture and processing the experimental data. The connections of experimental set-up has been configured, the types of measurements and implicit functions (Time, Fast Fourier Transform, Fourier Spectrum, Complex Time) were established. The results of measurement were displayed in a different task of soft and saved as files for proccesing with ME' Scope program.

The plywood and solid wood plates with geometry as in Fig 1 were tested. Before the effective tested, it was measured the moisture content of wood and the thicknesses of plates in 7 points, using the ultrasound moisture meter type Merlin PM1-E. In table 1 are summarized the average values of moisture content, thicknesses measured, density and Young's modulus from literature (Bucur, 2006, Curtu, 1984).

Table 1 The physical features of tested plates

Materials of plates	Thicknesses h [mm]	Moisture content U [%]	Density ρ [kg/m^3]	Young's Modulus E_L [MPa]
Spruce - Solid wood	2.8	8.7 %	450	14500
Spruce - Solid wood	2.6	7.4 %	450	14500
Alder - plywood	2.8	6,6 %	510	11800
Cherry - plywood	2.8	9.7 %	540	10900
Maple - plywood	2.5	8.9 %	580	13300
Walnut - plywood	2	7.2 %	640	11500
Mahogany - plywood	2	8.8 %	550	10000

4. RESULTS AND DISCUSSIONS

First results obtained with Pulse system refer to time capture of accelerometer signals as is shown in Fig. 2. It could be noticed that the dynamical behaviour of plates is governed by the damped harmonic motion.

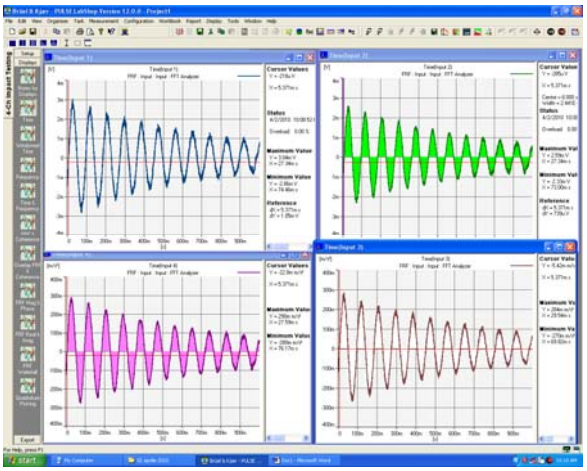

Fig. 2 Acquisition and visual display of output signal in terms of time capture

Appliyng the Fast Fourier Transform to the time signal exported from Pulse to ME' Scope soft, the values of natural frequencies and

damping coefficient were obtained as it can be seen in Fig. 3. Is found that the analyzed plates made from different species and with different composition present multiple natural frequencies.

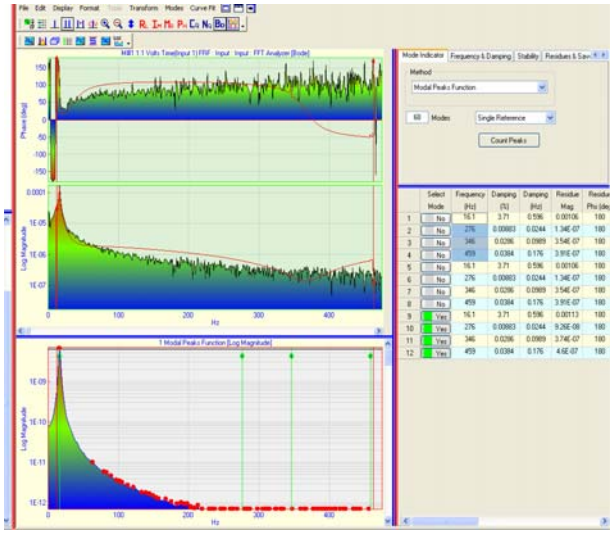

Fig. 3 The decay of amplitude

The results led to the grouping of analyzed species by the range of the fundamental frequency. Thus, in terms of classifying species as the fundamental frequency species can be grouped in low fundamental frequency (118 - 121 Hz-as in the mahogany case) and species with high fundamental frequency (287 - 295 Hz – where the cherry case is assigned) (Fig. 4) (Stanciu 2008).

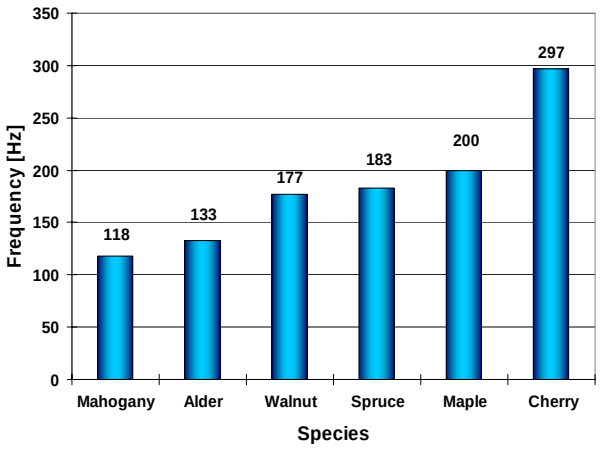

Fig. 4 Natural frequencies of composite lignocelluloses plates (Stanciu 2008)

The variation of the logarithmic decrement according to wood species can be seen in Fig. 5. The plates made from cherry and alder have approximate values. The spruce plates have an intermediary values comparison with studied species.

It was noticed that average values of damping coefficients depending on the particular characteristics of wood, even in the same species. These structural differences of the macro and microscopic wood to print the more acoustic characteristics - they are the result of the interaction of nano-structured material. Given the complex nature of the resonance phenomenon, as a result of interaction of different factors - biochemical, elastic, geometric techniques, sound, and Beldeanu and Pescarus (1996) introduced the concept of sound quality grade, making statistical studies on spruce bars valued as resonance wood. Thus they established the following groups of values of logarithmic decrement expressed as $2\pi tan\delta$, for a sound quality of spruce resonance: very good (0.0175 - 0.0197), good values (0.0197 - 0.0219) and failure values (more than 0.022).

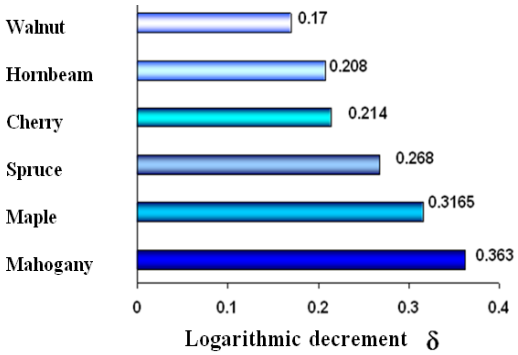

Fig. 5 Variation of logarithmic decrement depending on the species (Curtu 2009)

Other studies in the international literature (Bucur, 2006) using ultrasound performed on wood resonance bars shows that the optimum in the range 0.02 ÷ 0.026. Spruce is placed between the extreme natural frequencies.

The current research aimed to presents the advanced method used for determination of dynamical characteristics of lignocelluloses plates. In accordance with results, different wood species or composites materials can be used for acoustical insulation or in musical instruments construction.

5. CONCLUSION

In conclusion, the present method the presented method is an advanced variant of scientific research to study the dynamic characteristics of materials in a modern and relatively easy way. Impact hammer method involves the proper equipment, an adequate software and rigor in determination. This method of scientific investigation can be used for any type of structure and material. In our research the acoustical characteristics of lignocelluloses plates were presented. Each species presents its the macro and microstructure, for which appreciation acoustic characteristics requires a very rigorous statistical study, which is not subject to present research. Even within the same species, there were differences due non-homogeneity sensitive material timber and method of cutting. In the vibration laboratory of the Department of Strength of Materials have been tested other structures such as carbon fibres composite boards and fibreglass, car bodies, aircraft wings, propellers, engines, etc.

AKNOWLEDGEMENT

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ON HARDNESS OF A7075 T651 AT DIFFERENT HEAT TREATMENT STATES

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***Abstract**: The paper presents some results made on A7075 T651 alloy in different heat treatment states. A7075 T651 takes part from the remarkable series 7xxx used especially for structures in aviation, navy, transport. Therefore, this aluminum alloy needs to have strength and hardness in order to fulfill all the requirements. In the paper presents a classic artificial ageing versus a cyclic one and the advantages that come from using them.*

***Keywords:** hardness, aluminum alloys, cyclic artificial ageing, classic ageing,*

1. INTRODUCTION

Aluminum is a young and modern metal considered of being the second metal used around the worlds in different domains such as aeronautics, transport, electrics, food, and pharmaceutical industry etc.

Yet, its properties like soft and low weight does not make it a proper election so, in order to be get strength it needs other alloying elements that makes it stronger and harder.

Aluminum alloys properties are low specific density, high strength, workability, corrosion resistance, good thermal and electrical conductivity, and non-toxic, recyclable. Therefore, aluminum alloys count as one of the most important materials at the present days and of the future.

The main alloying elements that give strength to aluminum are copper, magnesium and zinc to whom it adds manganese, nickel, chromium and iron, to improve further on of the mechanical properties.

Aluminum alloys divide in more systems as follows Al-Si, Al-Mg, Al-Cu-Mg, Al-Mg-Mn, Al-Mg-Si, Al-Zn-Mg-Cu, etc.

A great part of the aluminum alloys used in aeronautics and electric industry can suffer modifications in physical-chemical properties after heat treatment. The major effect on exploitation quality of the pieces has solution quenching followed by artificial ageing. This system of heat treatments gives the material a better mechanical strength, a higher wear resistance, as well as a higher hardness [3]. Taking into consideration the importance of these heat treatments, any study regarding the practical importance of the treated aluminums is welcomed under the context of industrial efficiency.

The paper analyzes a variant of artificial ageing such as cyclic ageing, which would have as a first effect the shortening of work cycle because classic artificial ageing time is between 8 and 12 hours.

The aluminum alloys discussed within this paper takes part from the remarkable 7xxx series. They are wrought aluminum alloys that support heat treatment.

According to international nomenclature, wrought aluminum alloys divide in eight series as follows

- 1xxx – aluminum of 99% purity;
- 2xxx – Al-Cu alloys;
- 3xxx – Al-Mn alloys;
- 4xxx – Al-Si alloys;
- 5xxx – Al-Mg alloys;
- 6xxx – Al, Mg, and Si alloys;
- 7xxx – Al, Zn and Mg alloys;
- 8xxx – other alloys.

These alloys fall in two main groups as the work hardening alloys, where strength is related to the amount of "cold hardening" applied, and heat treatable alloys where strength depends on precipitation hardening.

The aluminum alloy discussed in this paper belongs to the group of heat treatable alloys that get strength from precipitation hardening.

2. PURPOSE OF THE PAPER

Physical-mechanical properties for AA7075 exploitation achieve after solution quenching and artificial ageing.

One of the most important properties achieved after the above-mentioned heat treatments is hardness. Hardness effect achieved in an aged alloy depends on diffusion phenomenon and has as a main parameter holding time. Therefore, this paper emphasizes its effect on heat-treated pieces.

If holding period is too long it is possible for the material to get a smaller hardness, which is the first effect of overageing (the precipitates have already formed and their coalescence leads to a distortion of the alloys).

If holding period is too short, a sufficient hardness of the material will not achieve. This fact happens because diffusion phenomena need an important quantity of energy for developing and holding time in artificial ageing is relatively high [1].

Taking as an inconvenient the long holding time in artificial ageing, the paper proposes an acceleration variant of the hardening processes through cyclic artificial ageing, which uses repeated thermal cycles made of heating and cooling so that work time is reduced to half.

A comparative analysis is made in the paper of the artificial ageing with five cycles and a variant of classic artificial ageing with 8 hours as holding time.

3. STAGES OF THE EXPERIMENT

1. Solution quenching achieved for the samples made of aluminum alloys type 7075 T651 (T_i = 491^{o}C, holding for 2 hours and quenching in cold water
2. Artificial ageing realized after solution quenching as follows:
   - For the classical artificial ageing - T = 120^{o}C, holding time for 8 hours, cooling in air
   - For the cyclic artificial ageing we chose the variant with 5 cycles – the maximum temperature was 120^{o}C as in classic ageing, holding time/cycle was 20 minutes and 5 minutes cooling in water
3. metallographic photos were made by terms of scanning electron microscope for both types of samples
4. Also, there were made measurements for hardness for both types of samples

4. RESULTS AND DISCUSSIONS

The samples made of AA 7075-T651 will be heat treated as follows: solution quenching at the temperatures mentioned before and artificial ageing as mentioned before. The chemical composition of AA7075 T651 was tabulated in the table bellow:

The aluminum alloy takes part from Al-Zn-Mg-Cu alloy system. The ternary diagrams that can bring light on the structure of such an alloy are presented in figure 1. In these figures are made sections in order to emphasize transformation temperatures and the identification of the phases present in the studied aluminum alloy. The presence of these precipitates (phases) lead to the hardening of the aluminum alloy.

Table 1. Chemical composition of AA7075

Si %	Fe %	Cu %	Mg %	Zn %	Cr %	Al %
0.09	0.25	1.2	2.25	5.53	0.21	rest

The aluminum alloy takes part from Al-Zn-Mg-Cu alloy system. The ternary diagrams that can bring light on the structure of such an alloy are presented in figure 1. In these figures are made sections in order to emphasize transformation temperatures and the identification of the phases present in the studied aluminum alloy. The presence of these precipitates (phases) lead to the hardening of the aluminum alloy.

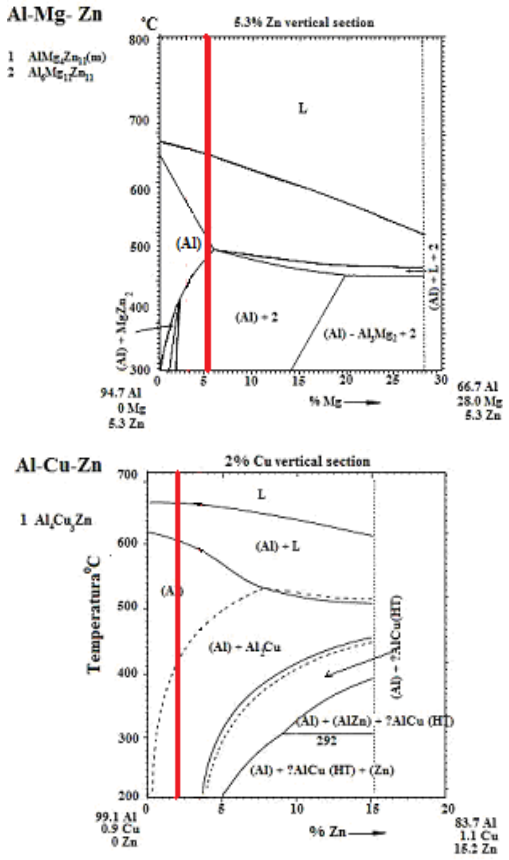


Figure 1: Sections through ternary diagrams of Al-Mg-Zn alloy and Al-Cu-Zn alloy [2]

Once again, the heat treatment of the studied aluminum alloy consists in solution quenching followed by classic artificial ageing with holding for 8 hours in furnace at 120°C and for cyclic ageing with five cycles, heating and cooling cycles consist in heating at 120°C – holding for 20 minutes followed by 5 minutes cooling.

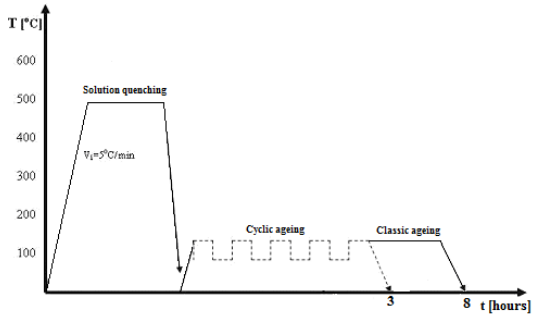


Figure 2. Complete heat treatment diagram

The sample that supported a classic artificial ageing of eight hours presents a semi-fragile fracture with withdrawal grains and a slight deformation of grains edges. Grain withdrawals and even partial fracture of some grains emphasize the presence of some harder, edgy micro fragments of small dimensions that find themselves both intergrains and intragranular and can be chemical compounds as precipitates.

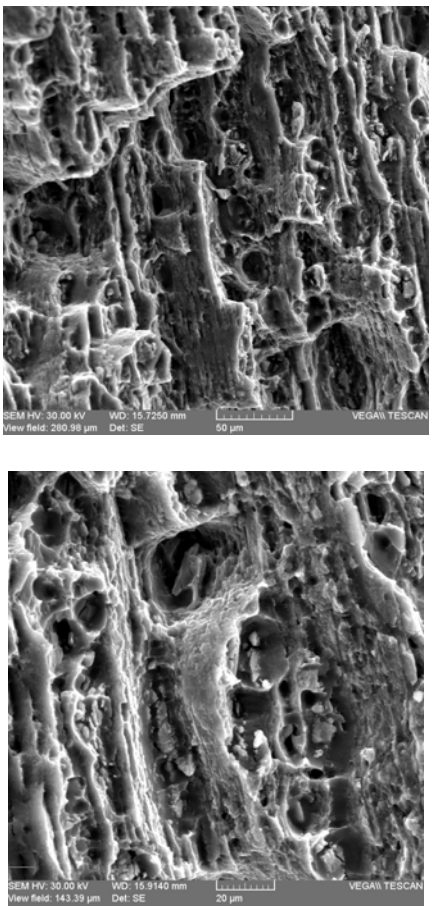
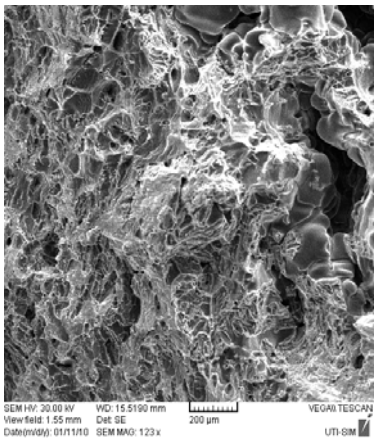


Figure 3. SEM photos of AA 7075 Solution quenched and classic artificially aged at different magnitude orders



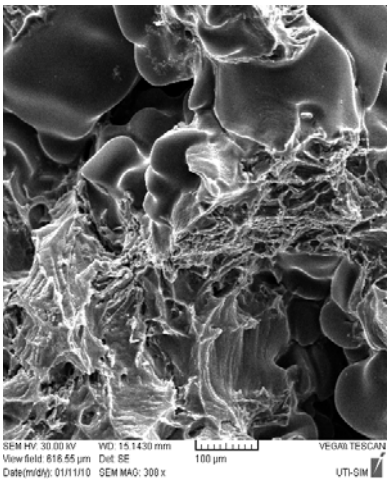


Figura 4. SEM photos of AA 7075 Solution quenched and cyclic artificially aged at different magnitude orders

The sample cyclic artificially aged presents in fracture, at scanning electron microscope analysis, grain partially fragile with micro fragments of hard particles, which represent intergrains micro precipitates.

After the brief analysis of the samples on scanning electron microscope, we did some measurements on hardness.

This measurement made on the hardness machine existent in the Faculty of Materials Sciences and Engineering from Iasi. For Al-Cu-Mg-Zn sample, hardness tested by means of Brinnel method, where pressing force of the indenter is 62.5 Kgf, with ball diameter of 2.5 mm.

The sample classically aged gained a value for hardness of 133.8 HB and the sample cyclically aged gained a value for hardness of 131.89 HB.

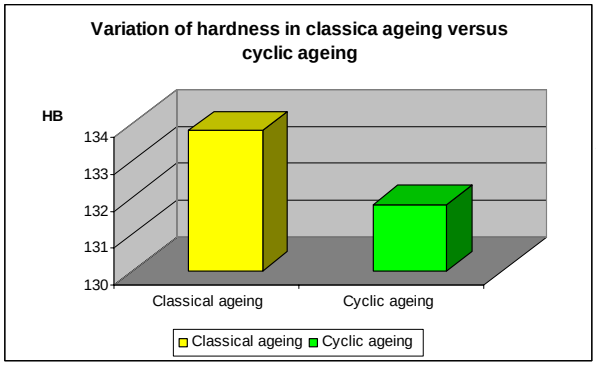


Figure 5. Variation of hardness in classic ageing versus cyclic ageing

It notices the fact that these values are almost similar although the artificial ageing was different.

5. CONCLUSIONS

Taking into account the economic importance of the final ageing treatment of some aluminum alloy, the study of a variant of cyclic artificial ageing respecting the necessary conditions and properties is of real use.

It notices the fact that cyclic artificial ageing shortens transformation period, meaning the proper holding period, from ten hours to three hours without diminishing physical, mechanical, and technological properties of the studied aluminum alloy.

In terms of hardness, it notices that cyclic artificial ageing presents a hardness near to the one met at the classic ageing and this represents a positive aspect with regard to cyclic artificial ageing.

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ASPECTS REGARDING THE USE OF GRANULAR MATERIALS FOR BLAST WAVE MITIGATION

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Abstract: *To protect the safety of those working in a threatened environment and to protect the safety of civilian or military buildings, considerable time and effort has been spent on research and development of protective equipment and neutralization products that mitigate the effects of explosions. It is already known that granular materials have the ability to absorb significant energy caused by a shock or an impact, due to their highly heterogeneous, nonlinear and dissipative behavior. This paper considers aspects and applications of soft granular materials (perlite) for blast mitigation and intends to expand on these applications into an important area, namely the blast (shockwave) protection.*

Keywords: *perlit, granular, mitigate, mitigation, blast, wave*

1. INTRODUCTION

"Soft" condensed matter (granular, porous materials, foams) can be successfully used for mitigation of shock wave caused by contact explosion and for reducing effects of non-contact explosion. Relatively inexpensive granular materials such as iron shot, easily available as a waste from metallurgical plants, proved to be very good shock damping medium. The unusual feature of granular materials is a negligible linear range of the interaction force between neighboring particles and highly heterogeneous state under loading (deviations from average values of parameters are comparable with the averaged values). Examples of successful blast confinement using "soft" condensed matter can be found in [1]. A fact of energy absorption by "soft" matter may not preclude anomalous behavior − a significant enhancement of shock amplitude or absorbed momentum can happen instead of expected mitigation. That is why understanding of shock wave decay in granular assemblies, foams and in composite high gradient barriers is essential for the development of strong shock absorbers for violent dynamic loading from such threats like contact and air explosion.

2. PROPERTIES OF "SOFT" MATTER RELEVANT TO SHOCK MITIGATION

It is very important to establish criteria for materials properties and geometry which will ensure mitigation for specific conditions of blast loading. The fact that such materials are efficient energy absorbers does not automatically guarantee their mitigation performance. For example application of a porous layer with small thickness equal to an effective radius of explosive charge did not result in damping of strains in explosive chamber [1].

Another interesting fact is that a copper powder [2] with high thermal conductivity and sawdust with low thermal conductivity provide the same effect according to the reduction of the wall strains despite a difference in a density of these materials more than one order of magnitude (at the same ratios of a radius of porous shell and chamber to the effective radius of explosive charge). This also means that heat conductivity of porous media does

not influence the reduction of the chamber's strains [4]. Air gap between explosive charge and porous media did not change mitigation effect. It demonstrates that heat losses due to the contact of cold powder and hot detonation products are of secondary importance.

The damping effect is mainly connected with the qualitative change of chamber loading regime caused by porous media [1]. The main parameters determining the effectiveness of blast mitigation are density, porosity and relative geometrical size of "soft" matter.

Significant improvement of mitigation capability of porous barrier can be achieved by appropriate "organization" of porous space. For example in case when structure is loaded by step function and reacts on the maximum pressure the porous barrier which ensures transition to ramped loading can decrease the maximum stress in two times and also prevent spall in a wall of protected structure. This may be achieved using multiporous materials. This structure introduces a new scale – radius a_0 of large pores. The width Δ of a strong stationary shock wave in this material can be evaluated by neglecting strength of granular matrix. In frame of Carroll-Holt model Δ is described by the following equation [1]

$$\left(\frac{\Delta}{a_0}\right)^2 = \frac{4\cdot 2^{1/3}(\alpha_{0G}-1)\alpha_0^2}{(2\alpha_{0G}^3-3\alpha_{0G}^2+1)}\left[1-\left(\frac{(\alpha_{0G}-1)}{(\alpha_{0G}+1)}\right)^{1/3}\right]$$

where α_{0G} is a porosity of multiporous material determined by ratio of initial density to the density of granular matrix (we consider a special case when large size pores are collapsed without densification of granular matrix – case of great importance for repeatable use of this material. If α_{0G} is about 2 the estimated Δ is about $1.2\alpha_0$, which can be made much larger than particle size in granular matrix - the shock front width in the "normal" granular material.

Multiporous geometry can be realized in experiments by placing hollow spheres or cylinders made from low strength materials, like thin walled metal or even plastic or paper shells, in granular matrix composed, for example, from iron shot. Specific shape of pores, different from spherical or cylindrical can be preferable for initiation of collapse by organizing flow of collapsing granular materials through appropriate type of instabilities due to initial geometry of porous space. This "internal avalanche" inside multiporous granular material can be very useful for energy dissipation purposes. The dissipated energy ε per unit mass in stationary shock is

$$\varepsilon = \frac{1}{2}p\left(V_0 - V_f\right)$$

where V_0 and V_f are initial and final specific volumes of multiporous material and p is a shock pressure. The mechanism of this dissipation can be due to large relative displacements of neighboring particles and their friction and collisions during collapse of large pores.

3. ENHANCEMENT OF SHOCK AMPLITUDE BY "SOFT" MATTER

It is often considered that high level of energy absorption by porous matter automatically ensures effect of shock mitigation. In reality it is often observed that application of low density porous layers results in increase of shock pressure in a protected barrier [1]. The reason for this behavior under air shock loading with shock pressure in incident wave P_0 is illustrated by self-explanatory P-u (shock pressure-particle velocity behind shock) diagram in Figure 1 (a).

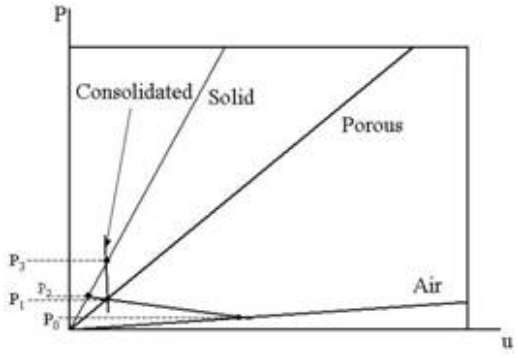

Figure 1 (a) Enhancement of shock amplitude due to porous intermediate layer for air shock

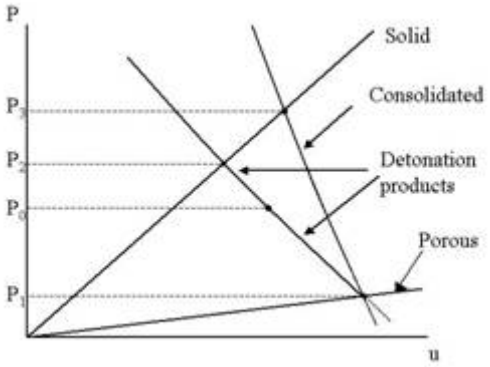

Figure 1 (b) Enhancement of shock amplitude due to porous intermediate layer for contact explosion.

Shock enhancement effect in case of contact explosion is illustrated by *P*-u diagram shown in Figure 1(b) and may be even more dramatic. In both cases shock pressure in a protected wall P_3 is significantly higher than shock pressure P_2 without protection layer. This enhancement can be especially severe for contact explosion with intermediate porous layer with extremely small density and small thickness.

Nature of this effect is due to the fact that shock loading of low density porous material results in a high velocity of consolidated thin layer with subsequent increase of pressure at impact of this dense material on the protected wall [5]. Mass, linear momentum and energy conservations laws for a stationary shock ensure that high value of dissipated energy in porous media is equal to kinetic energy of densified material behind shock (if potential energy is neglected). This may cause a major difference in application of "soft" matter in quasistatic and dynamic conditions.

The thickness of porous barrier must be greater than about six to eight characteristic diameters of the explosive charge. Otherwise opposite effect of load amplification is possible. Using optimal porosity of porous barrier is also very important [1].

This shock enhancement can be avoided using attenuation of shock wave in porous material with sufficient thickness. The critical thickness *H** of damping medium depends on material and on a pressure amplitude and duration of incident impulse. The equation for critical thickness of Porolon foam ensuring shock mitigation for relatively high shock pressures may be written as

$$H^* = 216 \cdot P_m^{0.6} t$$

where *H** is in mm, pressure in MPa and time in milliseconds [1].

4. EXPERIMENTAL DATA

Expanded perlite, a plastoelastic shock-absorbing material, is the case of a highly compressible granular medium and its physical properties makes it suitable to be used as a mitigating material.

Perlite aggregate is a naturally occurring siliceous rock which can be expanded from 4 to 20 times its original volume by heating, due to its 2-6% content of water, and can be fabricated at densities between 32-240 kg/m^3.

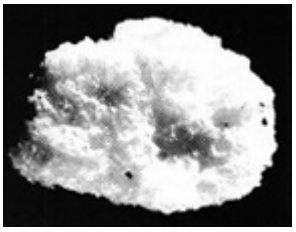

Figure 2 Enlarged image of a particle of perlite with a 4 mm diameter

The experimental work involved the use of high explosives charges and for that reason the tests took place in Jegalia and Dragomiresti ballistic test facilities in the winter of 2009. A series of wood boxes were fabricated at different thickness, with plastic covers on lateral open faces. The boxes were filled with perlite at a density of 200 kg/m^3, Figure 3.

Figure 3 10 cm thickness perlite box

The boxes were placed at different distances with the open faces towards a charge of TNT as shown in Figure 3 (above). In a special test two boxes were joined with an air filled space between, as shown in Figure 3 (below). Two M102 pressure transducers were used in order to measure the pressure in front and behind of perlite boxes. The signal was acquired with PicoScope® 6 - PC Oscilloscope. The transducers were mounted in a face-on position. In "face-on" measurements, the sensitive surface of a pressure transducer is positioned parallel to the blast wave front, so that the pressure behind the reflected wave, P_r, is actually measured and the respective value for the incident blast is then deduced using the normal shock relation

$$P_r = 2P_s \frac{7P_0 + 4P_s}{7P_0 + P_s}$$

In "side-on" measurements, the blast wave front is normal to the sensitive surface, and thus the pressure behind the blast wave, P_s, is directly recorded. The comparative pressure records for a "side-on" and "face-on" set-up is presented in Figure 5.

An overview of blast loading tests is presented in Table 1.

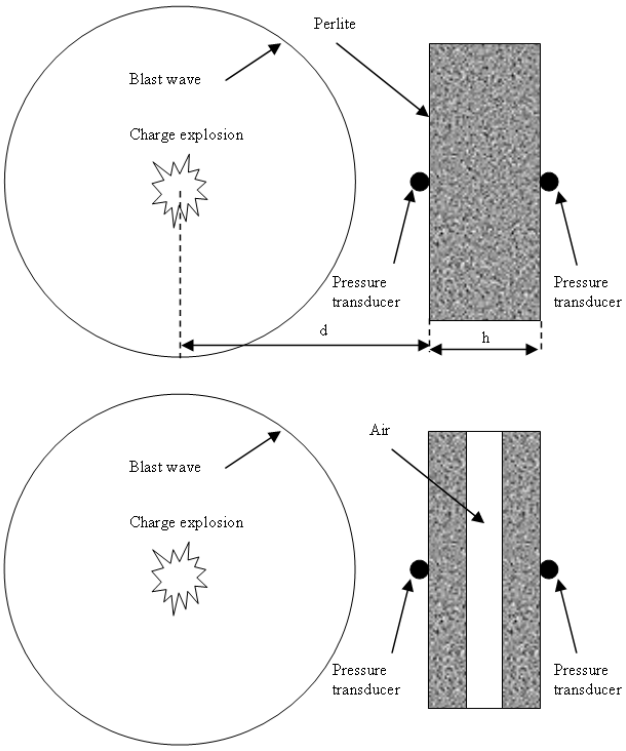

Figure 4 Tests schematic view

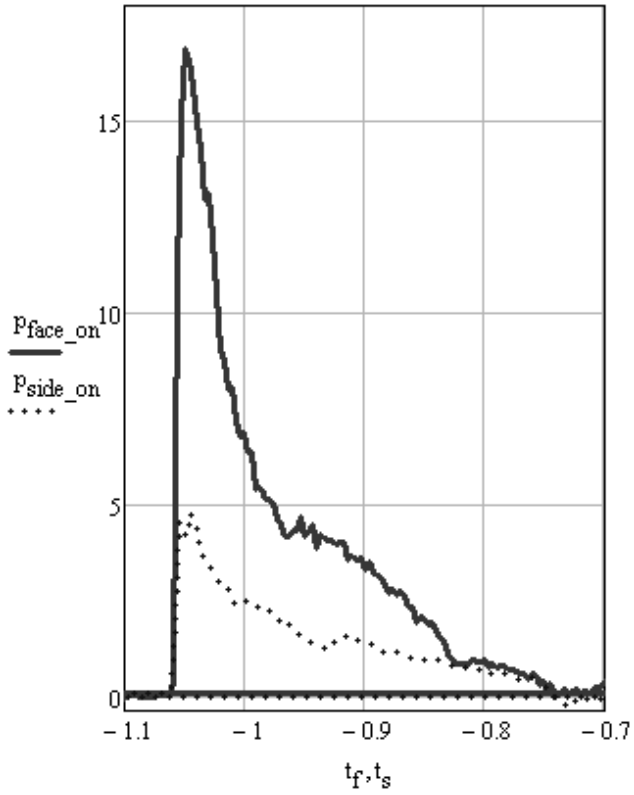

Figure 5 Face-on and side-on recorded signals for the same blast event

Table 1. Summary of the tests parameters

Test	Box thickness h (cm)	Charge mass (gr)	Distance d (cm)
1	5	200	82
2	5	200	77
3	10	200	85
4	15	300	59
5	5 /5 air/5	300	59

5. RESULTS AND DISCUSSIONS

The tests results indicate a good capacity of perlite to mitigate blast waves.

Some of the results were affected by abnormal transducers recording making impossible to estimate mitigation in terms of specific impulse amelioration.

A synthesis of test result in terms of pressure and specific impulse attenuation is shown in Table 2.

Table 2. Summary of the tests results

Test	P_f (bar)	P_b (bar)	$(P_f - P_b)/P_f$	I_f(Pa*s)	I_b(Pa*s)	$(I_f - I_b)/I_f$
1	8.04	1.74	0.78	131	68	0.48
2	9.38	2.23	0.76	121	150	-0.24
3	7.61	0.62	0.92	122	60	0.51
4	27.89	2.21	0.92	NA	NA	NA
5	27.85	1.41	0.95	NA	NA	NA

Blast waves pressure amelioration observed in tests range between 0.78 – 0.95, showing a good consistency with boxes thickness.

The amelioration of specific impulse do not showed the same consistency. For tests no. 1 and no. 3 the impulse is reduced to half but in case nr. 2 the specific impulse behind the box is greater.

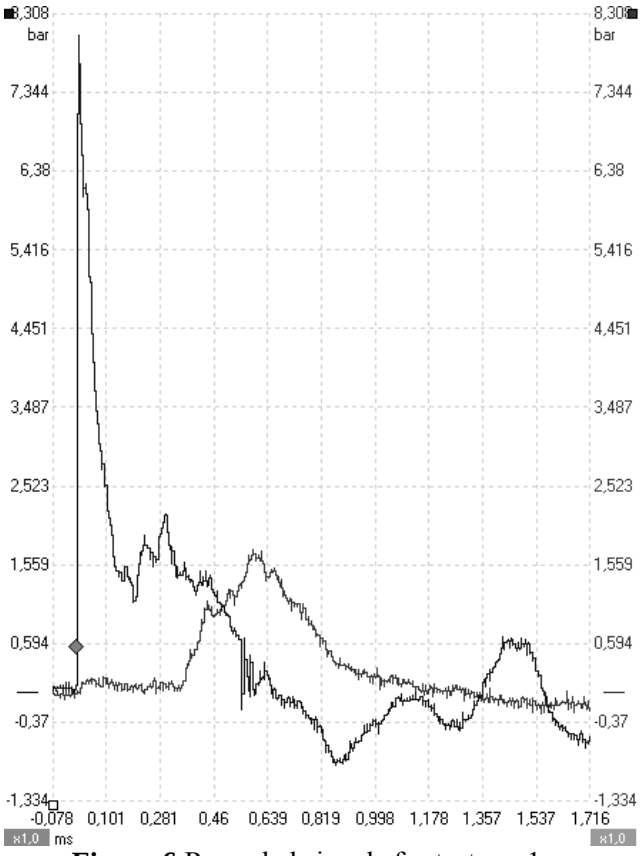

Figure 6 Recorded signals for test no. 1

In Figures 6, 7 and 8 are presented recorded signals with pressure transducers in front and behind perlite boxes.

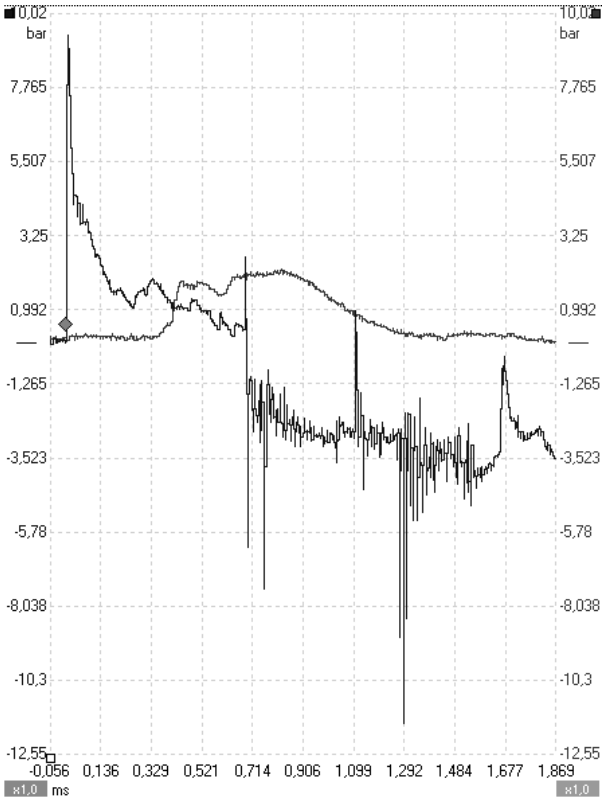

Figure 7 Recorded signals for test no. 2

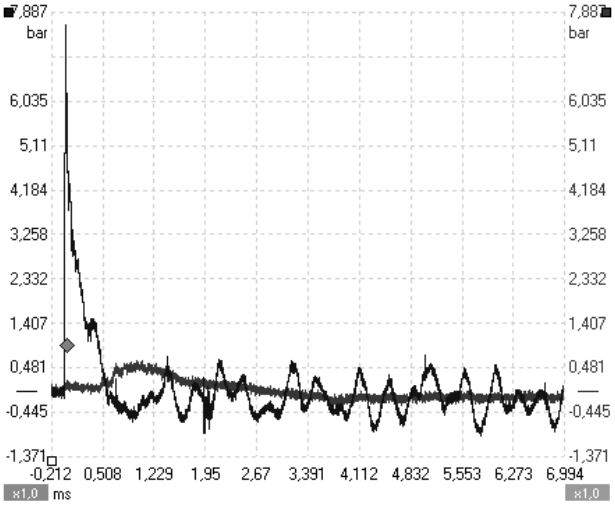

Figure 8 Recorded signals for test no. 3

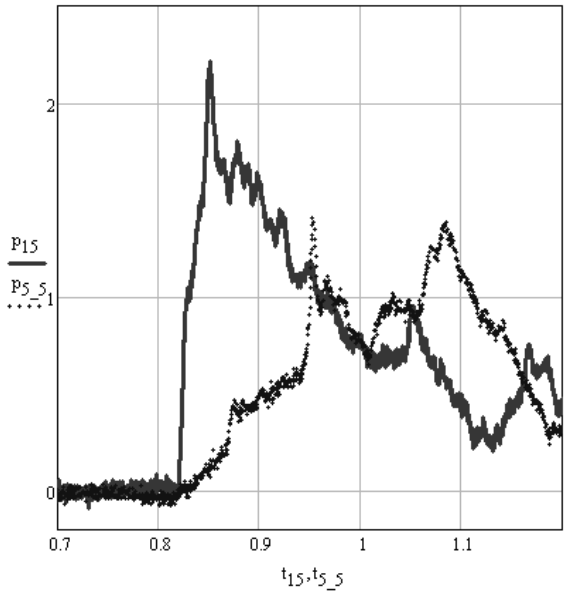

Figure 9 Behind boxes recorded signals for test no. 4 and 5

Altered signals from tests nr. 4 and 5 do not permit an interpretation in terms of impulse amelioration. However an analysis of the results can be made in terms of pressure attenuation (Fig. 9). A better pressure amelioration can be observed in the case of the double perlite layer even if the solution used in test no. 5 involves less material than the solution from test no. 4 (10 cm instead of 15 cm).

The improvement showed in the last test indicates a modification of the mechanisms of mitigation in that case. In addition to the property of perlite to crush, a possible explication is the biphasic flow of the first layer and the shock propagation through space between layers.

6. CONCLUSIONS

The test results indicate the capacity of perlite to mitigate blast wave pressure, in some cases with more then 95%. The short number of tests does not permit to establish a relationship between attenuation values and ratio perlite wall thickness/blast wave magnitude.

The 95% attenuation obtained for two perlite separated layers case is a promising result. Further tests are necessary to clarify the entire mitigation process.

A more accurate method for impulse amelioration measurement is imposed, a less susceptible one to be affected by abnormal transducers recording, as pendulum method.

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MAGNETORHEOLOGICAL FLUID

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Abstract: *Once viewed primarily as novelty materials, smart fluids have attracted a resurgence of interest with the emergence of improved chemistries and a budding commercial demand for their unique properties. They are finding use as dampers for vehicle vibration control, rotary brakes for aerobic exercise equipment, special-purpose devices for medical rehabilitation, and erasable Braille displays for the blind, as well as for seismic damping and virtual surgery.*

Key words: *smart fluid, MR fluid, nanowire-based fluids, ferro-particles, Magnetorheological dampers, seismic dampers, body armor, shock absorbers*.

Magnetorheological fluid

A magnetorheological fluid (MR fluid) is a type of smart fluid in a carrier fluid, usually a type of oil. When subjected to a magnetic field, the fluid greatly increases its apparent viscosity[1], to the point of becoming a viscoelastic solid. Importantly, the yield stress of the fluid when in its active ("on") state can be controlled very accurately by varying the magnetic field intensity. The upshot of which is that the fluid's ability to transmit force can be controlled with an electromagnet, which gives rise to its many possible control-based applications.

Fig. 1 Smart fluid

MR fluid is different from a ferrofluid, in which the particles are much smaller. MR fluid particles are primarily on the micrometre-scale and are too dense for Brownian Motion to keep them suspended (in the lower density carrier fluid). Ferrofluid particles are primarily nanoparticles that are suspended by Brownian Motion and generally will not settle under normal conditions. As a result, these two fluids have very different applications.

How it works

The magnetic particles, which are typically micrometer or nanometer scale spheres or ellipsoids, are suspended within the carrier oil are distributed randomly and in suspension under normal circumstances, as below.

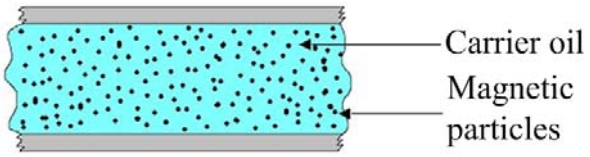

Fig. 2 Smart fluid off-state

When a magnetic field is applied, however, the microscopic particles (usually in the 0.1–10 μm range) align themselves along the lines of magnetic flux, see below. When the fluid is contained between two poles (typically of separation 0.5–2 mm in the majority of devices), the resulting chains of particles restrict the movement of the fluid, perpendicular to the direction of flux, effectively increasing its viscosity. Importantly, mechanical properties of the fluid in its "on" state are anisotropic. Thus in designing a magnetorheological (or MR) device, it is crucial to ensure that the lines of flux are perpendicular to the direction of the motion to be restricted.

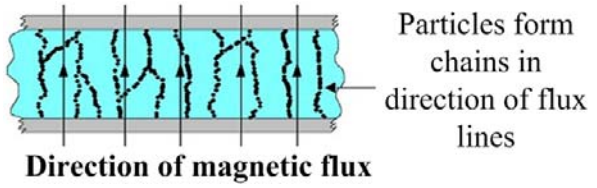

Fig. 3 Smart fluid on-state

Material behavior

To understand and predict the behavior of the MR fluid it is necessary to model the fluid mathematically, a task slightly complicated by the varying material properties (such as yield stress). As mentioned above, smart fluids are such that they have a low viscosity in the absence of an applied magnetic field, but become quasi-solid with the application of such a field. In the case of MR fluids (and ER), the fluid actually assumes properties comparable to a solid when in the activated ("on") state, up until a point of yield (the shear stress above which shearing occurs). This yield stress (commonly referred to as apparent yield stress) is dependent on the magnetic field applied to the fluid, but will reach a maximum point after which increases in magnetic flux density have no further effect, as the fluid is then magnetically saturated. The behavior of a MR fluid can thus be considered similar to a Bingham plastic, a material model which has been well-investigated.

However, a MR fluid does not exactly follow the characteristics of a Bingham plastic[2]. For example, below the yield stress (in the activated or "on" state), the fluid behaves as a viscoelastic material, with a complex modulus that is also known to be dependent on the magnetic field intensity. MR fluids are also known to be subject to shear thinning[3], whereby the viscosity above yield decreases with increased shear rate. Furthermore, the behavior of MR fluids when in the "off" state is also non-Newtonian and temperature dependent, however it deviates little enough for the fluid to be ultimately considered as a Bingham plastic for a simple analysis.

Thus our model of MR fluid behavior becomes:

$$\tau = \tau_Y(H) + \eta \frac{dv}{dz}, \tau > \tau_y$$

Where τ = shear stress; τ_y = yield stress; H = Magnetic field intensity η = Newtonian viscosity; $\frac{dv}{dz}$ is the velocity gradient in the z-direction.

Shear strength

Low shear strength has been the primary reason for limited range of applications. In the absence of external pressure the maximum shear strength is about 100 kPa. If the fluid is compressed in the magnetic field direction and the compressive stress is 2 MPa, the shear strength is raised to 1100 kPa [1]. If the standard magnetic particles are replaced with elongated magnetic particles, the shear strength is also improved [2].

Particle sedimentation

Ferroparticles settle out of the suspension over time due to the inherent density difference between the particles and their carrier fluid. The rate and degree to which this occurs is one

of the primary attributes considered in industry when implementing or designing an MR device. Surfactants are typically used to offset this effect, but at a cost of the fluid's magnetic saturation, and thus the maximum yield stress exhibited in its activated state.

Common MR fluid surfactants

MR fluids often contain surfactants including, but not limited to:

- oleic acid;
- tetramethylammonium hydroxide;
- citric acid;
- soy lecithin.

These surfactants serve to decrease the rate of ferroparticle settling, of which a high rate is an unfavorable characteristic of MR fluids. The ideal MR fluid would never settle, but developing this ideal fluid is as highly improbable as developing a perpetual motion machine according to our current understanding of the laws of physics. Surfactant-aided prolonged settling is typically achieved in one of two ways: by addition of surfactants, and by addition of spherical ferromagnetic nanoparticles. Addition of the nanoparticles results in the larger particles staying suspended longer since to the non-settling nanoparticles interfere with the settling of the larger micrometre-scale particles due to Brownian motion. Addition of a surfactant allows micelles[4] to form around the ferroparticles. A surfactant has a polar head and non-polar tail (or vice versa), one of which adsorbs[5] to a nanoparticle, while the non-polar tail (or polar head) sticks out into the carrier medium, forming an inverse or regular micelle,respectively, around the particle. This increases the effective particle diameter. Steric[6] repulsion then prevents heavy agglomeration of the particles in their settled state, which makes fluid remixing (particle redispersion) occur far faster and with less effort. For example, magnetorheological dampers will remix within one cycle with a surfactant additive, but are nearly impossible to remix without them.

While surfactants are useful in prolonging the settling rate in MR fluids, they also prove detrimental to the fluid's magnetic properties (specifically, the magnetic saturation), which is commonly a parameter which users wish to maximize in order to increase the maximum apparent yield stress. Whether the anti-settling additive is nanosphere-based or surfactant-based, their addition decreases the packing density of the ferroparticles while in its activated state, thus decreasing the fluids on-state/activated viscosity, resulting in a "softer" activated fluid with a lower maximum apparent yield stress. While the on-state viscosity (the "hardness" of the activated fluid) is also a primary concern for many MR fluid applications, it is a primary fluid property for the majority of their commercial and industrial applications and therefore a compromise must be met when considering on-state viscosity, maximum apparent yields stress, and settling rate of an MR fluid.

Modes of operation and applications

An MR fluid is used in one of three main modes of operation, these being flow mode, shear mode and squeeze-flow mode. These modes involve, respectively, fluid flowing as a result of pressure gradient between two stationary plates; fluid between two plates moving relative to one another; and fluid between two plates moving in the direction perpendicular to their planes. In all cases the magnetic field is perpendicular to the planes of the plates, so as to restrict fluid in the direction parallel to the plates.

Flow mode

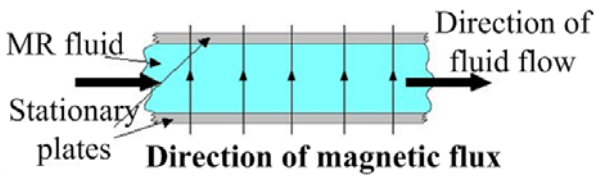

Fig. 4 MR fluid flow mode

Shear Mode

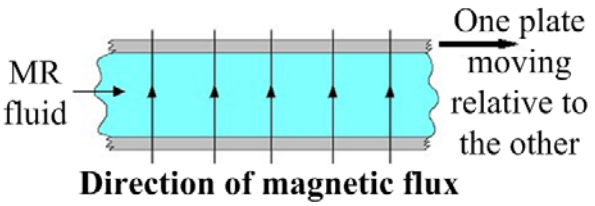

Fig. 5 MR fluid shear mode

Squeeze-Flow Mode

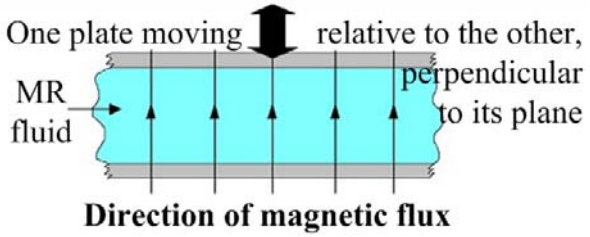

Fig. 6 MR fluid squeeze-flow mode

The applications of these various modes are numerous. Flow mode can be used in dampers and shock absorbers, by using the movement to be controlled to force the fluid through channels, across which a magnetic field is applied. Shear mode is particularly useful in clutches and brakes - in places where rotational motion must be controlled. Squeeze-flow mode, on the other hand, is most suitable for applications controlling small, millimeter-order movements but involving large forces. This particular flow mode has seen the least investigation so far. Overall, between these three modes of operation, MR fluids can be applied successfully to a wide range of applications. However, some limitations exist which are necessary to mention here.

Limitations

Although smart fluids are rightly seen as having many potential applications, they are limited in commercial feasibility for the following reasons:

High density, due to presence of iron, makes them heavy. However, operating volumes are small, so while this is a problem, it is not insurmountable.

High-quality fluids are expensive.

Fluids are subject to thickening after prolonged use and need replacing.

Settling of ferro-particles can be a problem for some applications.

Commercial applications do exist, as mentioned, but will continue to be few until these problems (particularly cost) are overcome.

Recent Advances

Recent studies which explore the effect of varying the aspect ratio[7] of the ferromagnetic particles have shown several improvements over conventional MR fluids. Nanowire-based fluids show no sedimentation after qualitative observation over a period of three months. This observation has been attributed to a lower close-packing density due to decreased symmetry of the wires compared to spheres, as well as the structurally supportive nature of a nanowire lattice held together by remnant magnetization. [3,4] Further, they show a different range of loading of particles (typically measured in either volume or weight fraction) than conventional sphere- or ellipsoid-based fluids. Conventional commercial fluids exhibit a typical loading of 30 to 90 wt%, while nanowire-based fluids show a percolation threshold of ~0.5 wt% (depending on the aspect ratio). [5] They also show a maximum loading of ~35 wt%, since high aspect ratio particles exhibit a larger per particle excluded volume as well as inter-particle tangling as they attempt to rotate end-over-end, resulting in a limit imposed by high off-state apparent viscosity of the fluids. This new range of loadings suggest a new set of applications are possible which may have not been possible with conventional sphere-based fluids.

Newer studies have focused on dimorphic magnetorheological fluids, which are conventional sphere-based fluids in which a fraction of the spheres, typically 2 to 8 wt%,

are replaced with nanowires. These fluids exhibit a much lower sedimentation rate than conventional fluids, yet exhibit a similar range of loading as conventional commercial fluids, making them also useful in existing high-force applications such as damping. Moreover, they also exhibit an improvement in apparent yield stress of 10% across those amounts of particle substitution [6].

Applications

The application set for MR fluids is vast, and it expands with each advance in the dynamics of the fluid.

Mechanical Engineering

Magnetorheological dampers of various applications have been and continue to be developed. These dampers are mainly used in heavy industry with applications such as heavy motor damping, operator seat/cab damping in construction vehicles, and more.

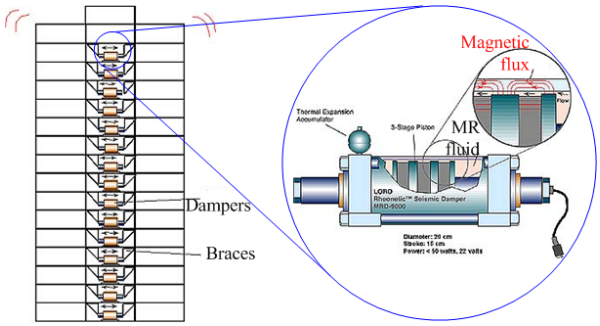

Fig. 7 Seismic damper

As of 2006, materials scientists and mechanical engineers are collaborating to develop stand-alone seismic dampers which, when positioned anywhere within a building, will operate within the building's resonance frequency, absorbing detrimental shock waves and oscillations within the structure, giving these dampers the ability to make any building earthquake-proof, or at least earthquake-resistant [7].

Military and Defense

The U.S. Army Research Office is currently funding research into using MR fluid to enhance body armor. In 2003, researchers stated they were five to ten years away from making the fluid bullet resistant. [8] In addition, Humvees, certain helicopters, and various other all-terrain vehicles employ dynamic MR shock absorbers and/or dampers.

Optics

Magnetorheological Finishing, a magnetorheological fluid-based optical polishing method, has proven to be highly precise. It was used in the construction of the Hubble Space Telescope's corrective lens.

Automotive and Aerospace

If the shock absorbers of a vehicle's suspension are filled with MR fluid instead of plain oil, and the whole device surrounded with an electromagnet, the viscosity of the fluid (and hence the amount of damping provided by the shock absorber) can be varied depending on driver preference or the weight being carried by the vehicle - or it may be dynamically varied in order to provide stability control. This is in effect a magnetorheological damper.

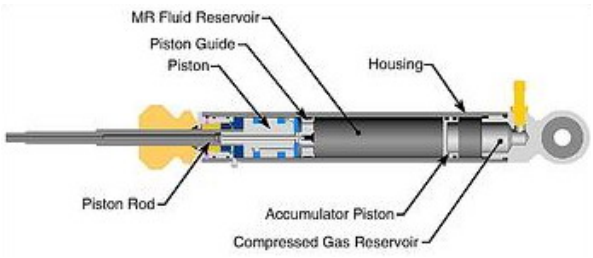

Fig. 8 Magnetorheological damper

The MagneRide magnetic ride control (a kind of active suspension) is one such system which permits the damping factor to be adjusted once every millisecond in response to conditions.

Fig. 9 Delphi MagneRide damper

GM is the origin company of this technology as applied to automobiles. Many other companies have paid for the use of it in their own vehicles. As of 2007, BMW manufactures cars using their own proprietary version of this device, while Audi and Ferrari offer the MagneRide on various models. All Corvettes made since 2005 have also employed a dynamic MR suspension system.

General Motors and other automotive companies are seeking to develop a magnetorheological fluid based clutch system for push-button four wheel drive systems. This clutch system would use electromagnets to solidify the fluid which would lock the driveshaft into the drive train.

Magnetorheological dampers for use in military and commercial helicopter cockpit seats, as safety devices in the event of a crash, are under development. This decreases the shock delivered to each passenger's spinal column thereby decreasing the rate of permanent injury during a crash.

Porsche has introduced magnetorheological engine mounts in the 2010 Porsche GT3 and GT2. At high engine revolutions, the magnetorheological engine mounts get stiffer to provide a more precise gearbox shifter feel by reducing the relative motion between the power train and chassis/body.

Human Prosthesis

Magnetorheological dampers are utilized in semi-active human prosthetic legs. Much like those used in military and commercial helicopters, a damper in the prosthetic leg decreases the shock delivered to the patients leg when jumping, for example. This results in an increased mobility and agility for the patient.

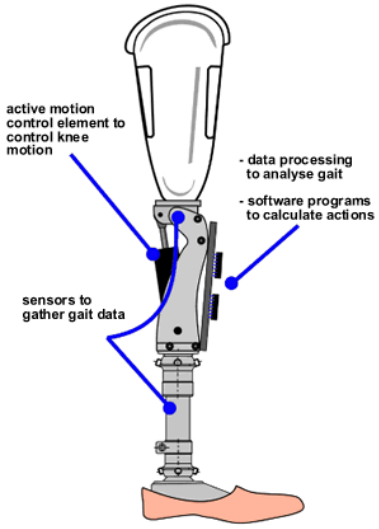

Fig. 10 Prosthetic leg

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[1] Apparent viscosity is a rheological property calculated from rheometer readings performed by a Mud engineer on drilling fluid. It is normally abbreviated as AV. It is expressed in cP (Centipoise). Centipoise is the amount of force required to move one layer of fluid in relation to another. One centipoise is equal to one hundredth of a poise. The poise is the unit of dynamic viscosity in the centimetre gram second system of units. 1 P = 1 $g \cdot cm^{-1} \cdot s^{-1}$. The analogous unit in the International System of Units is the pascal second (Pa·s): 1 Pa·s = 1 $kg \cdot m^{-1} \cdot s^{-1}$ = 10 P.

[2] A Bingham plastic is a viscoplastic material that behaves as a rigid body at low stresses but flows as a viscous fluid at high stress.

[3] Shear thinning is an effect where viscosity decreases with increasing rate of shear stress. Materials that exhibit shear thinning are called pseudoplastic. This property is found in certain complex solutions, such as lava, ketchup, whipped cream, blood, paint, and nail polish. It is also a common property of polymer solutions and molten polymers. Pseudoplasticity can be demonstrated by the manner in which shaking a bottle of ketchup causes the contents to undergo an unpredictable change in viscosity. The force causes it to go from being thick like honey to flowing like water. Unlike a thixotropic fluid, shear thinning fluid viscosity decreases with increasing shear rate, while thixotropic fluid viscosity decreases over time at a constant shear rate.

[4] A micelle is an aggregate of surfactant molecules dispersed in a liquid colloid. A typical micelle in aqueous solution forms an aggregate with the hydrophilic "head" regions in contact with surrounding solvent, sequestering the hydrophobic single tail regions in the micelle centre. This phase is caused by the insufficient packing issues of single tailed lipids in a bilayer. The difficulty filling all the volume of the interior of a bilayer, while accommodating the area per head group forced on the molecule by the hydration of the lipid head group leads to the formation of the micelle. This type of micelle is known as a normal phase micelle (oil-in-water micelle). Inverse micelles have the headgroups at the centre with the tails extending out (water-in-oil micelle). Micelles are approximately spherical in shape. Other phases, including shapes such as ellipsoids, cylinders, and bilayers are also possible. The shape and size of a micelle is a function of the molecular geometry of its surfactant molecules and solution conditions such as surfactant concentration, temperature, pH, and ionic strength. The process of forming micellae is known as micellization and forms part of the phase behavior of many lipids according to their polymorphism.

[5] Adsorption is the adhesion of molecules of gas, liquid, or dissolved solids to a surface. This process creates a film of the adsorbate (the molecules or atoms being accumulated) on the surface of the adsorbent. It differs from absorption, in which a fluid permeates or is dissolved by a liquid or solid. The term sorption encompasses both processes, while desorption is the reverse of adsorption.

[6] Steric effects arise from the fact that each atom within a molecule occupies a certain amount of space. If atoms are brought too close together, there is an associated cost in energy due to overlapping electron clouds (Pauli or Born repulsion), and this may affect the molecule's preferred shape (conformation) and reactivity.

[7] The aspect ratio of a shape is the ratio of its longer dimension to its shorter dimension. It may be applied to two characteristic dimensions of a three-dimensional shape, such as the ratio of the longest and shortest axis, or for symmetrical objects that are described by just two measurements, such as the length and diameter of a rod. The aspect ratio of a torus is the ratio of the major axis R to the minor axis r.

SHAPE MEMORY ALLOY

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Abstract: *Shape memory alloys (SMA's) are metals, which exhibit two very unique properties, pseudo-elasticity, and the shape memory effect. Arne Olander first observed these unusual properties in 1938 (Oksuta and Wayman 1998), but not until the 1960's were any serious research advances made in the field of shape memory alloys. The most effective and widely used alloys include NiTi (Nickel - Titanium), CuZnAl, and CuAlNi.*

Key words: *SMA, engineering materials, martensite, austenite, variable geometry wing*

A *shape memory alloy* (SMA, smart metal, memory metal, memory alloy, muscle wire, smart alloy) is an alloy that "remembers" its original, cold, forged shape, and which returns to that shape after being deformed by applying heat. This material is a lightweight, solid-state alternative to conventional actuators such as hydraulic, pneumatic, and motor-based systems. Shape memory alloys have applications in industries including medical and aerospace.

The three main types of shape memory alloys are the copper-zinc-aluminum-nickel, copper-aluminium-nickel, and nickel-titanium (NiTi) alloys but SMA's can also be created by alloying zinc, copper, gold, and iron. NiTi alloys are generally more expensive and change from austenite to martensite upon cooling; M_f is the temperature at which the transition to Martensite is finished during cooling. Accordingly, during heating A_s and A_f are the temperatures at which the transformation from Martensite to Austenite starts and finishes. Repeated use of the shape memory effect may lead to a shift of the characteristic transformation temperatures (this effect is known as functional fatigue, as it is closely related with a change of microstructural and functional properties of the material).[1]

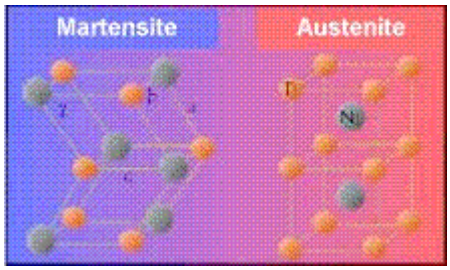

Fig. 1 The Martensite and Austenite phases

The transition from the martensite phase to the austenite phase is only dependent on temperature and stress, not time, as most phase changes are, as there is no diffusion involved. Similarly, the austenite structure gets its name from steel alloys of a similar structure. It is the reversible diffusionless transition between these two phases that allow the special properties to arise. While martensite can be formed from austenite by rapidly cooling carbon-steel, this process is not reversible, so steel does not have shape memory properties.

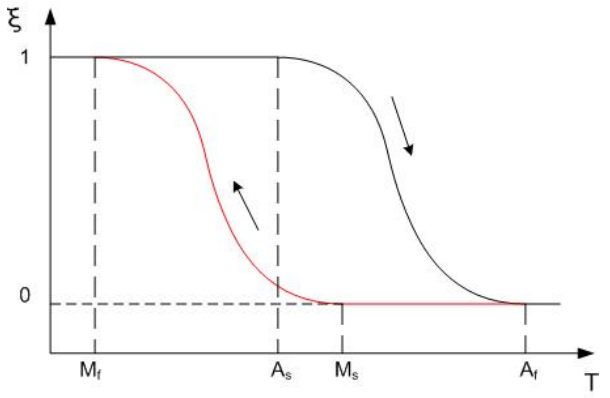

Fig. 2 SMA wire

In this figure, ξ(T) represents the martensite fraction. The difference between the heating transition and the cooling transition gives rise to the hysteresis effect where some of the mechanical energy is lost in the process. The shape of the curve depends on the material properties of the shape memory alloy, such as the alloying[2] and work hardening.[3]

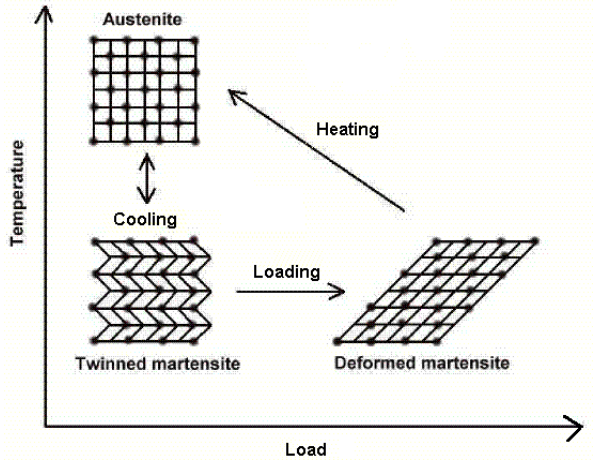

Fig. 3 Microscopic Diagram of the Shape Memory Effect

One-way vs. two-way shape memory

Shape memory alloys have different shape memory effects. Two common effects are one-way and two-way shape memory. A schematic of the effects is shown below.

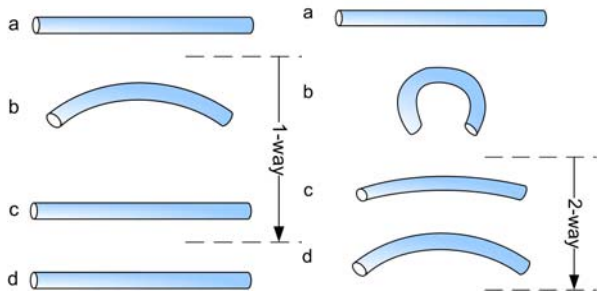

Fig. 4 One-way/two-way shape memory

In the figure above, the procedures are very similar: starting from martensite (a), adding a reversible deformation for the one-way effect or severe deformation with an irreversible amount for the two-way (b), heating the sample (c) and cooling it again (d).

One way memory effect

When a shape memory alloy is in its cold state (below A_s), the metal can be bent or stretched and will hold those shapes until heated above the transition temperature. Upon heating, the shape changes to its original. When the metal cools again it will remain in the hot shape, until deformed again.

With the one-way effect, cooling from high temperatures does not cause a macroscopic shape change. A deformation is necessary to create the low-temperature shape. On heating, transformation starts at A_s and is completed at A_f (typically 2 to 20 °C or hotter, depending on the alloy or the loading conditions). A_s is determined by the alloy type and composition. It can be varied between -150 °C and 200 °C.

Two way memory effect

The two-way shape memory effect is the effect that the material remembers two different shapes: one at low temperatures, and one at the high temperature shape. A material that shows a shape memory effect during both heating and cooling is called two-way shape memory. This can also be obtained without the application of an external force (intrinsic two-way effect). The reason the material behaves so differently in these situations lies in

training. Training implies that a shape memory can "learn" to behave in a certain way. Under normal circumstances, a shape memory alloy "remembers" its high-temperature shape, but upon heating to recover the high-temperature shape, immediately "forgets" the low-temperature shape. However, it can be "trained" to "remember" to leave some reminders of the deformed low-temperature condition in the high-temperature phases. There are several ways of doing this[4]. A shaped, trained object heated beyond a certain point will lose the two way memory effect, this is known as "amnesia".

Pseudo-elasticity

One of the commercial uses of shape memory alloy involves using the pseudo-elastic properties of the metal during the high temperature (austenitic) phase. The frames of reading glasses have been made of shape memory alloy as they can undergo large deformations in their high temperature state and then instantly revert back to their original shape when the stress is removed. This is the result of pseudoelasticity; the martensitic phase is generated by stressing the metal in the austenitic state and this martensite phase is capable of large strains. With the removal of the load, the martensite transforms back into the austenite phase and resumes its original shape.

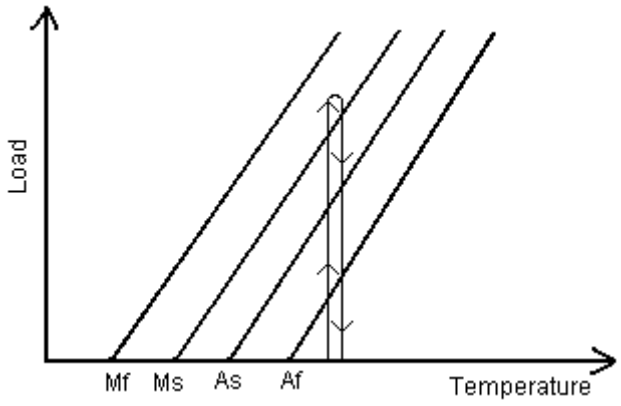

Fig. 5 Load Diagram of the pseudo-elastic effect Occurring

This allows the metal to be bent, twisted and pulled, before reforming its shape when released. This means the frames of shape memory alloy glasses are claimed to be "nearly indestructible" because it appears no amount of bending results in permanent plastic deformation.

Transition temperature

The martensite start temperature of shape memory alloys at which they function is dependent on a number of factors including alloy chemistry. Shape memory alloys with transformation temperatures in the range of 60-1450 K have been made. Zarinejad and co-workers have recently shown that the martensite start temperature increases with the decrease of the valence electron density (concentration) of these alloys.

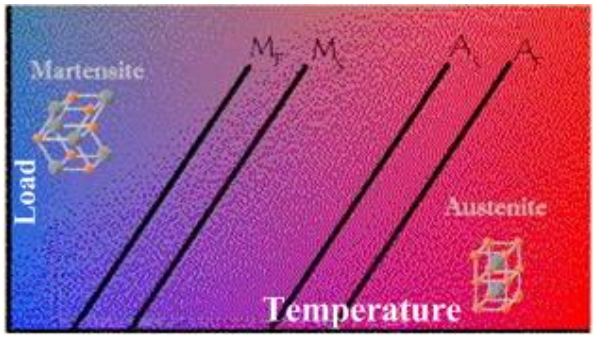

Fig. 6 The Dependency of Phase Change Temperature on Loading

Crystal structures

Many metals have several different crystal structures at the same composition, but most metals do not show this shape memory effect. The special property that allows shape memory alloys to revert to their original shape after heating is that their crystal transformation is fully reversible. In most crystal transformations, the atoms in the structure will travel through the metal by diffusion, changing the composition locally, even though the metal as a whole is made of the same atoms. A reversible transformation does not involve this diffusion of atoms, instead all the atoms shift

at the same time to form a new structure, much in the way a parallelogram can be made out of a square by pushing on two opposing sides. At different temperatures, different structures are preferred and when the structure is cooled through the transition temperature, the martensitic structure forms from the austenitic phase.

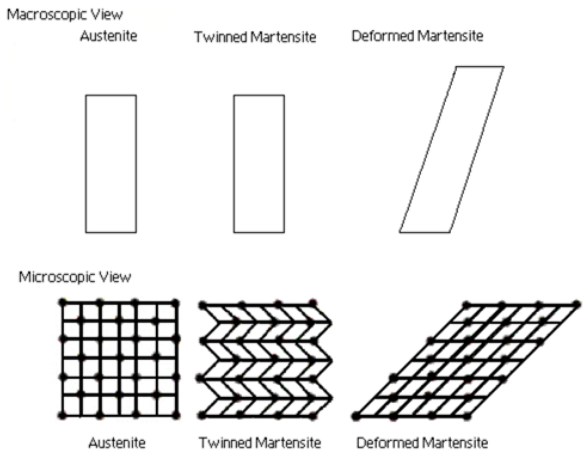

Fig. 7 Microscopic and Macroscopic Views of the Two Phases of Shape Memory Alloys

Manufacture

Shape memory alloys are typically made by casting, using vacuum arc melting or induction melting. These are specialist techniques used to keep impurities in the alloy to a minimum and ensure the metals are well mixed. The ingot is then hot rolled into longer sections and then drawn to turn it into wire.

The way in which the alloys are "trained" depends on the properties wanted. The "training" dictates the shape that the alloy will remember when it is heated. This occurs by heating the alloy so that the dislocations re-order into stable positions, but not so hot that the material recrystallizes. They are heated to between 400 °C and 500 °C for 30 minutes. Typical variables for some alloys are 500 °C and for more than 5 minutes.

They are then shaped while hot and are cooled rapidly by quenching in water or by cooling with air.

Properties

The copper-based and NiTi (nickel and titanium)-based shape memory alloys are considered to be engineering materials. These compositions can be manufactured to almost any shape and size.

The yield strength of shape memory alloys is lower than that of conventional steel, but some compositions have a higher yield strength than plastic or aluminum. The yield stress for Ni Ti can reach 500 MPa. The high cost of the metal itself and the processing requirements make it difficult and expensive to implement SMAs into a design. As a result, these materials are used in applications where the super elastic properties or the shape memory effect can be exploited. The most common application is in actuation.

One of the advantages to using shape memory alloys is the high level of recoverable plastic strain that can be induced. The maximum recoverable strain these materials can hold without permanent damage is up to 8% for some alloys. This compares with a maximum strain 0.5% for conventional steels.

Applications

A. Industrial

Piping

The first consumer commercial application for the material was as a shape memory coupling for piping, e.g. oil line pipes for industrial applications, water pipes and similar types of piping for consumer/commercial applications. The late 1980s saw the commercial introduction of Nitinol as an enabling technology in a number of minimally invasive endovascular medical applications. While more costly than stainless steel, the self expanding properties of Nitinol alloys manufactured to BTR (Body Temperature Response), have provided an attractive alternative to balloon expandable devices. On average, 50% of all peripheral vascular stents currently available on the worldwide market are manufactured with Nitinol.

Aircraft

Boeing, General Electric Aircraft Engines, Goodrich Corporation, NASA, and All Nippon Airways developed the Variable Geometry Chevron using shape memory alloy that reduces aircraft's engine noise. All of Boeing's new aircraft will be equipped with this new technology.

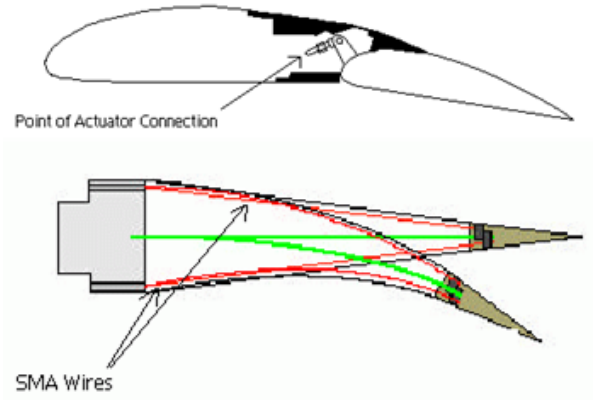

Fig. 8 Variable Geometry Wing

Robotics

There have also been limited studies on using these materials in robotics (such as "Roboterfrau Lara"[7]), as they make it possible to create very light robots. Weak points of the technology are energy inefficiency, slow response times, and large hysteresis.

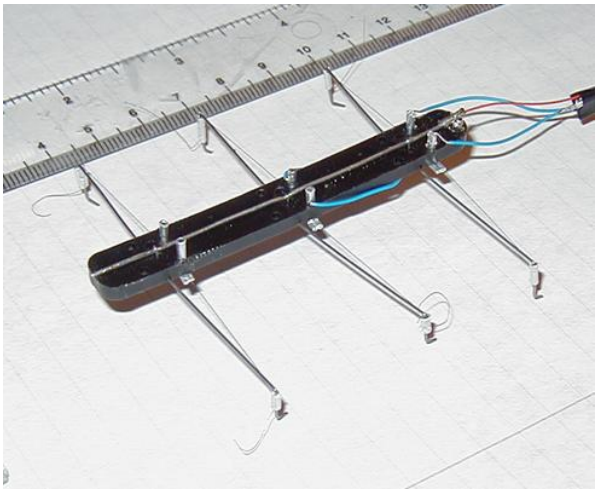

Fig. 9 Stiquito robot

Nitinol wire is also used in robotics (e.g. the hobbyist robot Stiquito) and in a few magic tricks, particularly those involving heat and shapeshifting.

B. Medicine

Optometry

Eyeglass frames made from titanium-containing SMAs are marketed under the trademarks Flexon and TITANflex. These frames are usually made out of shape memory alloys that have their transition temperature set below the expected room temperature. This allows the frames to undergo large deformation under stress, yet regain their intended shape once the metal is unloaded again. The very large apparently elastic strains are due to the stress-induced martensitic effect, where the crystal structure can transform under loading, allowing the shape to change temporarily under load. This means that eyeglasses made of shape memory alloys are more robust against being accidentally damaged.

Orthopaedic surgery

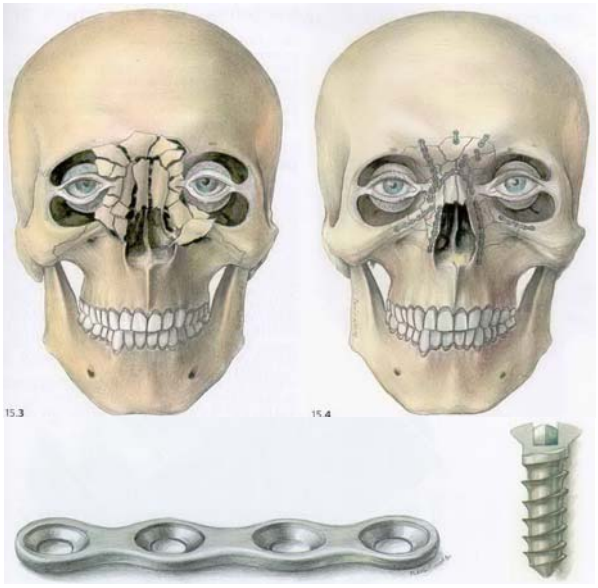

Fig. 10 Example of how even a badly fractured face can be reconstructed using osteosynthesis tools - bone plates

Memory metal has been utilised in orthopaedic surgery as a fixation device for osteotomies, typically around the foot and ankle. The device, usually a staple, is stored in a refrigerator in its malleable form and is implanted into pre-drilled holes in the bone across an osteotomy. As the staple warms it returns to its non-malleable state and compresses the bony surfaces together to promote union of the osteotomy.

Dentistry

The range of applications for SMAs has grown over the years, a major area of development being medicine. One example is the prevalence of dental braces using SMA technology to exert constant tooth-moving forces on the teeth; the nitinol archwire was developed in 1972 by orthodontist George Andreasen.[8] This revolutionized clinical orthodontics and has also had an effect on fiber optic development. Andreasen's alloy has a patterned shape memory, expanding and contracting within given temperature ranges because of its geometric programming.

Harmeet D. Walia later utilized the alloy in the manufacture of root canal files for endodontics.

Materials

Alloys of metals having the memory effect at different temperatures and at different percentages of its solid solution contents.

Ag-Cd 44/49 at.% Cd
Au-Cd 46.5/50 at.% Cd
Cu-Al-Ni 14/14.5 wt.% Al and 3/4.5 wt.% Ni
Cu-Sn approx. 15 at.% Sn
Cu-Zn 38.5/41.5 wt.% Zn
Cu-Zn-X (X = Si, Al, Sn)
Fe-Pt approx. 25 at.% Pt
Mn-Cu 5/35 at.% Cu
Fe-Mn-Si
Pt alloys
Co-Ni-Al
Co-Ni-Ga
Ni-Fe-Ga
Ti-Pd in various concentrations
Ni-Ti (~55% Ni)
Ni-Mn-Ga

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PLASMA METAL CUTTING

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***Abstract**: The paper is summarizing the results and benefits of plasma cutting materials. There are given some experimental data on the achievement by this process to some parts of rolling stock industry.*

***Keywords**: plasma gas, plasma generator, cutting machine, arc welding*

1.INTRODUCTION

Plasma - the fourth state of matter. The term „plasma" was first used to name an ionized gas in 1929 by the american scientist Irving Langmuir. Plasma represents a conductive complex of particles charged electrically or neutral, manifesting collective effects; plasma lead electricity and generates magnetic fields. Plasma is ionized state of matter, and always appear when ordinary matter is heated to a temperature higher than 104 ° C. Depending on the nature of plasmagen gas and its energy, plasma jet temperature can reach values of 20 000 K. The materials thus obtained are different in terms of electricity, gas or fluids, which are strongly influenced by Coulomb type interactions with ions and electrons, and by the presence / action of magnetic fields, by the nature of the external applied field or fields generated by currents that develop inside the plasma.

Continuously supplying energy to material produce a increase in its temperature to rise, first, to transform it into liquid and then gaseous. By adding further energy, the energy of motion of the elementary components of matter increases with increasing temperature so that at some point the atomic shell is destroyed due to collision with molecules and atoms gas that appear negative electrons and positive ions.

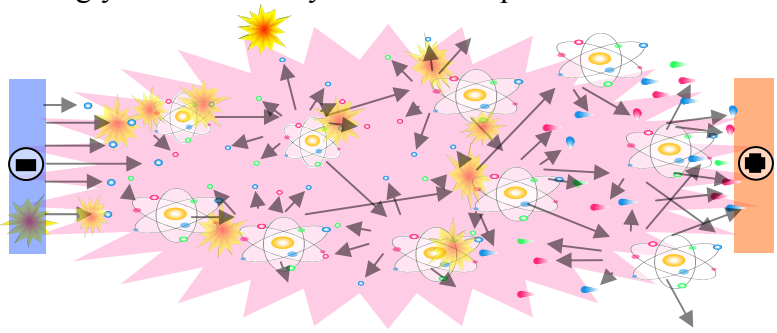


Fig. 1 Plasma state (scheme)

This electrically neutral mixture made of particles electrical charge (positive and negative) is called **plasma** (fig.1.) and is characterized by electrical conductivity due to high temperature value which characterizes him.

Plasma cutting machine using plasma diatomic gas (N_2, H_2 ,O_2) ensure quality cutting of intermediates metal materials (especially of high-alloy steel, refractory and stainless steel, aluminum alloys, copper, titanium) and composites with metal matrix or plastics (thermoplastic, thermosetting, elastomers).

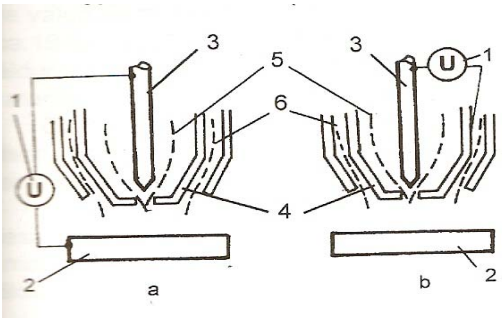
For processing carbon steel workpiece with thickness up to 75 mm can be used, instead of inert gas, air or oxygen. The quality of plasma jet cutting is at least as good as that achieved by oxyacetylene cutting, but with a smaller heat affected zone of maximum 1.5 mm.

There are three possibilities of plasma cutting (Fig. 2):

-Plasma arc welding with plasma transferred arc maintained between the non-fusible electrode and workpiece - (a);

-Plasma arc welding with not transferred arc maintained between the non-fusible electrode and the inner wall of head welding nozzle - (b);

- Arc welding and plasma arc.



where:
1 - power supply
2 - piece
3 - electrode non-fusible
4 - nozzle
5 - plasma gas
6 - protection gas

Fig.2 Ways of forming the plasma arc.

The theoretical and experimental study of processes taking place in the cut cavity, in the cut generator and its power supply, and which would help improve these processes and to develop procedures and new equipment, more efficient for metal cutting with plasma jet. For this purpose it is necessary to resolve the following issues:

-to analyze the known theoretical and experimental studies in this area;

-to accomplish a theoretical and experimental study of formation processes of cut cavity for establishing their particular, to determine new technological solutions that would lead to increased productivity and quality of metal cutting;

-to accomplish an experimental and theoretical study of the processes of plasma generators for cutting in order to increase essential their power and productivity, and also to extend the possible field of use;

-to accomplish a theoretical study of processes in power supplies for plasma generators for cutting in order to determine the specifics of these processes to ensure stable and reliable operation of plasma generators for cutting;

-to develop construction on various kinds of efficient plasma generators with longer lasting life which uses advanced electrodes for metal cutting ;

-to develop different types of power supplies for plasma generators for cutting;

-to make practical use of process and equipment developed and assess their efficiency. A considerable influence on the process and character of cavity cut formation it has the current distribution and heat flow in frontal areas and lateral length of cut. gradients

of concentration of substance which, if This paper will study the formation of cut cavity by the action of the plasma arc. In this case there are complex thermal processes, dynamic gas, electromagnetic and chemical, which interact with each other. Heat flow and plasma gas, which is blast through the generator nozzle cavity cutting, metal forming in a temperature gradient field, which leads to intensive heating and melting metal, and then to evacuate of molten metal from the cut cavity.

generally they are not stationary.

The examined processes of heat and mass transfer: mechanical mixing of molten metal, the substance state change occurring in the entire volume near the front wall of the cavity cut. These processes, overlapping one another, leading to the formation of temperature gradient field, mechanical force field, electomagnetic field and field

For large thicknesses of metal a greater influence on the depth of cut it has the current work and, therefore, and the electric power generator of plasma

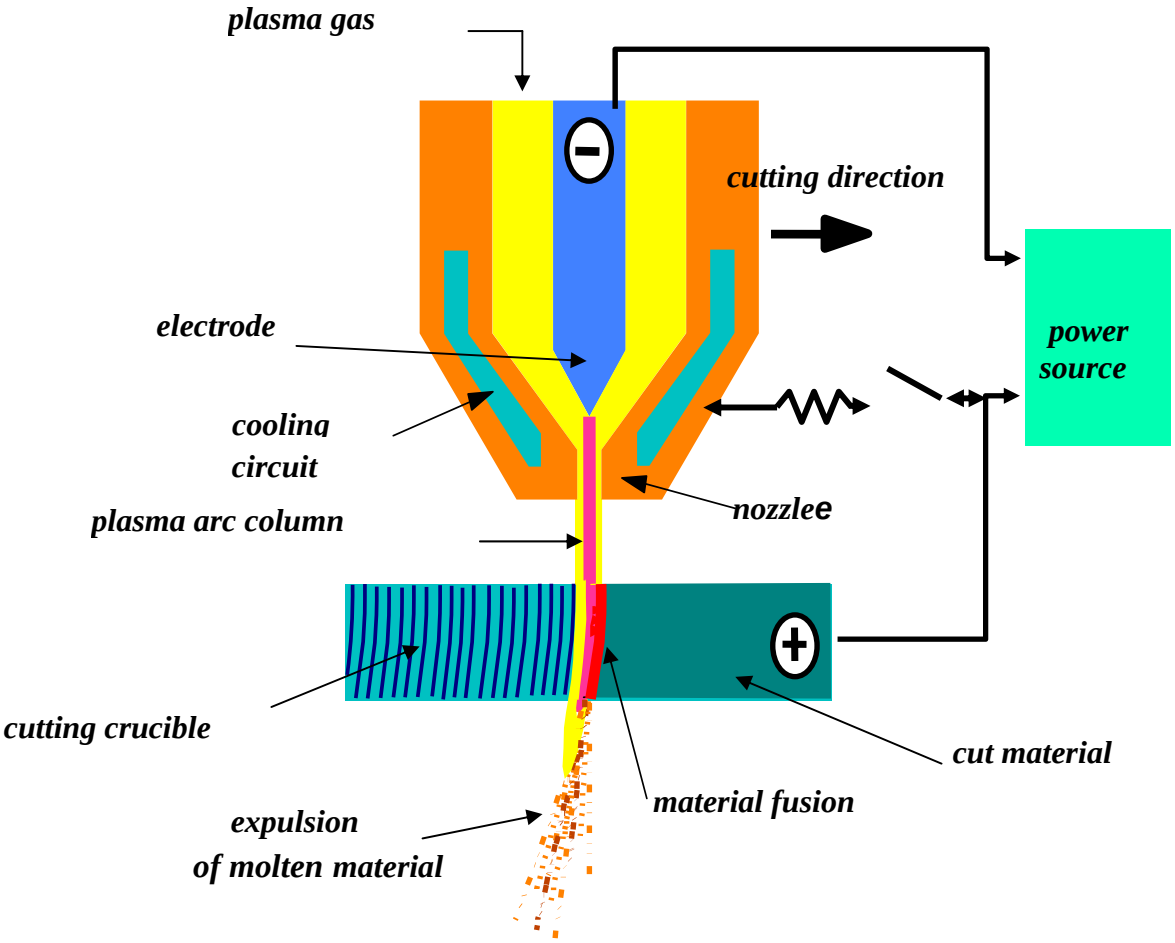


Fig.3. Plasma metal cutting.

For large thicknesses of metal a greater influence on the depth of cut it has the current work and, therefore, and the electric power generator of plasma .To majority of working current the depth of cut increases.Thus it could be observed a dependence almost directly

proportional between the depth of cut and work flow.In second place regarding the influence it is the speed of the plasma generator. Increase speed of movement of plasma generator is diminishing depth of cut and metal plasma flow interacts better format, which is closer to the bottom of the nozzle.

The influence of plasma air flow is not essential.The gases used in plasma cutting and welding have three purposes:

-plasma gas is the medium that forms plasma between the electrode and workpiece. Argon or argon-hydrogen mixture is often used as plasma gas for stainless steels, and mixtures of argon- helium for non-ferrous metals;

-a separate protective gas is necessary to protect the solder bath and heat affected material. Protective gas is introduced into some outer holes that surrounding the plasma gas as a ribbon;

-depending on the type of gas, arc concentration can be increased through the protective gas. However, often the same gas is used as plasma gas and as gas protection;

-a holder gas at the root is applied on the root side through its protection devices, since the molten metal and heat affected material of the root must also must be protected. Root protection gas is usually argon, or mixtures of argon-hydrogen (or nitrogen).

One of the most important features of the plasma generator for cutting with transferred arc is an intensive strangulation of arc column on to the walls channel nozzle. In this case the arc diameter is sharply limited, increasing arc plasma temperature and heat flux density.

Another feature of plasma generators for cutting consists in, that in plasma generator is located only a spot of spring support and only part of his column. The second spot of support and a considerable part of the arc column is located in the cut cavity. Plasma arc has a position free of the supporting spots ,both inside hollow electrode of generator examined, and also into the cut cavity.

Size power and arc voltage are subject to behavior and design value parameters system of plasma generator.

The studies will seek to establish the influence of behavior parameters and constructive parameters of plasma generator on the parameters that determine the efficiency and quality of cut mouth, cut depth, width of mouth cut, productivity of separation surface forming and melting of metal in the cavity cut, energy consumption and efficiency of cutting process.

Mathematical models in the form of polynomial equations will allow the optimization process of forming the cavity cut. Plasma jet is being used increasingly in cutting high alloy steels, nonferrous metals and even non-metallic materials. It may be use as plasma gas : argon, nitrogen, hydrogen, helium. Using plasma generators with installed power of up to 150 kW it can cut materials which, in case of steels, reaching up to 120 mm thick, and for aluminum up to 125 mm.

2. EXPERIMENTAL TESTS:

Track has been achieved in SC CFR ″Maintenance and repair of railway waggon Constanta″, and followed the differences between plasma cutting and manual cutting. The experiment was performed for cutting of an upper side of a brake spider often used on freight wagons and passenger.To implement the 10 parts it has been chosen a blackboard with the following dimensions: L = 1000 mm, L = 650 mm, w = 8 mm.

Fig.4. Plasma cutting machine

1. Cutting using plasma cutting machines. (fig.4)

Technological process:
a) transportation from storage to machine metal cutting t = 10 min
b) drawing on the computer and transfer performance of the machine t = 20 min (still in computer memory)
c) placing the board on the machine t = 5 min
d) introducing cutting parameters t = 5 min
e) cutting their own - called t = 20 min
f) ensuring cutting rates after t = 2 min
10 tracks total run time is 62 min.
Consumables:a)power;b)oxigen; c) nozzles + electrode.For this operation there have been used:- two workers for transport and putting the table on the machine plate;- an engineer for drawing and placing it in the machine;- an operator ;- one that runs through cutting machine;-a master craftsman to check heights.
Labor cost + materials for the whole operation is about 80 RON
Note that after cutting the 10 parts,these do not require further finishing work.

Fig. 5. Part plasma cutting

Example - cut piece by this process (Fig. 5)
2.Manual cutting:
Technological process:
a) transportation from storage to machine metal cutting t = 10 min
b) executing the original design template after t = 20 min
c) marking pieces on the board t = 10 min
d) preparation of cutting equipment t = 15 min
e) cutting their own - called t = 50 min
f) ensuring cutting rates after t = 2 min
Total running time is 107 min
Consumables
a) carbide
b) water
c) oxygen
d) cutting knife
For this operation or use:
- Two workers for transport and putting the table on the machine plate;
- A welder for draw and cutting pieces.

Fig.6. Manual cutting part

Example - cut piece by this process (without completion): Fig.6

Note that after cutting the 10 parts ,they go to the mechanical workshop for polishing and finishing .. t = 100 min

Labor cost + materials for the whole operation is about 200 RON

Fig.7. Comparison between the two parts

observation:

On the sheet metal it may enter "n" drawings of different shapes and sizes without changing any parameter, while the manual cutting must be exchanged the necessary equipments for cutting some forms (ex. for cutting trolley in line or circle etc.)

3.CONCLUSION:

Following the experiment in production were found some advantages when using cutting with plasma namely:

1. It can cut a wide range of metals (high-alloy steel, refractory and stainless steel, alloys of Al, Cu, Ti) in different forms (tables, round tube, square tube, etc.)
2. high productivity - high number and variety of pieces cut.
3. Reduced working time.
4. minimum employees.
5. parts that results should not be finished further.
6. Clean workplace.
7. High employment protection.
8. Negligible waste.

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ASPECTS OF FACTORS AFFECTING LASER TRANSFORMATION HARDENING

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***Abstract*:** *In laser transformation hardening, a laser beam is scanned over the surface of the material to be treated. The surface is heated to a controlled depth by the absorption of beam energy. But how does it find, the right conditions of laser power and surface scanning speed to produce a hardened surface of the required depth?Thus, types of lasers such as carbon dioxide lasers, neodymium YAG, direct diode, and fiber lasers can be used for transformation hardening. Most common steels, stainless steels and cast irons can be suitable materials for laser heat treating. Each kind of steel has special characteristics which need to be considered .*

keywords: *laser transformation hardening, absorption, depth, wavelength of light.*

1. INTRODUCTION

There are conventional and unconventional methods used to harden the surface of ferrous materials. Among conventional methods, is induction hardening,where case hardened depths of several millimeters are obtained but with significant thermal distortion of the components such that rework is usually required.[1,2]. The use of unconventional techology increases, transformation surface hardening being an alternate technique. Most important, laser surface hardening generates low thermal distortion,which mean that there is no need for refinishing of the part.

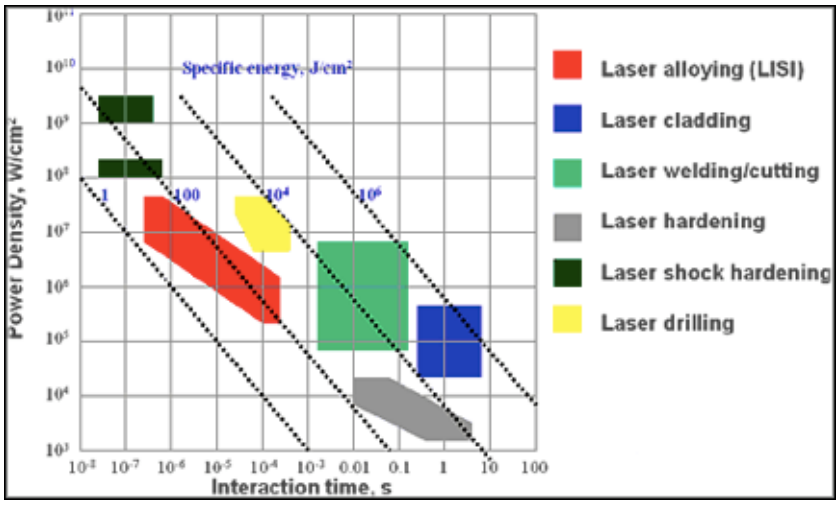

Fig. 1. Processing Parameters Compared to Other Laser Processes.[3]

Surface heat treatment applications include surface alloying, cladding, annealing and transformation hardening of materials.
Unlike cutting and welding, most surface modification techniques are performed using beam power densities in the range 10^3 to 10^4W/cm^2. In laser transformation hardening, energy is transmitted to the materials surface in order to create a hardened layer by metallurgical transformation. The laser is used as a heat source, and rapidly raises the surface temperature of the material. Lasers used for heat treating have wavelengths that fall between 0,80 and 1,06 μm.
The output of Nd: YAG, direct diode, and fiber lasers are at wavelengths that are shorter than that of the CO_2 laser and are more readily absorbed by the steel being hardened. With these laser types, the transformation hardening process can be carried out without painting the work piece beforehand.

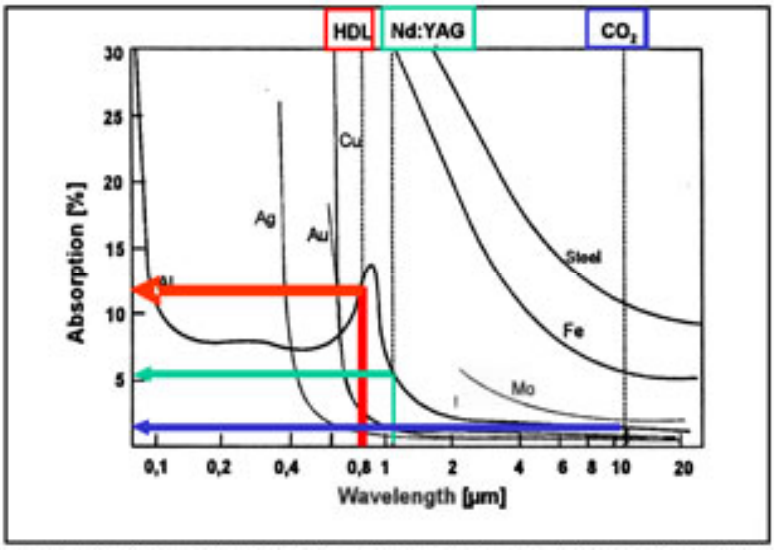

Fig. 2.Comparision of laser energy absorption for all metals:
HDL 0,88 μm, Nd: YAG 1,06 μm, CO_2 10.6 μm.[4]

Recently, it has been developed reliable high power continuous Nd:YAG lasers of power levels in the 500 - 2000 watt range suitable for heat treating. Nd:YAG lasers generally , smaller in size and for most metals, work more efficiently than CO_2 lasers. The laser head is smaller in size and can be moved, and used with robotics, machine vision and fiber optic beam delivery systems. Real-time monitoring of laser transformation it has been studied by reserchers, using an infrared monitor, which has the purpose to monitor the process of surface hardening. For collecting the infrared emission signal associated with the process, the monitor was integrated into the beam delivery optics and used oversized, off- axis optics.Monitor output voltages as a function of time were collected using data acquisition hardware and software (GW Instruments, Somerville, MA) with an Apple Macintosh computer. The data collection rate used was 2500 to 5000 Hz. The Rockwell C hardnesses along the treated tracks were measured using a portable hardness tester.Case depths of treated tracks were determined by measuring the hardness on cross-sectioned samples.

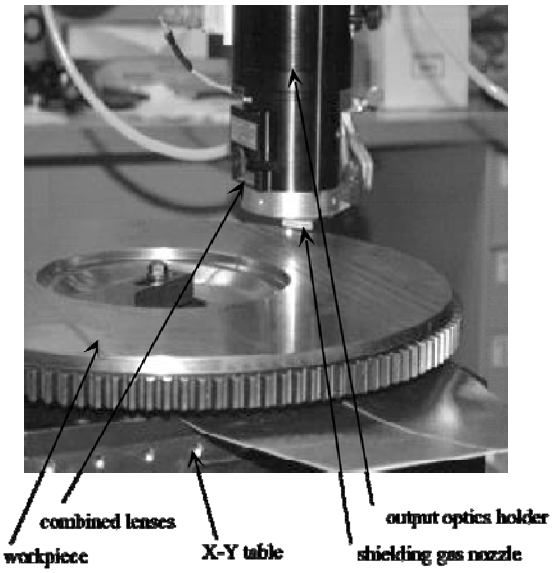

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Fig. 3. Nd:YAG set-up laser surface hardening with monitor integrated into the beam delivery optics. [5]

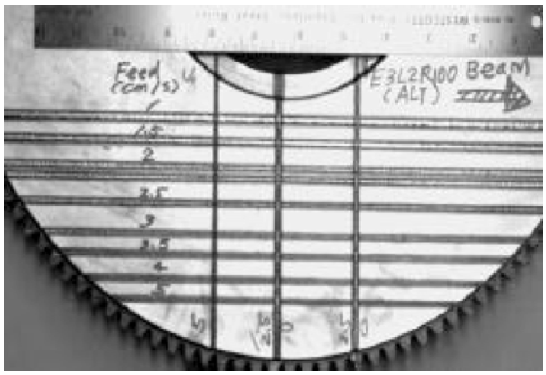

Fig4. The heat treated tracks produced on a gray cast iron component. The horizontal tracks are obtained before the vertical tracks.

2. MATERIALS

The nature of the laser transformation hardening process is rapid heating and hardening to obtain the desired microstructure. As a result there are several items that must be considered in advance in order to fully take advantage of this process: *Microstructure of parts.* The most desirable types of microstructures for the laser process are quenched and tempered or austenitized and tempered conditions; *Microstructural homogeneity of the parts*. Laser surface heat treating requires a homogeneous structure because there is little time in which to diffuse and redistribute the alloy elements throughout the material. Parts with heavy segregation will not respond uniformly to the laser process;

Fine microstructure or small grain size. The smaller the grain size in the part, the faster the response to the laser process. Grain size is one of the major factors in determining the hardenability of parts; *Hardness of core*. Core hardness is important if the part will see service at high pressure conditions after heat treating. If the background material is dead soft, the hardened layer will peel off very quickly in service; *Parts cleaning.* The surface of the parts which will be laser heat treated should be thoroughly cleaned. Heavy dirt, rust, and grease on the surface will cause uneven case depth; *Surface coating.* When using CO_2 lasers, a thin layer of coating is commonly applied to the metal surface to enhance the absorptivity of the metal by the laser beam. Phosphate and black paint are the most common coatings due to their low susceptibility to moisture, but oxide and graphite can also be used.

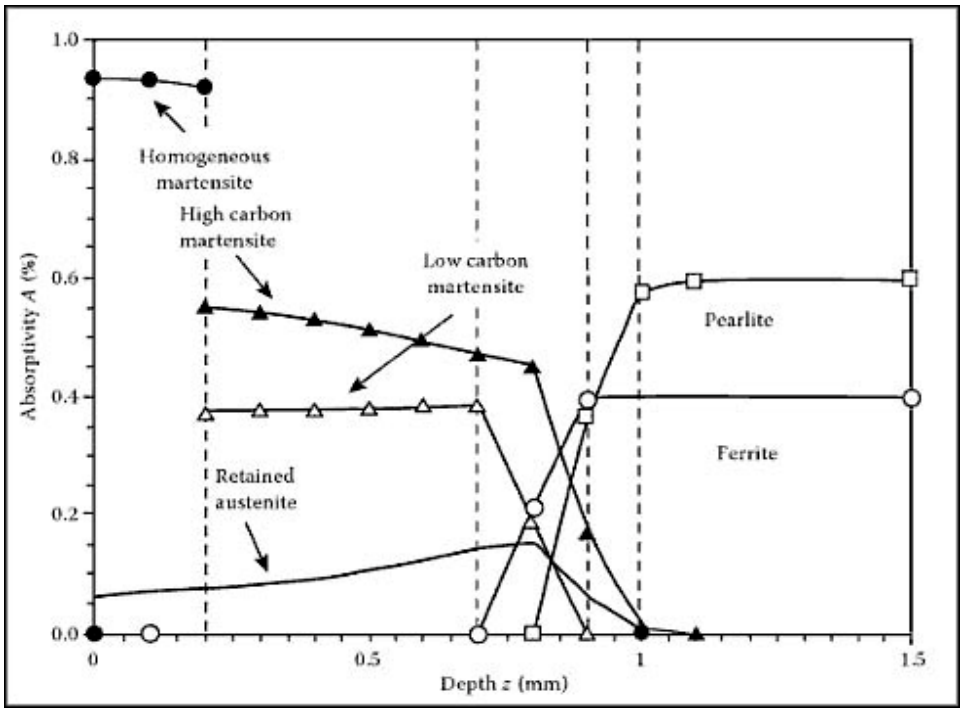

Fig. 5. Hardness profiles versus depth in the middle of the track.[6]

The depth of the hardened zone is dependent on heat imput. Deep hardening requires longer exposure time and, therefore requires closer attention to the possibility of surface melting. That maximum hardness which can be reached is dependent upon the percent carbon content in the steel. Thus,in *low carbon steel* (0.08% to 0.30% carbon) , very rapid hardening is required to form martensite. A shallow case depth of up to 0.5 mm can be achieved. *Medium and high carbon steel* (0.35% to 0.80% carbon) are better choices than low carbon steel because the higher carbon content allows a longer period for hardening in order to reach high hardness. The maximum case depth without use of a water quench is around 1.0 mm. *Alloy steel* is the most desirable type of steel to use with the laser process. The alloy elements, specifically manganese, molybdenum, boron and chrome, aid in hardenability. These steels can be heat treated up to a 3 mm case depth without concern for back tempering. The maximum hardness which can be achieved is dependent upon the carbon content. *Tool steels* can be treated easily by the laser process. Results are similar to those achieved with alloy steels. All cast irons with pearlitic structures can be hardened by the laser. Because of the uneven distribution of carbon along the graphite flakes, some finger melting can be occasionally found close to the hardened surface.

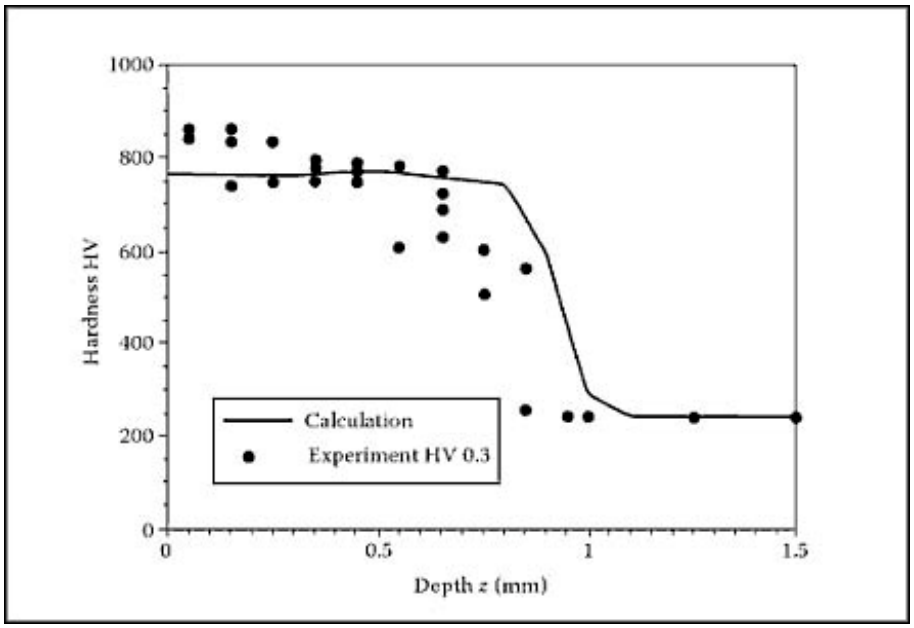

Fig. 6. Hardness versus depth in the middle of the track.

The variability of laser transformation hardening parameters and changing materials properties with temperature results in some scatter. With the use of dimensionless parameters to simplify computation, results applicable to all materials are obtained. In mathematical modeling the following assumptions were considered:

- Surface absorptivity A is constant.
- Latent heat of the α and γ transformation is neglijable.
- Thermal conductivity λ and thermal diffusivity α of steel are constants.
- Eutectoid temperature T_{A1} is as given by the phase diagram.
- Radius of the Gaussian beam r_B is the distance from the beam center to the position where the intensity is 1/e times the peak value. The origin of the coordinate system is in the beam center.

$$T - T_0 = \frac{Aq}{2\pi\lambda v[t(t+t_0)]^{1/2}} \cdot \exp - \frac{1}{4\alpha}\left[\frac{(z+z_0)^2}{t} + \frac{y^2}{(t+t_0)}\right], \quad (1)$$

where :

q[w] is the beam power ;

v [ms^{-1}] is the traveling speed;

t [s] is the time;

t_0 [s] is the heat flow time constant;

λ [Jm^{-1} s^{-1} K^{-1}] is the thermal conductivity of the steel ;

α [m^2s^{-1}] is the thermal diffusivity .

The equation contains two reference parameters, defined by $t_o = r^2_B/4a$ and z_0, which is a characteristic length, as a function to limit the surface temperature. The following parameters are defined according to Shercliff et. al.[9].

$T^* = (T - T_0)/(T_{A1} - T_0)$ is the dimensionless temperature rise;

$q^* = Aq/r_B\lambda\ (T_{A1} - T_0)$ is the dimensionless beam power;

$v^* = vr_B/a$ is the dimensionless traveling speed;

$t^* = t / t_0$ is the dimensionless time;

$(x^*,y^*,z^*) = (x/r_B, y/r_B, z/r_B)$ are dimensionless x,y,z, coordinates.

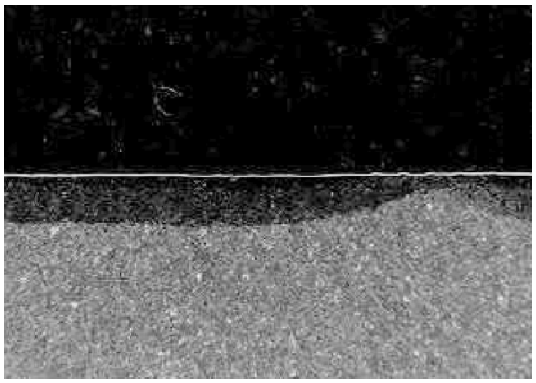

Fig. 7. Photomicrograph of a cross section of an iron-cylinder showing hardened-case and overlap region.[8]

Fig. 8. Photomicrograph of a cross section of hardness zone. Max. hardness is 47HRC and at a case depth of 0.5 mm is 41HRC.

3. CONCLUSIONS

Although the maximum hardness that can be achieved on a given material is governed by the carbon content in the material, when a maximum hardness is required for a certain carbon content, then the case depth is controlled by the cooling condition of the part. If the hardness requirement is lower, then we can lower the power density and slow the travel speed to allow more time to drive the heat down deeper and create a deeper case depth. Studies effectuated reveal that the case depth increases when the power density highers and decreases when the travel speed is increased.The linear relationship of the monitor voltage signal with hardness and case depth makes it easy to monitor process hardness, case depth and quality.

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QUALITY BASED AVIATION EDUCATION FOCUSED ON SECURITY FACTORS VERSUS CAPACITY OF THE STUDY PROGRAMMES

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Abstract: *The operation of air traffic generally covers a variety of activities, which, in some cases, have to be carried out by highly trained specialists. Their professional preparation, the scale and depth of the knowledge and skills of the personnel working on aircraft and in airports and in related areas of activities, must meet the requirements defined in aviation legislation. Quality education focusing on security factors and designed for air traffic personnel is absolutely necessary for the proper fulfilment of the tasks connected with air traffic jobs.*

Keywords: *education of aviation personnel, educational programs, aviation legislation.*

1. INTRODUCTION

A university and a lifelong study of pilots and air technical personnel was in the past provided by the Gen. M.R. Stefanik Air Force Academy that was established in Kosice in the former Czechoslovakia in 1972 and continued its work in Slovakia for more than 30 years, even after the republics split.

Beginning in 1991 the accredited university was an integral part of the republic's school system and focused on the preparation of military and civilian students. Its graduates had been trained as aircraft pilots and specialists in air traffic control, aerial management, aerial engineering, and aerial electrical engineering.

A transformational process that military universities underwent led to the Air Force Academy being incorporated with the Technical University of Kosice on 1 September 2004, and it commenced its existence on 1 May 2005 as the ninth faculty of the Technical University of Kosice with the name of Faculty of Aeronautics as a successor of the former Air Force Academy - a university acknowledged both in Europe and in the world. It became a follower of long-term experience in training of both civilian and military pilots and air specialists.

2. FACULTY OF AERONAUTICS

The basic mission of the Faculty of Aeronautics is to contribute to the mission of the Technical University in air technologies, aviation, aeronautics, and related spheres. The Faculty of Aeronautics provides and organises education in study specialities in all three levels of university degrees. Study is focused on science and technology in compliance with the current status quo. A necessary part of the training of air personnel is also lifelong learning in the form of specialised courses and retraining courses of study in air control and operational technologies with a strongly practical or theoretical character for achieving the skills and habits necessary to perform particular activities.

The Faculty of Aeronautics provides university education in all three levels of degrees in accredited study programs that follow the requirements of national and European legislation and European Aviation Law. It is a holder of the Slovak Republic Civil Aviation Authority certificate of specialised competence to provide theoretical

preparation in pilot training (JAR-FCL1) and the certificate for PART147 Maintenance Training Organization Approval, which authorises the faculty to train air technical personnel according to the requirements of European Union Aviation Legislation, which also considerably widens the ability of graduates to find employment abroad [1].

The organisation of all degrees and forms of university study is based on a credit system according to the principals of the European Credit Transfer System (ECTS), which enables the evaluation of a student's load depending on graduated study program units in accordance with the regulations included in a particular study programme. A student's academic year standardised load is expressed in the total number of 60 credits. The transformation into a three degree model of university education has created conditions for the full use of all available advantages: study compatibility in the Slovak Republic and European Union, mobility of students (a credit-Based system study), higher proficiency, motivation for their individual and independent work, of course, adapted in teaching methodology.[2,3].

3 ORGANIZATION OF THE STUDY

The Faculty of Aeronautics offers academic education of aviation experts in accredited study programs in all three degrees - bachelor, engineering and doctorate, and observing the requirements of the national and European aviation legislation. The study programs can be, in terms of content, divided into three basic groups in specializations: air operations control (pilots, air traffic controllers, managers), aeronautical engineering (airframes, engines) and avionics (avionic systems, sensors)

Teaching in various study programs is currently provided by six science teaching departments of the faculty: Department of Aerodynamics and Simulations, Department of Avionics, Department of Aviation Technical Studies, Department of Aviation Engineering, Department of Air Traffic Management.

The faculty has undergone the regular cycle of training with the education of students in all years of accredited study programs and engineering bachelor's degree.

4. CAPACITY OF STUDY PROGRAMMES

The overview of study programs in which training will be provided in AY 2009/2010:

- The bachelor degree study programmes: Air Transport Management, Professional pilot, Air Transport controller, Airport operation, Aircraft operation, Avionic systems.
- The engineering/master study programmes: Air Transport Management, Aircraft operation, Sensors and avionic systems.
- The doctoral study programmes: Aircraft operation, Aviation and industrial electronic systems, Air Transport Management.

Professional Pilot study programme

This programme has the goal of providing the knowledge and skills necessary for aviation transport operators to work as professional pilots, and to do other aviation related jobs. The programme aims to provide the required theoretical preparation for a student to be able to perform, at the same time, practical training at a selected aviation school up to the level necessary for practical competence that would enable the student to acquire the qualification of business pilot. After finishing flight training, a student can pass a theoretical and practical exam conducted by the Civil Aviation Authority of the Slovak Republic in a suitable type of airplane.

Air Traffic Controller study programme

The goal of the programme is to provide students the knowledge and skills necessary to perform the activities of air traffic controlling for air traffic operators as well as to hold posts to meet the appropriate requirements for air traffic controls in compliance with European aviation regulations. Another aim of the study program is to provide a student with a complete bachelor's education in the

profession and at the same time enable the student to pass the theoretical exams that together with the health tests and health background check allow the student to acquire a "student air traffic controller" licence. The theoretical preparation is organised so that during studies a student has the option of obtaining basic practical skills on ATC simulators.

Study programmes in the sphere of management

These programmes have the goal of providing students the knowledge that they need to solve the routine technological and economic problems of aviation traffic. Students acquire knowledge about aviation technology and the principals of leading work groups and learn about relevant legislation and legal standards, economics, and the use of information technologies. Students also learn the basic methods of planning, organising and managing aviation traffic. Graduates of these programs can be employed as airport or aviation company workers. Since these study programs were created so that they provide a wide range of knowledge in the spheres of management, economics, law, and informatics, they guarantee the successful activities of the graduates in other branches as well. After finishing studies, graduates can decide to work or continue in the following engineering study programme.

The graduates of the engineering study programme are highly skilled, qualified, university-educated specialists who can organise, manage and control aviation operations, airports, and aviation equipment operations. They are prepared for air traffic planning and the economic and business activities of organs and organisations operating, controlling and overseeing air traffic and specific aviation work at home and abroad. They have knowledge of modern traffic technologies, and they master control methods and modern information technologies needed for traffic system control. They are able to solve complex problems of aviation traffic individually and creatively and to use modern means of decision support and optimise the operation of aviation traffic systems and their parts.

Study programmes in the sphere of aviation engineering

The bachelor's degree study programme Aircraft Operation has the aim of imparting basic knowledge in general mechanical engineering, air mechanical engineering, diagnostics and air technical skills and fault detection, control and diagnostic equipment servicing, airplane maintenance and repair, air technical and operational support, preparation and training of the personnel as required by international aviation regulations. Graduates of this study programme are prepared to perform the functions of airplane operation technical workers according to European aviation regulations.

The Aircraft Operation engineering study program has the goal of completing the knowledge imparted in the bachelor's degree program and its extension to the engineering level. The graduates of this study program are able to analyse, propose, construct, operate and maintain the means of transport within a given specialisation. They are able to use solutions with high creativity, complexity, independence and responsibility. They obtain knowledge in the area of theoretical engineering and in the areas of constructing, projecting, and operating means of air transport within a given specialisation. They are able to formulate the required scientific approach and professional perspective for applications in which they will use advanced methods and techniques of design, development and operation of air means of transport and their systems by obtaining experience in formulating and verifying hypotheses and experimental proposals and analysing the data obtained.

The aim of the Aircraft Operation doctoral study programme is to provide students the tools to master scientific methods and the development of air means of transport. Graduates are able to solve the most demanding scientific and research tasks focused on developing diagnostic systems and means of air transport as well as their testing and certification.

Graduates learn the principles of management, scientific work done independently or as a member of a team, scientific research, and the formulation and solution of complex scientific problems and presentation of scientific results. Graduates are also able to analyse and solve complex and non-standard tasks in this field and to come with their own original and new solutions. Students who complete this program can find jobs in research, development and design agencies solving problems and proposals and analyses in terms of high technology applications in, private and government sector, or work as a member of teaching faculty or research team sector at universities.

Study programmes in the sphere of aviation electronics

The Avionics Systems bachelor's degree study program has the goal of providing knowledge about electronics and cybernetics; electrical, special, radio, radio technical equipment and operational airplane security; aviation technology diagnostics and fault detection; control measuring services and diagnostic equipment; maintenance and repairs of on-board airplane systems; and the information and adequate practical experience defined by European aviation regulations. The graduates of this study programme are able to solve practical problems of electronic system operations in the sphere of their aviation applications and cooperate with managers and aviation company specialists or repair and construction enterprises. They are also prepared to perform the functions of airplane operation technicians according to European aviation regulations.

The Avionic Systems engineering study programme has the goal of supplementing the knowledge achieved in the bachelor's degree study programme and extending this knowledge to the engineering level. The graduates of this study programme are able to specify, propose, introduce and maintain vast integrated solutions, with a focus on electronic systems on board airplanes, and to work on projects that include identification of a problem and the analysis, proposal and implementation of solutions together with testing and adequate documentation of particular quality aspects. They are able to work effectively as independent workers or team members or lead work groups. They can also manage big projects in the sphere of electronic systems on board airplanes. They are able to take responsibility for complex and progressive solutions in this particular area and to organise education and professional development. They manage to maintain contact with the latest developments in their specialty and to follow adequate procedures in compliance with professional, legal and ethical frameworks.

The Aviation and Industrial Electronic Systems doctoral study programme is focused on theoretical knowledge and practical experience from key electronic spheres at the level of the current state of research in the world in compliance with the aim of a thesis. Graduates learn the principals of independent and team research work, scientific research, the scientific formulation of problems, and the presentation of scientific results. Students who finish this programme are also able to analyse and solve complex and non-standard tasks in the branch of electronics. Graduates are able to introduce new solutions, monitor the latest scientific and research trends in electronics, and update their knowledge in the form of lifelong study. They manage to communicate and cooperate with scientific project managers and specialists of other professions, too. These graduates can find jobs in research, development, and design agencies solving complex problems, proposals and analyses in terms of high technologies applications in industry, private and government sectors or as a member of the teaching faculty or research team at universities.

3 THE STUDY AT THE FACULTY OF AERONAUTICS

Several reasons for which the applicants decide about a selection of the study program at the Faculty of Aeronautics:

1. Long tradition, rich experience in university aviation training of professionals.

The Faculty of Aeronautics, despite a seemingly short period of its existence, has

many years of experience in training pilots and aviation specialists, and not only civilians but also military. Aeronautical faculty endorses the tradition of the Air Force Academy of GMRS in Kosice, in Europe and the world renowned educational institution for over 30 years provided academic education of pilots and aviation technicians.

2. Studying the most progressive technology.

Development of aircraft has confirmed that at every stage of their improvement they have belonged to the means of the highest technical level together with space technology, with the broadest application of the latest scientific and technical knowledge and most advanced technologies. Aircraft today is a complex of technical equipment, which development has always been a reflection of changes in aircraft design themselves and respected the necessity to solve various tasks of the flight of the aircraft identification. History confirms that the majority of board space and aircraft technologies has been gradually and successfully used and spread in ground facilities and equipment.

3. The wide choice of study curriculum - comprehensive coverage of air issues.

Aviation technology now provides academic education for over 1800 students in all three degrees - bachelor, engineering and PhD in daily and external study. The study in three main areas is offered to students interested in the study courses: Air Traffic Management, Professional Pilot, Air Traffic Control, Aeronautical Engineering, Repairs and Operation of Aviation Equipment, Avionics and Electronics (Avionic Systems). In addition, each student acquires the knowledge of even non-technical areas as economic, humanities and social sciences, foreign languages. The selectivity of subjects is applicable in the study programs by which the student specializes in a chosen field.

4. Studying is difficult but very interesting and flexible, capable of adapting to the pace of students´ abilities and activities under existing legislation.

The organization of all levels and forms of academic education at the Faculty of Aeronautics is based on a credit system, which allows evaluating student's workload in the course of study curriculum using credits.

5. Using advanced technologies in teaching.

The Faculty of Aeronautics pays particular attention to the availability of the latest information and communication technologies, including fast internet connections.

6. The Faculty of Aeronautics creates the conditions for freedom of scientific research and research activities.

A component of the Faculty of Aeronautics in the science and technology is also conducting scientific research and carrying out basic, applied and cognitive research in the areas covered by the faculty. The research is an integral part of the study in the second and third degrees (engineering and doctoral studies). Involvement in research activities is also possible in the first stage of the study (particularly by appropriate choice of a final Bachelor's project).

7. The Technical University/Faculty of Aeronautics provides students with an extensive social program

The social support is provided to students directly and indirectly, for example, includes nutrition in student's canteens, accommodation in student hostels, scholarships, student loans, health care and physical culture, support of social life and students´ free time activities.

4. CONCLUSIONS

The aim and content of study programs come out of current study programme content and qualification requirements included aviation regulations. The creation of the regulations was based on problem integration between the basic spheres as technical, economic and legal of air traffic operations. The aim of the module structure used for individual subjects was to create possibilities for grouping them into integrated parts or into higher study units. It will be possible to interchange, suppress, include, innovate and react according to actual practical requirements. The approach introduced fully satisfies modern educational technologies with the use of electronic media and also respects the possibilities of further continuous study in

the second (engineering) and third (doctoral) levels of university study or in the further education of aviation personnel in the form of specialised aviation and technical courses to obtain skills and habits in performing certain activities [4,5].

The Faculty of Aeronautics relies on its renowned academic staff and scholars. The period of recent five years have proven successful in fulfilling the Faculty's mission, in accordance with the goals set for this higher education institution, while establishing itself as a fully recognized centre of tuition and research. We feel entitled to state that the viability and prospects of the Faculty of Aeronautics have already been justified. The numbers of students applying for study are proofs of evidence.

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INVESTIGATION OF THE POSSIBILITIES TO EXTEND THE CONCEPT OF STABILITY TO MILITARY AIRCRAFTS

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Abstract*: The stability of military vehicles is a new concept that was analysed in detail in my doctor's degree paper. In this work, we will try to apply this concept at the level of military aircrafts. The concept, the definition and the stability factors are presented in the first part, whereas their interdependence will be analyzed in the second part. Because it is a new concept, we had difficulties in translating it. The word "stability" will be used in spite of the fact that sometimes the word "durability" (or "viability") can also be met. This term could be confused with the older exploitation characteristic "durabilitate" that has more the meaning of reliability. "Viability" has been used in the fields of cybernetics and electronics.*

Keywords*: stability, military aircrafts, stability factors.*

1. THE STABILITY OF MILITARY AIRCRAFTS – CONCEPT, DEFINITION, STABILITY FACTORS

In the NATO Romanian Army, taking into account the alliance partners' expectations, it is necessary to improve the ways of intervention by increasing the stability of act capabilities of the specialized squads. The improvement of the global stability of the military technique assets can be accomplished only by borrowing and adapting some data taken from other fields. These details and the other existing ones related the act tactic and combat management technology have as a result the improvement of initial data in the system of the act capacity, and through a proper algorithm, the result will be the optimization of the combat stability factors and, finally, the success of military actions.

Applied to the Air Force**,** the stability is the reliability of the military technique aviation to which a practical and tactical assembly of measures and preoccupations is added (the capacity of military aircrafts and people to avoid the wastage, to avoid in time the enemy's gun strikes and their ability to fast recover their strike, fire, maneuvers and protection capacities) that guarantee the fulfillment of the intervention. In order to analyze and understand the concept of stability the stability factors are studied thoroughly: the performances of military aircrafts, the reliability, the efficiency of maintenance and maintainability works, air traffic specifications, combat service, combat service support (logistics), the quality of the infrastructure, the management of the human resources and the co(-)operation for support. After that, their interdependency is studied. In other words, it could be said that the possibility of a military system to accomplish its mission as good as possible, could be better expressed by studding thoroughly the stability factors taking into account their reciprocal influence.

In conclusion, analyzing the behavior of military system related to its stability, it could be expressed to what extend the act system technically suits its missions.

Conclusions drawn from the analysis of stability factors:

- **The performances of military act systems (**military aircrafts in this situation)

The maximum performances which can be reached by a military system are very important, especially in bad acting conditions.

The promptness of the intervention, its quality, the way the people who fulfill it are protected and supported depends on the maximum level of the performances of the military aircrafts. For instance, this is the reason why the larger and high acting capacity military aircrafts are widely used (large capacity of targets strike especially for the combat area).

- **The reliability**

The second important factor of stability is the reliability because of its direct influence on the performances of the military systems. As we know, during exploitation, the technique assets change their performances in a negative way because of the worn out of their parts and ageing of some component materials. It is important for the technique assets not to undergo a major malfunction during intervention because these would compromise the mission.

- **Maintenance**

Maintenance represents all the organizational and technical activities done in order to maintain and re-establish the technical state of a product so that this product could fulfill all the functions it was created for. The optimization of the exploitation of the military technique assets in military activities can be done only if the maintenance work was very well organized during the period of peace.

- **Traffic specifications** (flight tracks rules of organization)

The planning of flight tracks to interventions is one of the most important parts of air missions' organization activity and it is done following the orders of the superior echelons. Many times the reconnaissance missions are very important. The initial reconnaissance of the field in order to take into account the real flight conditions to choose the best track, military aircraft, its position into a possible flight formation as well as applying some coefficients which consider some unexpected elements becomes vital.

- **Combat service**

It represents all the measures taken in order to protect the troops from the surprising attack of the enemy, in order to give them the possibility to engage on time and in an organized way in a fight, in order to keep combat capacity and to fulfill their missions. The most important part of combat service is the reconnaissance. To draw up an intervention plan an initial detailed reconnaissance of the main access routes is needed. These could be done with the support of civilian factors. During fighting, a permanent air supervision, which keeps under surveillance the area, is obviously necessary.

- **Combat service support** (logistics)

It has an overwhelming importance during training the fight, but a small one during the actual fighting. The supplying of the logistics resources on time and in a sufficient quantity is necessary in order to assure a quick and prompt intervention.

- **The quality of the airport infrastructure and flight tracks**

The choice of a suitable route and airports in combat conditions is decisive for the fighting. It can bring about an important advantage but, in the opposite situation, it can provoke the failure of the mission. That is why the theoretical study of the field on the map, its practical study and by using other means must be done in detail.

- **The management of the human resources**

Many times the supplying of human resources is done to complete the necessary personnel of the units, because the fighting casualties or because personnel deficit caused by other reasons.

This requires monitoring, centralizing and analyzing the data concerning casualties and the level of personnel employment, drawing up and sending the personnel request, receiving, repartition and, the permanent connection with military local offices.

The handling of military aircrafts can be very difficult, stressing to the maximum both the technique asset and the operator (the pilot) because of difficult conditions of the mission. The last one has to know very well the theoretical notions about the operation of the technique asset and, that is why the decision of the manager of the mission, regarding the choice of the operator, is very important too. The operator's training level as well as his partners (the co-pilot or the flight crew) can

influence in a decisive way the operating mod of the technical system. That is why, it is necessary, for the very important missions, to use only very well trained personnel, capable of fulfilling the mission without any problems.

For the military helicopter, in Romanian Army, the assignment of the second pilot should be more important helping the main pilot to overcome the difficult situations. The helicopters flying intervention capacity used into combat missions depends a lot by the human factor. The training level of the pilot and of the second pilot can influence in a decisive way the operating mod of military helicopter. That is why, it is necessary to use in combat areas only the personnel very well trained for military aircrafts in these kinds of conditions. The role of the second pilot should be more important helping the pilot to overcome the difficult situations.

- **Co(-)operation for support**

The co-operation represents an activity used to ensure the working together of the forces taking part in the mission (in time, space and actions), cooperation based on the plan of the action and on the coordination done by the commander in order to concentrate and total their efforts, the aim being the success of the mission.

This has to be permanently assured during the mission and, when from different reasons it is lost, the commanders will give emergency orders to reestablish it, mainly the links for reciprocal informing.

Eventually, we could say that the possibility for a military aircrafts to fulfill its mission in perfect conditions could be better expressed by the thoroughgoing study of the stability factors taking into account their reciprocal influence.

2. THE INTERDEPENDENCE OF THE STABILITY FACTORS

The explanation of connections (Fig. 1):

1. The higher or lower maintainability indirectly influences the rapidity and the quality of the execution for maintenance operations and, sure, in an indirect way, the stability.
2. The decrease, sometimes very low, of aircrafts performances, happens because of the reliability of global system. If the reliability is higher, the performances will decrease less and in a longer period of time.
3. At the same time with the increase of the easiness and the rapidity of maintenance the reliability parameters increase too, and the inverted phenomenon is true because if the reliability is high, the maintenance interventions are more rare, easier and faster; that means the maintenance parameters are higher.
4. If the management is a modern one, the operators are well trained, the performances of technical systems can be used to maximum; it is obvious that the manager of the pilots has to apply the principle “the adequate person at the adequate place”, because, it is not necessary only the pilots to be very well trained, but, through joining more factors, the professional experience, the training level, behavior features, the decision factors must choose the fit people to accomplish the specific assignments.
5. This thing has to be applied in the case of maintenance teams; moreover, they have to be trained in order to be specialized in some domains to increase the workmanship and the rapidity of the execution; also, during the training program of workmen and operators, the teaching of principles and systems will be underlined at first and after that each of them will be specialized in one domain; so, the receiving of other kinds of military aircrafts will be without any problems.
6. The general level of training increases because of the change of experiences between different domains.
7. The maintenance could be easier by cooperation with the superior echelons especially for difficult situations.
8. A high combat service support could be ensured by co(-)operation, especially for missions abroad but only when the frictions caused by the differences between civilizations and cultures do not appear.

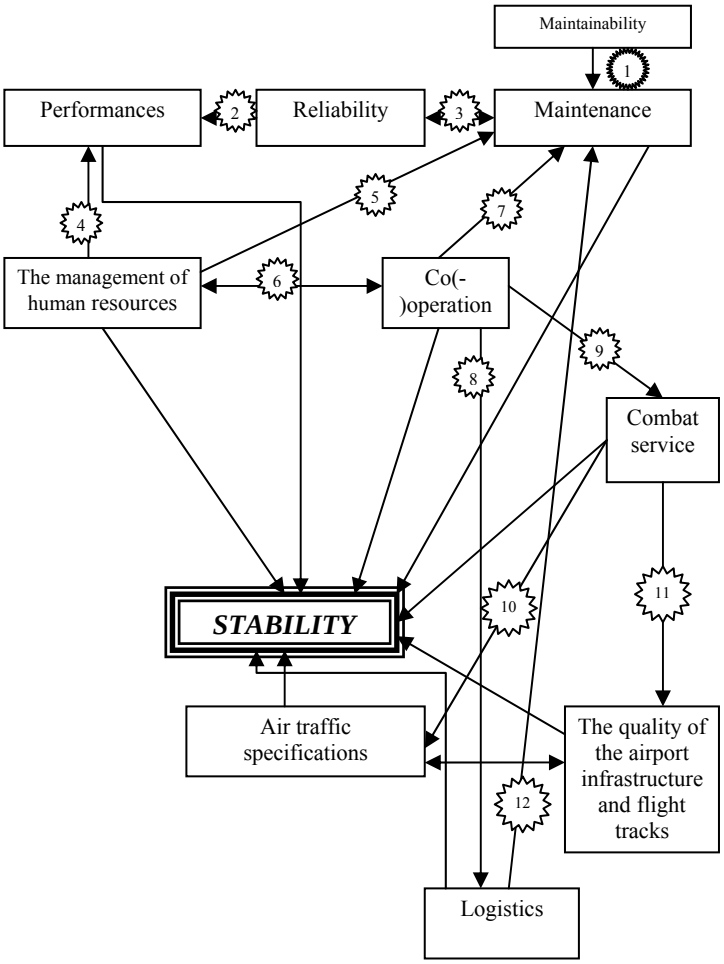

Fig. 1 The chart of interdependence of the stability factors [1]

9. During reconnaissance missions, the reconnaissance of the field could be executed and with the support of the obtained data the decisions about air traffic specifications will be made.
10. During combat service the protection against sabotage acts is also ensured; this fact directly influences the quality of the airport infrastructure and flight tracks.
11. The method to execute the maintenance depends on the rapidity and the quality of the supply with tools, devices, spare parts and POL.

3. CONCLUSIONS

The stability of military vehicles is a new concept. In this work, we tried to apply this concept at the level of military aircrafts. Because it is a new concept, we had difficulties in translating it. The word *stability* will be used in spite of the fact that sometimes the words *durability, sustainability* (or *viability*) can also be met. This term could be confused with the older exploitation characteristic "durabilitate" (in Romanian language) that has more the meaning of reliability.

Finally, we can say that the possibility of a vehicle to execute the mission in the best conditions can be expressed best by deepening the stability factors and taking into account their mutual influence.

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THE ASPECTS CONCERNING MANEUVRE OF MILITARY ASSETS IN OUTER SPACE

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Nowadays, societies around the world have relied increasingly on satellites for vital communications services, environmental monitoring, navigation, weather prediction, and scientific research. This largely beneficial trend is expected to intensify: more countries are developing satellite technology and using the services derived from it.

The same technologies have made possible the development of military capabilities in space that go far beyond those employed during the Cold War for intelligence gathering early warning. Some people see space as a critical enabler for bringing decisive military force to bear anywhere on Earth with little or no warning.

***Key words**: circular orbit, de-orbiting maneuvers, satellite, kinetic energy, space-based weapons*

1. INTRODUCTION

We appreciate that technical realities must be considered in any military – policy analysis of space weapons and anti-satellite weapons.

Unless debate about these issues is grounded in an accurate understanding of the technical facts underlying space operations, the discussion and policy prescription will be irrelevant or, worse, counterproductive for all.

All of us know that the cost of operating in space is often high relative to the cost of operating in the air or on the ground. Physics on the other hand, places fundamental limits on space operations that will not change with time.

An example of a fundamental limit posed by physics is the fact that satellites in low orbits[1] cannot remain stationary over a given location an Earth, so are required multiple satellites to ensure that one is always near that location.

The behavior of objects traveling at very high speed in space (over 6km/s) is much different from the behavior of objects in motion on the ground or in the atmosphere and is largely outside day-to-day human experience.

The motion of objects in the atmosphere differs in three important ways from the motion of objects in space. First, the speed of an airplane bears no particular relationship to its flight path or altitude: two airplanes can follow the same flight path at different speeds. In contrast, a strict relationship holds between a satellites orbit and its speed: as an example, for circular orbits, all satellites traveling at the same altitude must have the same speed, and satellites at different altitudes must have different speeds.

Second, an airplane uses the presence of the air not only to stay aloft, but also to maneuver. In the vacuum of space, this is not possible. A satellite must instead use small rocket engines to maneuver. Because such rockets require propellant, this has important implications for the design and capabilities of satellites.

Third, since air resistance to an airplane's motion continually slows it down, engines to stay in flight must continually power an airplane. This is not true for a satellite in the vacuum of space. A rocket booster is needed to place a satellite in orbit, but once there it

[1] Satellites in low earth orbits (LEO) operate at altitudes of hundreds of kilometers up to around 1000km. LEO satellites have orbital periods of roughly 90 minutes.

circles the Earth in its orbit without requiring constant powering from rocket engines.

We appreciate that technical realities must be considered in any military –policy analysis of space weapons and anti-satellite weapons.

Unless debate about these issues is grounded in an accurate understanding of the technical facts underlying space operations, the discussion and policy prescription will be irrelevant or, worse, counterproductive for all.

2. BASIC SATELLITE MANEUVERS

The main properties (characteristics) of the satellite in orbit are: its orbital speed, orbital period and the orientation of the orbit with respect to the equator. In general, satellite orbits are ellipses. However, the circular orbits are simpler to understand and they used for many applications. The choice for a particular orbit for a satellite depends mainly on its mission. For example, a remote-sensing satellite that collects high-resolution images of the Earth's surface should be as close to the Earth as practical. Consequently, such satellites are in low earth orbits. On the other hand, a commercial broadcast or communications satellite has other requirements. It should be able to send and receive signals from a large geographic area. It should preferably be in a fixed location, so ground stations will not need expensive satellite-tracking equipment. For these reasons, most communications satellites are in equatorial geostationary orbits.

We consider that, this tight correlation between mission and orbit has very important consequences for military decision-makers. For example, only a few special orbits are uniquely suited to a specific purpose and are therefore highly valuable. As a pursuit, it is often possible to guess at the function of an unknown satellite by observing what orbit it follows.

Mainly, to maneuver a satellite in orbit we must use rocket engines to change the magnitude or direction of its velocity. Because the orbital speed of satellites is so large, the velocity changes required for maneuvering may also be large, requiring the thrusters to use large amounts of propellant a satellite can carry since it increases the total mass (that must be) launched into orbit. How much and how quickly a satellite can maneuver in space, depends on the amount and type of propellant it carries.

Every time when a satellite maneuvers, it changes its orbit.

To change orbits are used three basic maneuvers (recall that, all satellite orbits lie in a plane that passes through the center of the Earth):

- changing the shape or size of an obit within the orbit plane;
- changing the orbital plane by changing the inclination of the orbit;
- changing the orbital plane by rotating the plane around the Earth's axis at constant inclination.

A general maneuver will be a combination of these basic maneuvers. Designing a maneuver that changes the altitude and orbital plane at the same time, rather than through sequential maneuvers, can reduce the velocity change required.

Maneuvers within the orbital plane allow the user to change the altitude of a satellite in a circular orbit, change the shape of the orbit, change the orbital period, change the relative location of two satellites in the same orbit and de-orbit a satellite to allow it to return to Earth. Since the speed of a satellite is relative (related) to its orbit, maneuvering can be complicated. Maneuvers that change orbital plane of a satellite can require very large changes in the satellite's velocity, especially for satellites in a low earth orbit (LEO). This has important implications for the feasibility and utility of space-base systems that require such maneuvers. To indicate the scale of velocity changes required for some common orbital maneuvers, Table 1 shows such maneuvers along with a characteristic value of the velocity change needed in each case:

Table 1

No	Type of Satellite Maneuver	Required ΔV(km/s)
1	Changing orbital altitude within LEO (from 400 to 1000	0.3

	km)		
2	De-orbiting from LEO to Earth		0.5 - 2
3	Station-keeping in GEO over 10 years		0.5 - 1
4	Changing inclination of orbital plan in GEO	by $\Delta\theta=30^0$	2
		by $\Delta\theta=90^0$	4
5	Changing orbital altitude from LEO to GEO (from 400 to 36000 km)		4
6	Changing inclination of orbital plan in LEO	by $\Delta\theta=30^0$	4
		by $\Delta\theta=90^0$	11
LEO = low earth orbit GEO = geosynchronous orbit Δv = shows a change in satellite velocity $\Delta\theta$ = is the change in inclination			

For better understand, it is helpful to keep in mind that the speed of 1 km/s is four times faster than a passenger jet, in addition, generating a velocity change of 2 km/s with conventional propulsion technologies would require a satellite to carry its own mass in propellant thus doubling the mass of the satellite.

Maneuvers that change the shape or size of a satellite's orbit without changing its orbital plane can be made by changing the magnitude but not the direction of the velocity.

If the speed of the satellite is suddenly increased by ΔV at some point on the orbit (without changing the direction of the velocity) the satellite does not go faster around the same orbit, instead, the orbit becomes an ellipse in the same orbital plane (see Figure 1).

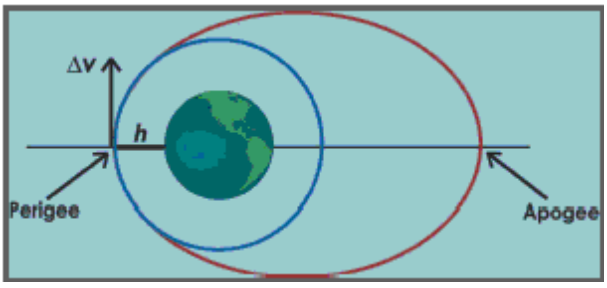

Fig. 1 Influence of increased magnitude of velocity over the orbit

A relatively small value of ΔV results in a significant change in altitude at apogee. As an example, for satellites in orbit at an altitude of 400 km, a ΔV of 0.1 km/s would lead to a change in altitude at apogee of 350 km, so that apogee lies at an altitude of 750 km.

On the other hand, if the speed of a satellite an a circular orbit is reduced at some point on the orbit by thrusting in the direction opposite to the satellite motion, that point becomes the apogee of an elliptical orbit, with an altitude or "h" at apogee. The perigee then lies at an altitude less than "h".

Satellite placed in geostationary orbits are frequently placed in a low earth orbit initially, and then moved to geostationary orbit because this process requires the minimum amount of energy for this transfer.

Maneuvers to change the shape and altitude of the orbit can be used to change the period since the orbital period of a satellite depends on the altitude and shape of the orbit. Such maneuvers may be useful, for example, to vary the revisit time of a reconnaissance satellite, making it less predictable.

As an example, a satellite in a circular orbit with an altitude of 400 km has an orbital speed of 7.67 km/s and a period of 92.2 minutes. Increasing the orbital speed by 0.1 km/s would increase the period by about 3.6 minutes, while an increasing of 0.3 km/s would increase the period by 10.8 minutes.

As discussed above, these velocity changes would cause the orbit to become elliptical: the resulting apogees would have altitudes of 750 km and 1,460 km, respectively, while the perigee would remain al 400 km.

For military reasons is very important changing the relative locations of satellites in the same orbit. Changing the period of one satellite can change its position relative to other satellites in the same orbit through a multi-step process. For example, we consider two satellites in the same circular orbit. Since they must have the same speed, the distance between them will stay the same as they move around the orbit. To change the distance between them, simply increasing the speed of one of the satellites will not work, since that would change the orbit. Instead, one satellite can be moved relative to the other by putting it temporary into a higher or lower orbit to change its period and then moving it back into

the original orbit enough time as passed to put the satellites in the desired relative positions.

As an example, consider two satellites that are near one another in a circular orbit at an altitude of 400 km. Giving one of them a ΔV of 0.1 km/s to place it on an elliptical orbit changes its period by 3.6 minutes, requiring about 13 orbits, or 20 hours, to move it halfway around the orbit relative to the second satellite, witch remains on the original orbit.

Moving the first satellite back onto the original circular orbit requires another ΔV of 0.1km/s, for a total ΔV of 0.2 km/s. Doubling the amount of ΔV cuts the transition time roughly in half since it changes the period of the satellite by twice as much (7.2 minutes) as in previous example.

To rendezvous one satellite with another we can use this type of maneuvering. It can be also use to position multiple satellites around an orbit, to increase the ground coverage of a satellite constellation. These satellites can be placed in the same orbit by a single launcher, and then shifted around the orbit by this kind of maneuver.

Maneuvers that change the plane of the orbit require changing the direction of the velocity of the satellite. Since the orbital velocity of a satellite is very large, (see Table 2) changing its direction by a significant amount requires adding a large velocity component perpendicular to the orbital velocity. Such large changes in velocity require large amounts of propellant. Note that the speed needed to keep a satellite in orbit does not depend on the mass of the satellite. This aspect is fundamental to understanding issues related to space: the trajectory of an object in the vacuum of space does not depend on its mass.

Table 2 Some values for the speed and altitude of satellites in circular orbits

Altitude (km)	Orbital Speed (km/s)
200	7.8
500	7.6
1,000	7.4
5,000	5.9
10,000	4.9
Semi synchronous: 20,200	3.9
Geosynchronous: 35,800	3.1

Another aspect, also very important in our opinion is de-orbiting maneuvers. For some missions, an object in orbit will use its thrusters to accelerate out of orbit and back toward the Earth. The Space Shuttle must do this to return to Earth, similarly, an orbiting weapon intend to strike the Earth would need to carry propellant to kick it out of orbit. The dynamics of the de-orbiting are complicated because once the satellite moves to low enough altitudes, the increasing density of the atmosphere affects its trajectory.

These effects include drag forces, witch slow the object, and lift forces, which are sideways forces and pull the object off its trajectory. At high speed, both effects can be important for accomplish the mission.

Table 3 The de-orbiting time for a satellite at an initial orbit at an altitude of 3.000 km

Initial Coordinates of Satellite	ΔV (km/s)	Time (minutes)	Range (km)
Altitude = 3,000 km Speed = 6.5 km/s	6.5	19	0
	2.0	26	6.200
	0.65	60	20.000

We can notice that the reentry trajectory if the satellite's orbit speed were reduced by 2km/s, it would take 26 minutes for the satellite to fall to Earth, and it would hit the Earth at a point 6.200 km along the Earth's surface from point zero. If the orbital speed were reduced by only 0.65 km/s, so that the satellite takes 60 minutes to de-orbit, it would hit the Earth halfway around the world from point zero at a ground range of roughly 20.000 km.

However, let' us analyze a case more relevant to space security issues. A satellite in an orbit with an altitude of 500 to 1.000 km, since this is where missile defense or ground

attack satellites might be stationed. In calculating the de-orbit time and ΔV required in this case, assume that the thrust given to the satellite is oriented vertically downward toward the Earth. Applying thrust in this direction results in somewhat shorter de-orbit times than simply reducing the orbital speed as done for the cases illustrated in Table 3. For a satellite in a circular orbit at an altitude of 500km(with an orbital speed of 7.6 km/s), a ΔV of 0,7 km/s results in a de-orbit time of 10 minutes. Nevertheless, the precise time required for the satellite to de-orbit depends in part on its drag coefficient, which is partially determined by its shape.

In conclusion higher values of ΔV, can lead to shorter de-orbit times. Though the satellite would need to carry a large amount of propellant, high ΔV's have been discussed for kinetic energy weapons intended to attack ground targets, which must hit their targets at high speeds.

In de-orbiting maneuvers an important issue is that as the atmosphere slows the satellite large amounts of heat build up in the layers of air around the satellite, because the kinetic energy of the satellite is converted to thermal energy of the air, largely through compression of the air in the front of the satellite. Atmospheric heating is important when considering the possibility of delivering kinetic energy weapons either from space or by ballistic missile. The motivation of such weapons is that their destructive power would come from the kinetic energy resulting from their high speed rather than from an explosive charge.

For example, a mass must be moving at about 3 km/s for its kinetic energy to be equal to the energy released in the explosion of an equal mass of high explosive (the energy released by TNT is roughly 1,000 calories per gram, which equals 4.2×10^6 J/kg, while the kinetic energy of one kilogram mass moving at 3 km/s is $V^2/2 = 4.5 \times 10^6$ J/kg).

To be effective,such weapons must hit the ground with very high speed.For exemple, a modern U.S nuclear reentry vehicle,which is designed to pass through the atmosphere quickly to improve its accuracy,has aspeed of about 2.5 km/s when it reaches the ground:designing the warhead to travel faster is limited by its ability to withstand the heating.

In addition,not only do atmospheric forces cause drag,which leads to heating,they can olso produce strong lateral forces-called lift forces-that change the object`s trajectory.the reentering body can be designed to use the significant lift forces resulting from its high speed in the atmosphere to maneuver in directions perpendicular to its trajectory.Document describing the goals for ground-attack weapons state thatthease weapons should be able to travel thousands of kilometers in these directions using only lift forces.

3. COMPLETIONS AND CONCLUSION

A number of forces act on a satellite to change its orbit over time. These include the slight asymmetries in the Earth's gravitational field due to the fact that the Earth is not completely spherically symmetric: the gravitational pull of the Sun and Moon, solar radiation pressure, and, for satellites in low earth orbit, atmospheric drag.

As a result, the satellite must periodically maneuver to maintain its prescribed orbit. For this task, it must carry sufficient propellant. The orbits of some satellites must be strictly maintained, either to fulfill their missions or because their orbital locations are governed by international agreements.

The relationship beetwen maneuvering and propellant mass has important aplications for spacemissions such as the proposed military space plane.The space plane is envisioned as a vehicle that,after being launched into orbit,maneuvers to accomplish avariety of tasks. These might include placing satellites or ground-attack weapons in orbit or rendezvousing with satellites to inspect,repair,or refuel them.

Therefore,space –based weapons can be designed to destroy their targets in one of several ways:with direct impact(called kinetic kill weapons),an explosive warhead,or a laser.Space is much better suited to some types of operations than to others.

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RISKS ARISING FROM SOCIAL CRISIS ON ROMANIA'S SECURITY

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Abstract *: In the new security challenges, Europe can bring, both direct and indirect, stability to the risks and security threats on the Romanian national security and international, because the risks of military traditional confrontation on the European continent have declined considerably.*

The author draws attention in the paper that the nature of risks and threats change over time in response to developments in national and international structures, and involves a complex of factors that can make their very uncertain outcome directly, but also their consequences in a wider sense. Their complexity increases while the threats start to collide the measures taken to forestall them, a process best illustrated by the arms race and the various wars.

Since international threats are so ambiguous and knowledge of their fairly limited, national security policy formulation becomes necessary.

Keywords: *national security, social crisis, migration, social and societal security*

1. INTRODUCTION

The unprecedented period of peace and stability that Europe crossed from the end of the twentieth century until the beginning of the twenty-first century is due to the European Union. It has generated not only a high level of economic development on the continent, but a new approach to security, based on the peaceful settlement of disputes and multilateral international cooperation through common institutions [1].

In order to ensure the European security, we should mention the important role played by the United States of America, both through the material support provided by European integration, and by the security commitments that made to Europe within NATO.

Compared to the positive development of the western continent, in other parts of Europe, and especially in Balcans, it occurred after 1990 a series of crises that have generated risks and threats within these states, rather than outside, and which took place in the context of geopolitical reestablishment that followed the end of the Cold War.

To the new context created the European Union gave new impetus to the strengthen efforts of security and defining the size of defence at European level, particularly after 1998, which led to the development of both national security policy as well as international, some of which are specifically mentioned in the Amsterdam Treaty.

During this time, the European countries, individually and at the European Union level, have shown increasing concern for completion the internal institutional reforms especially in the context of enlargement. And also, they are preoccupied with debates end on the political construction that will define the future of Europe. Thus, since January 2007, the European Union is defined as a union of 27 countries, bringing together approximately 485 million people and produces about 25-28% of global GDP. As a global economic actor, the EU will need to participate more substantially for ensuring the mechanisms of national and international security, even if the concrete forms of this involvement are not yet well defined.

2. RISKS AND THREATS TO SECURITY

In this context, the Europe can bring, both direct and indirect, stability to the risks and security threats on the Romanian national

security and international, because the risks of military traditional confrontation on the European continent have declined considerably.

The explanation for this development at European level results from two issues: *the security actual interests and objectives of the European states not generated conflict situations, rather, they foster cooperation and solidarity; the national and international security environment is positively influenced by the processes of European and Euro-Atlantic integration* [2], in fact by the extension community of states that share and promote the values of democracy and market economy in the context of deepening regional cooperation.

Against the new risks and threats to security, the EU may respond by three strategic objectives.

1) The ensuring of stability and good governance in the immediate neighborhood

This will involve the extending of the security zone around Europe and ensuring that the countries of this region are well governed.

2) The creating of an international order based on effective multilateralism.

In a world of globalization (global threats, global markets), the security and prosperity depend on the existence of an efficient multilateral system. Therefore, one of the European Union objectives must be the development of a stronger international society, characterized by existence of active international institutions and also the existence of an international order based on respect for the laws in the first place, the principles submitted in the UN Charter.

The quality of international society depends on the quality of governments that compose it. The best defense for European security is given by the existence of a world composed of well-managed democratic states. Therefore, the spread of good governance, fighting corruption and abuse of power, establishment of law rule and protection of human rights are the best ways to strengthen the world order.

3) The preparation of a response to the new risks and threats.

This response has included the package of anti-terrorism measures adopted after September 11, 2001, also the measures to support non-proliferation of mass destruction weapons and to assist the states with weak or unstable structures from Balkans, Afghanistan, East Thymol and Africa (Democratic Republic of Congo). The identification of responses to the new risks and threats must be based on the fact that they often occur at large distance, are more dynamic and complex [3].

The dynamic nature will require removal of the focus on crisis prevention, risks and threats. The complexity character will require also solutions that will include the export controls, economic, political or military pressure. The European Union has all the tools for taking such complex solutions.

In the current national and international framework the ensuring of societal security concerns the society's capacity to preserve its essential characteristics, in the sharp changes conditions of various risks and threats, others than the traditional ones. Barry Buran identified three of the most common security threats to society:

- *Migration,* the ethno-national composition of the population X is altered by emigration or mass immigration (eg. Russian immigration of the Soviet period in Moldova, the Moldovian emigration after 1991 in European countries via Romania).
- *Horizontal competition,* although we can identify X population living in a country, it is about to change their identity because of Y influence (eg. The fear of Americanization of Quebec residents, Russification of the Baltics, of Moldova, changing the identity of Tibet because of Chinese occupation).
- *Vertical competition,* X population stops to consider it as such because of an integration project (such as the European project), or a secessionist project (Quebec, Scotland, Corsica), these projects provide a broader identity or rather more narrow [4].

Other types of societal security threats are the organized crime and terrorism. However associated with high rates of divorce, abortion, poverty, alcoholism, are the expression of what is called social anomie and is a general societal crisis. It is a dangerous decrease of

sociability, with reduction below critical thresholds of social relations.

After the extinction from the social and political scene of totalitarian regimes in Europe, the nature of risks and threats affecting national and international societal security can be identified according to *areas of activities (economic, political, informational, social, cultural, environmental, technology, religious) community and religious entities, geographical area, time, size, importance/ interest / severity and probability.*

"Depopulation or population" of some countries from the European area have the main issue the migration, which is one of the oldest social phenomena. Thus, the migration is above all a security issue, some empires, states have appeared and disappeared as states due to population migration [5]. However, the migration has begun to be studied in terms of security recently. Theoretically, the concept of societal security includes the issue of migration as a key, the threat posed by migration is mainly dependent on how the relative number of migrants interact with the absorption and adaptation capacity of society.

Migration is an expression of imbalances of social relations between developed and less-developed areas of the world. Welfare status from the Western Europe countries is attractive for the populations of the European periphery. Even the difficulty of finding a job or a marginal existence in Western Europe are considered preferable of an economic, social and political status, from the countries of Eastern Europe.

In the vision of the European security school, there are two dimensions that require this approach. First, there is the specific social process of redefining Western Europe after the Second World War. In the context of reduction the external functions of the state, Western societies have developed a new social equilibrium as the welfare state, they have homogenized, equalized the social opportunities, increased the social participation for creating wealth and its distribution.

Moreover, this social optimum of the Western European is obtained by individual and joined efforts and is affected by migration, rising unemployment, economic competition, support the enlargement process of EU to Eastern and Central Europe, aging population and others have questioned the welfare status. Thus, a number of *visible* events (crime, especially crimes against the person and personal property, street violence, *"ghettos"* of immigrants from the periphery of cities, the dirt in public places, long-term unemployment, housing crisis, violence in schools) transferred responsibility for the situation on the immigrant communities.

All these state of affairs gave rise to anti imigration political movements in Western Europe.

The EU official answer is contained in a series of documents. Now we are witnessing an institutionalization of a immigrationist policy as migration becomes a public policy issue. The foreign policy and security, although no explicit reference to migration is made, there is a warning regarding the potential mass migration generated from humanitarian crises. We can say that immigration can generate risks and threats to security both in the receiving countries, in transit countries and in providing immigrants countries. In addition to persons able to work from supplying countries, there are other persons who dont act acording to the law from the origin country so it is encouraging the phenomenon *of human trafficking* [6].

Thus, in addition to the risks and threats to societal security, in the departure, transit and destination countries, the migration can generate *military* risks, such as:

- *irredentist activities,* carried out by immigrants which try to affect the political process in the origin countries (eg. the situation of Albanian minorities from Western European countries that were involved in conflicts in Kosovo and Macedonia);
- *imported conflicts* by immigrant groups, that lead to violence in the host country (eg. Palestinian groups);
- *terrorist activities* (eg. Al Qaeda groups active in almost all Western countries);
- *political initiatives* in the host country to stop by military intervention, the flow of immigrants from supplier countries (eg. the

Italian military intervention in Albania in 1997).

Outside the *"great"* reasons, that may generate risks and threats to the national and European societal security, can be identified other causes: *anarchist minorities* which perform violent actions (eg. Greenpeace groups); *ethnic groups* which may engage in violent actions at the initiative of the origin state (eg. Libyan minority in France); *minority groups* who react violently to the political ideas of extremist political parties (eg. nazi groups); *alienated minority groups*, usually recruited from among marginalized immigrants within the EU countries (without jobs or houses); *many immigrants* that arrive in the EU countries because of the situation in the origin countries (eg. Croat refugees in Austria and Germany).

In the period that followed the end of the Cold War, Central and South-East Europe, is rightly considered the most eventful of Europe. The transformations that took place were performed on a background characterized by: *the fragmentation of states, armed conflicts, ethnic and religious tensions and conflicts, autonomist and secessionist tendencies and so on.* The main processes carried out in this area were particularly political, institutional and economic, regarding the general change from centralized systems controlled by state to descentralized systems that benefit from specific tools necessary to implement democratic institutions and market development.

Following the disintegration of centralized systems, the result of these events has consisted in an aggressive competition for resources, with a series of negative results for the region's stability, because it benefited from the existence of such ethnic and religious tensions that have been activated in particular from the extremist nationalist forces. These led in some cases to armed conflict, which had the ethnic and religious source.

3. DEVELOPMENTS IN THE NATIONAL SOCIETAL SECURITY

Regarding the risks and threats to the national societal security, "the terrorism requires significant levels of violence, politically motivated, generated by substatal actors which may, in a certain extent, be sponsored, but which are not normally controlled by a sovereign state" [7]. Where we are dealing with state that sponsored terrorism, and it is not the subject of societal risks and threats, this type of terrorism falls within the political risks and threats and, ultimately, military. In terms of societal security, the terrorism is a form of war between society and state, in the sense that violent organizations (eg. Al Qaeda) define their identity and fight for political ideals over the state. The violence, as an exclusive prerogative of the state in the modern period, is privatized by organizations and networks that act above the state [8].

Since terrorism is not the subject of our paper, being too important, requiring a detailed research, and exceeding the societal security it was noted by us only in the context of examples. More than terrorism as a risk factor to the societal national and European security, there can also be listed: *transnational organized crime, illegal traffic of arms, people and drugs, widespread corruption.*

We see therefore that the concept of security in general is currently undergoing major changes. The first reason would be that, nationally, the risks and threats have changed, now involving actions of non-state actors, leading to proliferation of phenomena such as organized crime, drugs traffic, terrorism and others. The interstate conflicts, the environmental degradation, the large masses of refugees are new risks and threats. Another phenomenon that occurs nationally and internationally and is a true scourge of risk and threat to security is *the exaltation of corruption*. The corruption causes, first of all, confidence in key state institutions, often seriously affects social relations, undermines the democratic foundations of society and the state's credibility. The world today determines us to keep in mind that we can not assure the security, mandatory for progress and prosperity. We depend more and more on each other to fight threats to our common future.

Thus, a number of problems can be better addressed and resolved in a relatively

homogeneous manner, where there is some societal cohesion and a common development experience.

The nature of risks and threats is changed over time in response to developments from national and international structures, and involves a complex of factors that can make very uncertain their directly outcome, but also their consequences in a wider sense. Their complexity increases while the threats start to collide by the measures taken to forestall them. This process is best illustrated by the arms race and the various wars.

It follows that national insecurity is a very complicated phenomenon, and each state, in a sense, is the central point of a universe of risks and threats. These threats define the insecurity by the way it interacts with its vulnerabilities and fix the national security agenda as a major issue. But, unfortunately, these are not a set of computable, consistent and comparable risks. As the international threats are so ambiguous and their knowledge very limited, the statement of national security policies is necessarily a very imperfect art [9].

In this cotext, we can say that societal security has the generally meaning of people confidence and the state has the ability to prevent the use of force by its opponents. We can conclude that there are two dimensions of national security concept, one objective, the physical existence of threats, and the other subjective, relating to attitude and perception of most citizens.

Society, as a reference term, is ambiguous for security. The question that naturally follows is: What is society? Sociologicaly, the society is a process, not a unit of analysis. The concept may be too vague. Typically, the state is the one who speaks in the name of society. If the state decreases its functions, whoever else, sufficiently well-organized (parties, groups) may take over the functions of the state.

Thus, the societal security concept can be retrieved and manipulated to legitimate the social violence outside the government institutions, that leads to undermining the legal order in society. The non-state actors may pretend that they speak in the name of society or they can be substituted to the civil society.

3. SOME CONCLUSIONS

Although efforts maded till now, there is a certain difficulty to delimit what is *social* by what is *societal.* For example, the difference between social security and societal security presents some specific difficulties. The social security refers explicitly to the economic and financial security, to housing, employment, family situation, specific to the members of society, the societal security concerns the identity, culture and religion security understood as processes that run between individuals and groups. The societal security can be considered as a warning concept specific the emergencies and it addresses to the long-term events and processes.

In our opinion, the societal security is a comprehensive and complex concept, which defines the ability of the state to organize the evolution rules of the traditional elements of language, culture, identity, religion, customs, but also an adequate existential level for the individual and human communities.

On the background of the European integration and in order to prevent destructive processes in society it is recommended to strengthen the social cohesion, to encourage associativity, to multiply the cultural, religious and intellectual structures of civil society, to increase the participation and social inclusion.

The risks, threats and challenges are part of the dynamic of planetary life, the dynamics of human life. They exist and will exist as there will be worldwide. They are hard to find, because they have complex determinations and are especially, very difficult to locate, evaluate and defused. However, their investigating and improving is continuous, absolutely necessary and concerns in the highest degree the whole human society.

The risks and threats are so many as the human activities but, virtually all, affect or can affect, in one form or another, the individual or collective human security, their economic social, cultural, political, informational or psychological security, as the security of states and societal systems.

Between the future risks and threats, as in fact the future confrontations, there will be those related to the civilizational entities.

These entities will identify ever more with the value systems that define them and with their interests that express and determine where they stand and what is their role in the international area. Already this trend is felt also within countries, to the ethnic groups that are becoming increasingly reserved to the state nationalism, although their common shares of individuality and even separation of national or states federal entered in the same range and the same nationalist determinations. The ignorance of such developments may lead to chaos and social crisis.

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THE EFFECTS OF THE FINANCIAL CRISIS IN TERMS OF SECURITY

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Abstract *: The authors are investigating the impact of crisis to the global security environment and particulary, the case of the Romania security.*

The fall of the national economy has many serious effects, from the economic security of the individual and his family up to reducing the state economic security, from the vulnerabilities amplification political, economic, social and military rule, up to shock the architecture of security and regional and global stability.

This study examines the consequences of the current economic and financial crisis, which is often called the great recession, on the North Atlantic Treaty Organization (NATO) and also the consequences of shrinking defense budgets on NATO's operations and on Alliance burden sharing at a time when there is already a significant mismatch between NATO's obligations and the resources provided by the member states.

Keywords: *national security, global economic crisis, NATO challenges, defence budget.*

1. INTRODUCTION

The economic crisis, by definition, is a situation where the national economy experiences a sudden drop in its strength. In terms of globalization, the national economic crisis induces a climate of insecurity at regional or global level, as in fact a global recession may lead to economic collapse of one or more states. An economy in crisis will have a safe drop of GDP, a significant decrease in liquidity and an alternating trend in prices.

The impact of financial crisis on security should not be underestimated. U.S. National Intelligence Director said that the crisis has replaced terrorism as "the main security concern in the short term", both on an internationally and nationally level. In this context, security policies and strategies will be affected by significantly reducing budgets, but also by imposing mutations in the strategic plan.

In the context of these approaches, it must operate at the conceptual distinction between *the economic security* and *the economic dimension of security*. If the first concept concerns the functioning of an economy and is equated with "safety tomorrow" in terms of prosperity, welfare, standard of living decent/adequate, economic independence, the second captures the operation of the social and political systems, the state, public institutions, and national organizations as part of international alliances and coalitions [1].

2. NEW CHALLENGES FOR NATO

The crisis has complex effects on all areas of activity, all structures and functions, especially on those which regard security and defense.

As a collective defence alliance, the North Atlantic Treaty Organization (NATO), is at the heart of a vast and expanding network of partnerships that now includes 28 members. Through strategic coordination of its collective contributions, NATO can act as a force multiplier, in exchange offering each member a complete defence package in exchange for their contributions [2].

However, it is expected that many NATO countries and, especially, the partners of the Alliance will significantly reduce the costs of defense, already modest, and rely increasingly substantially on NATO.

According to International Monetary Fund forecasts of GDP growth, approximately half of the NATO member states (12 out of 25) are

expected to register negative growth into 2010. Furthermore, most of Central and Eastern European member states are expected to decline the steepest during the rest of 2009 and 2010 (Table 1). From the larger NATO member states, only Canada is expected to show modest growth by 2010 [3].

	2008	**2009**	**2010**
Bulgaria	6,0	-2,0	-1,0
Czech Republic	3,2	-3,5	0,1
Estonia	-3,6	-10,0	-1,0
France	0,7	-3,0	1,4
Germany	1,3	-6,2	-0,6
Greece	2,9	-0,2	-0,6
Hungary	0,6	-3,3	-0,4
Romania	7,1	-4,1	0,0
Slovenia	3,5	-2,7	1,4
Turkey	1,1	-5,1	1,5
United Kingdom	0,7	-4,2	0,2
United States	1,1	-2,6	0,8

Table 1 GDP Growth Forecast
Source: IMF World Outlook, 2009

Moreover, the crisis causes the impossibility of maintaining independent security and defense forces - they become a real luxury that few countries it will allow - and this increases dependence on NATO and on the collective defense and security systems.

Moving the focus on collective defense and collective security requires the increase of the completeness of the Alliance and, of course, the increase of the degree of dependency of the national security structure and collective defense [4].

The equipment costs rise by up to 10% per year leading to smaller numbers being procured; thus resulting in small production runs for defence industries and smaller front-line forces for the Armed Forces. Both the US and some of NATO member states have an ambitious forward equipment program which is under-funded leading to delays, cost overruns and reduced production numbers.

In the UK, all major political parties have promised a Defence Review after the next election (to be held by June 2010 at the latest). Such a Review will affect front-line units and major new equipment programmes involving reduced numbers or cancellations. Possible candidates for these cancellations include the Astute submarines; the Trident replacement; the Type 45 destroyers; the two aircraft carriers and their Joint Strike Fighters (JSF); the balance of the Typhoon program; and the A400M airlifter. Within this list, two projects are in their early stages, namely, the carrier program and the Trident replacement so that cancellation offers substantial savings. However, complete cancellation of either or both programs will be radical and unlikely. Instead, there are possibilities for achieving some worthwhile savings by reducing the carrier buy to one carrier and a limited number of JSFs initially (with the option of buying a second carrier when the UK budget improves) and reducing the Trident replacement to three rather than four submarines. Interest groups in the political-military-industrial complex will favour such solutions rather than complete cancellations.

In the United States, F-35 aircrafts will equip the USAF, but, especially, the 10 carriers of the U.S. Navy and 3 Marine infantry carriers. But lack of money for their purchase and production will slow enough resource prolong F-18 aircraft with another 6000 hours (to cover the time required to service introduction of the aircrafts F-35) [5].

Despite the global financial crisis NATO has reaffirmed its long-term commitment to Afghanistan at its Brussels and the Bucharest summits last year.

The Alliance is engaged in a highly complex struggle in Afghanistan in which it hopes to provide sufficient security for the rehabilitation of the Afghan state, civil society and economy.

NATO's role is a key part of the Afghanistan Compact – a five year plan between the Government of Afghanistan, and the international community, which sets goals relating to security, governance and economic development of the country.

U.S. officials developed the concept of Provincial Reconstruction Teams (PRTs) in 2002 to help the U.S. military refocus its effort on stabilization and reconstruction. Since August 2003, NATO has been leading the

International Security Assistance Force (ISAF), in assisting the Government of Afghanistan in expanding its authority and implementing security, thereby, helping to remove the conditions in which terrorism could thrive. While not a counter-terrorism operation, ISAF represents NATO's determination to help the people of Afghanistan build a stable, secure and democratic state free from the threat of terrorism. In 2004, it adopted the PRT model offering the possibility for coalition militaries to support the NATO operation without necessarily engaging in combat operations.

Today there are 26 PRTs operating throughout Afghanistan [6].

In addition, many NATO Allies have forces involved in Operation Enduring Freedom, the ongoing US-led military counter-terrorism operation whose major activities are in Afghanistan.

Also, NATO peacekeeping forces in the Balkans continue to help in creating the conditions necessary to restrict potential terrorist activities. Such assistance includes support for stopping the illegal movement of people, arms and drugs that offer important economic sources for the financing of terrorism. NATO forces also work with regional authorities on border security issues [7].

The international economic and financial crisis, arguably the deepest since the end of the Second World War, will have a major impact on the budgets of all NATO countries. In most European NATO member states, defense budgets are likely to be more affected than civil expenditures, as it is politically easier to cut military spending instead of social costs.

3. THE GLOBAL ECONOMIC CRISIS AND ROMANIA'S SECURITY

The analysis of the security environment in the after Cold War phase can not be complete if it had not extended to the political, economic, social and environmental domain.

"The economic primacy" [8] is a key component of national security, at least in terms of resources and in order to ensure the dynamic balance of other components of this system [9].

To define the economic security of Romania requires to identify all the necessary conditions to be provided for the country's economic development and catching of development with the Western EU countries.

On the other hand, if economic security is a direct consequence of the economic power of the state, the economic dimension of security is relevant to the fact that without a strong modern economy , the safety and stability of the state or the international community can not really exist.

On the national security, the crisis carries two main pressures:

- the sharp decreasing of the military spendings (Table 2) amid on the inability to provide the necessary budget;
- the increase of the insecurity degree of the population, the institutions and the state.

Year	Percentage of GDP (%)	Amount (thousands lei)
2008	2,38	7.542.924
2009	1,31	6.957.884
2010	1,31	7.000.794

Table 2 The evolution of the Romanian defence budget

The analysis includes two indicators on the first pressure: international operations and endowment. For the first indicator, the draft budget of Ministry of National Defence 2010 warns that, in terms of increasing the number of Romanian troops deployed in theaters of operations, is required an allocation of the additional resources, otherwise, in the long term, the effects could be felt in the difficulty of maintaining standards (the ensuring operation and the maintenance of the systems equipment).

For the second indicator, the endowment, the situation is even more concerning. The six strategic programs endowment (multirole aircraft, corvette multifunctional, mines hunter, armored transporters for troops, armored and unarmored land vehicles and ground-air missile systems with large stroke)

approved by the Country's Soupreme Defense Council (Fig. 1), due to costs, it is in delay acquisition situation, at least to achieve the regulatory changes that are applicable to finance the investment longer of one year projects.

Fig. 2 JAS 39 Gripen

Romania has risked a lot when it decided to reduce the defense spending under 2% of GDP, following the model of NATO and EU countries, whose defense capabilities are substantial and decrease amid security threats [10].

In terms of increasing the insecurity degree of the population, the institutions and the state, for Romania, a country considered to be affected average by the crisis, the analysis focuses evolution of the next macroeconomic indicators:

- Unemployment returned on an upward trend since the second half of 2008. Unemployment reached 6.3% in July 2009, a level that has not been confirmed from 2006. Most of those who remained unemployed in 2009 come from the private sector, more sensitive to shocks in the economy. The government planned to reduce the vast bureaucracy of the year 2010, the number of unemployed will probably exceed the threshold of 1 million.
- Inflation has changed its upward trend at the same time with major reductions in spending population. Thus, the annualized inflation down by nearly 4 percent from the maximum recorded in summer 2008, reaching 4.7% at the end of 2009. Some banking analysts argue that this level is still slightly higher because of the monopolistic markets where consumers can not exercise sufficient pressure to determine the reduction rate of price increase.
- Industrial production went into negative territory since the fall of 2008. The decline deepened in 2009 when there were significant monthly decline, in the context of the low demand which caused the companies to reduce the volume of manufactured goods. In the II quarter, Romania's industrial output dropped by over 8%, while in some European countries dropped by over 20%. Amid the decline of exports and domestic demand weak, some factories even produce at half of their capacity.
- External debt of Romania's medium and long term exploded in 2009, reaching 57.2 billion EUR. Analysts argue that because the most debt is represented by the long term, the major risks in the economy are minor.
- GDP, after in 2008 reached a record 126.4 billion EURO, up by 7% compared to 2007, declined by 7.1% in 2009. This is the first annual decline after 2000, during which nominal GDP of Romania increased by more than tripled. Decreased the exports, the industrial production and the foreign investment have put huge pressure on emerging countries in Eastern Europe, including Romania, which have seen no source that fueled the economies in the past.
- Net average wage has continued to grow and in early 2009 but at rates much lower than previous years. Thus, in June 2009 it was 1379 lei, by 8.3% above the same month in 2008. The wage growth has stopped speaking of a "freezing" of the wage income of the entire 2010 budget. The high pressures to reduce costs recorded also in the private sector.
- Foreign direct investment in the Romanian market in 2009 saw a decline of almost 37% compared to 2008, year of the post-revolutionary maximum (over 9 billion EURO). Now, the investors are more alert regarding the risks of operations in emerging markets, especially in a time when funding is more difficult obtained than previously.
- The exports of the Romanian companies have declined in the late of 2008,

amid contractions developed economies of Western Europe. During January-June 2009 exports registered an average decline of almost 19% over the same period in 2008, while imports recorded an average contraction almost double. Thus, the Romanian commercial deficit in the first 6 months of 2009 was 4.3 million EURO, 6.8 million EURO less than the same period of 2008. Following of the output recession signals in the Western European economies, it is expected to demand a return of Romanian products since 2010.

Paradoxically, should Romania is able to effectively manage EU funds under the anti-crisis plan, alongside with a program and a properly tailored crisis budget, flexible enough, it could get out of this crisis stronger, with a substantial increase in economic security.

4. SUMMARY

The response to the crisis may take the form of actions by more powerful states to solve internal problems or the initiatives will be of strategic nature, systemic, and will actually materialize through a reform of the global economic system that will benefit most countries of the world.

The study of the national security in terms of the effects of the economic crisis becomes of particular importance because it offers the posibility to structure of integrated response policies to reducing the state unsecurity.

The consensus forecasts suggest that NATO member states have reached the 'bottom' of the current economic and financial crisis following the deepest decline since the Second World War, However, the subsequent recovery is likely to be weak, fragile and prolonged with some of the larger NATO member nations facing considerable debt burdens. The implications to future discretionary spending, such as defence, are not promising. Fortunately, the magnitude and severity of the impact on NATO need not be acute.

The security support they provide Romania's membership in NATO and the EU shows that our country is not alone in the "fight" to limit the effects of the current economic crisis.

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Theoretical and practical aspects of the Coandă effect

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Abstract: *Coanda effect is the phenomena in which a jet flow attaches itself to a nearby surface and remains attached even when the surface curves away from the initial jet direction.In free surroundings, a jet of fluid entrains and mixes with its surroundings as it flows away from a nozzle. When a surface is brought close to the jet, this restricts the entrainment in that region. As flow accelerates to try balance the momentum transfer, a pressure difference across the jet results and the jet is deflected closer to the surface - eventually attaching to it.*

Key words: *slot, attached jet, static pressure, centrifugation zone, suction zone.*

1. THE BASIC ASPECTS OF COANDA EFFECT

The Coandă effect is a natural phenomenon with action on the flow attached to a divergent wall (volet or airfoil) characterized by a high assimmetry. It is posible to remark the following aspects(fig.2):
1. The depressured zone determines:
a. *flow acceleration upstream in the slot*, without increasing upstream pressure or temperature
b. *the displacement of the local fluid*
2. Detaching and re-attaching is caracterized by histerezis (the reattaching is produced at smaller angles than the detaching).
3. The global flow that results from the mixing between the main flow and the displaced one is situated in the depressure zone and is characterized by lower temperature.

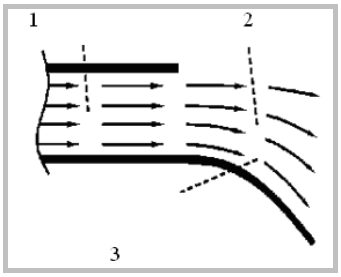
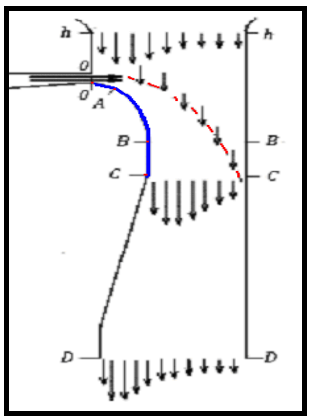


Fig.2 Coandă flow (2D)

3. A GLOBAL ANALYSIS OF THE MIXING PROCESS IN THE EJECTION DEVICE

Let consider an ejection device that we are going to analyse from the point of view of the mixture between the primary flow , the active one, through which energy is introduced into the system, and the secondary flow.



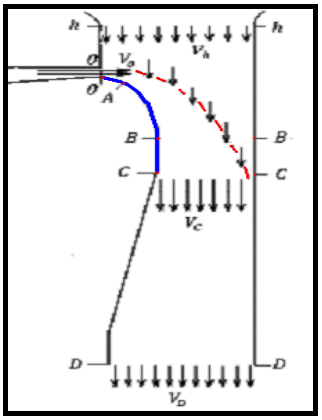


Fig.5 Coanda ejector with non uniform speed distribution Fig.6 Coanda ejector with uniform speed distribution

In the inlet (Section **0-0)**, the primary flow is introduced by compression, acceleration or through

absorbtion directly from the environment. The absorbtion section (h-h) through which the resulting inflow moves only and is characterized by the fact that the total enthalpy i^* of the flow is the same with that of the environment i_H^*. The place around A is supposed to be the spot where the depressurization flow is maximal. Section B-B shows the end of the Coanda profile (line OAB). Section C-C is where the absorption section ends and the thickness of the mixin region equals that of the C-C section. D-D is the exit section from the ejection disposal and is characterized through the fact that the static pressure is equal with that of the environment static pressure p_H. The area **h-0-C-B-h** is considered to be the absorption area where the total enthalpy i^* of the flow is the same as that of the environment i_H *. Area **0-ABC-C-0** is considered to be that of the mixture where the whole quantity of generated flow is received through the permeable surface **C0**. Area **C-D-D-C** is the area of acquiring uniformity for aerothermogazodynamic parameters in section C-C and it usually has a divergent form which contributes to the increase of efficiency of the ejection device. Its existence leads to the increase of the generated flow but it doesn't necessarily mean an increase of the propulsion force. The research on the force increase will have to take into consideration the entire geometry of the ejection device. The known factors are the geometry of the ejection device in its sections (**Ah, A0, AB=AC, AD**), the fuel conditions in the slot (p^*, P_0), and environmental conditions (p_H, ρ_H, i_H^*). Also, for this global analysis of the mixture in the ejection device the values of the energetic performance ηC, ηD on sections **00-CC**, **00-DD**, are considered as known.

In fig.7 is presented the distribution of speed in a section of the Coanda ejection device with two different regions, an asymmetrical one (d width), and a uniform one (D-d width) where the length of the boundary layer at the wall being s.

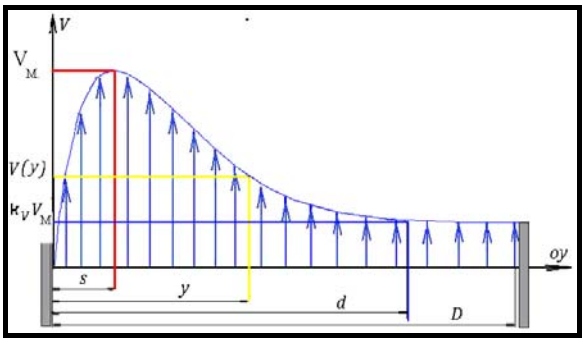


Fig.7 Distribution of speed in a section

4. CASE STUDY: COANDA EJECTION DEVICE WITH UNEVEN SPEED

Let a Coanda ejector with non uniform and variable speed distribution. In the D exit section, the static pressure p_D equals the environment pressure p_H. The power transferred to th fluid in D section is:

$$P_0 = \eta P_D = \int_{A_D} \rho_H V_D(y)\left(i_D^* - i_H^*\right) dA_D =$$

$$\frac{\rho_H V^3{}_{MD} A_D \chi_{3D}}{2} \qquad (1)$$

The gain force is given by the difference between the two force distributions, with a maximal value corresponding to A:

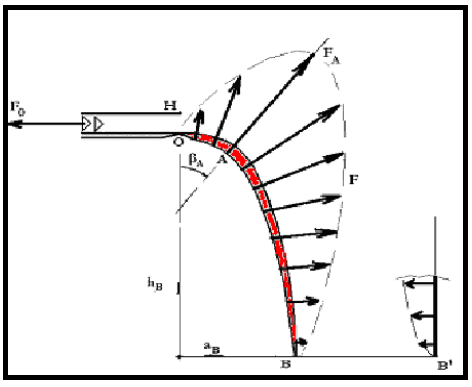


Fig.8 Force distributions on Coanda airfoil

Let detail Coanda flow by using two zones with special properties, the centrifugation zone and the suction zone.

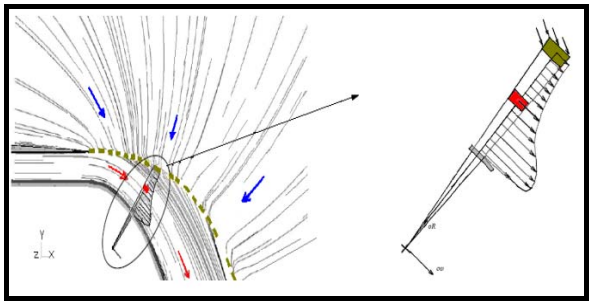


Fig. 9 Detailed analysis of Coandă flow

The equations for the centrifugation zone which is associated to the mixing region 0-ABC-C-0 with C0 permeable are:

$$\frac{1}{r}\cdot\frac{\partial(\rho\cdot u_\omega)}{\partial\omega}=0 \qquad (2)$$

$$-\frac{u_\omega^2}{r}=-\frac{1}{\rho}\frac{\partial p}{\partial r} \qquad (3)$$

$$u_\omega\frac{\partial u_\omega}{\partial\omega}=-\frac{1}{\rho}\frac{\partial p}{\partial\omega} \qquad (4)$$

$$i^*=i_H^*\left(\frac{p}{p_H}\right)^{\frac{k-1}{k}}+\frac{u_\omega^{\,2}}{2} \qquad (5)$$

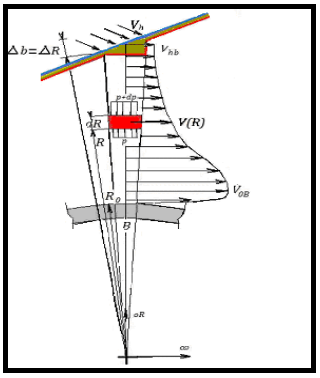


Fig.10 Element of jet

For a small element of jet flow, the radial movement equation is:

$$\frac{dR}{R}=\frac{dp}{\rho u_\omega^2} \qquad (6)$$

For $\boldsymbol{B_i}$ on the profile:

$$u_\omega=u_{\omega 0}f_u(R)\qquad u_{\omega 0}=u_0f_{u0} \qquad (7)$$

and the total enthalpy is conserved:

$$i^*(R)=\frac{[u_\omega(R)]^2}{2}+\int\frac{[u_\omega(R)]^2}{R}dR\big|_R+i_c^* \qquad (8)$$

The static pressure is expressed by:

$$p(R)=p_H\left(1+\frac{1}{i_H^*}\int\frac{[u_\omega(R)]^2}{R}dR\big|_R\right)^{\frac{k}{k-1}} \qquad (9)$$

and the static density ad static temperature are:

$$\rho(R)=\rho_H\left(1+\frac{1}{i_H^*}\int\frac{[u_\omega(R)]^2}{R}dR\big|_R\right)^{\frac{k}{k-1}} \qquad (10)$$

$$T(R)=T_H\left(1+\frac{1}{i_H^*}\int\frac{[u_\omega(R)]^2}{R}dR\big|_R\right)^{\frac{k}{k-1}} \qquad (11)$$

The gain in force at $\boldsymbol{B_i}$

$$\phi_{Bi}=\frac{1}{b_0}\int_{R1}^{R2}\left(1+\frac{1}{i_H^*}\int\frac{[u_\omega(R)]^2}{R}dR\big|_R\right)^{\frac{k}{k-1}}f_{u0}^2f_u^2(R)dR \qquad (12)$$

and the corresponding efficiency is:

$$\eta_{Bi}=\frac{1}{b_0}\int_{R1}^{R2}\left(1+\frac{1}{i_H^*}\int\frac{[u_\omega(R)]^2}{R}dR\big|_R\right)^{\frac{k}{k-1}}f_{u0}^3f_u^3(R)dR \qquad (13)$$

We note that the flow attached is situated in the depressure zone defined by the exit from slot, 0-0, B-B section and D-D exit with a maximal value in A.

5. EXPERIMENTAL RESEARCH ON THE APPLICATION OF THE HELICOPTERS

Coanda Effect Small Appliance experimentally validated results Coanda effect on the tail of the helicopter beams are obtained by linking the theoretical and computational study and realization of profiles that require permanent adjustments, consisting of: - changes in flow air induced by the main rotor (here we have 2 variables that blades gave up their rotation speed), - changes in flow induced by fan beam tail in blood flow adjustable - profile geometry (in this case is the beam tail) - Coanda slot number, their geometry (including width and length l). We should also note that good and realistic fluid flow in Coanda effect has been obtained from practical experiments using hundreds of adjustments and amendments agreed to variables. The experiments in real physical scheme (fig.11) is the model helicopter IAR316B, 1:10 scale, which are installed drive components that measure and control equipment. - It is considered a technical unit that has the structure:

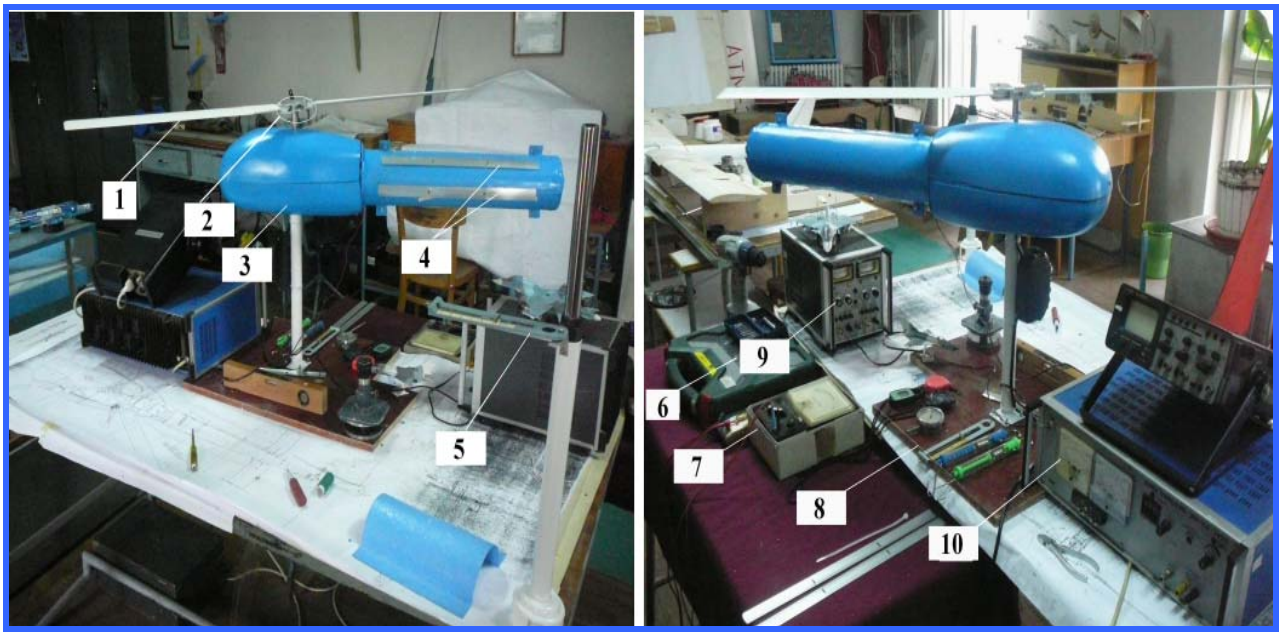


Fig.11 Experimental device: 1-NOTAR helicopter blades carbon fiber, 2 -hub pitch, 3-structure helicopter fiberglass, 4-Coanda slots, 5-device measuring dynamometer force F, 6-tool kit with 7-measuring and control equipment (multivoltampermetre) 8-instruments for making measurements (timer, dynamometers, Anemometers electronic, mechanical comparator, roulette), 9 - dual source DC power, 10-stabilized power source and electronic oscilloscope.

A structure helicopter consists of two main components: a cabin and tail beams of composite materials (glass and carbon fiber).

Fig.11 hub and blades of carbon fiber highlighting the Coanda effect and performance measurement on the beam parameters of the experimental device queue (v.fig.5.14) seeks a lateral force F as possible. He looked fluid flow along the tail beam, the desired length to be studied, and of the lateral force F due to Coanda effect. This was attempted obținerera a Coanda profile optimally adjustable, depending on the flows data load-bearing rotor, fan tail, position and geometry of the slot. This optimization allows the replacement of the rotor anti-torque eliminating its disadvantages and lead to the advantage given to obtain high lateral forces (maximum) with low energy consumption, which is found in formulas elements performance helicopters.

Table 1 Results from the experimental device with dimensions: length l = 30cm gap width = 2 mm and up blades p = 4^0

Nr. crt	P	p	P_c	V_{GC}		V_f	V_R	Q_R	Q_{gc}	$2Q_f$	E_{fc}	F
UM	[W]	[θ_p ^{0}]	[W]	Km/h	[m/s]	[m/s]	[m/s]	[m^3/s]	[m^3/s]	[m^3/s]	[N/W]	[N]
1	70	4	6	19,4	5,30	5,74	7,22	8,161	4,242	0,00688	0,0783	0,47
			7,2	21,6	6,00	5,93			4,804	0,00710	0,0708	0,51
2			8,4	25,3	7,02	7,24			5,621	0,00868	0.0678	0,57
			9,6	28,3	7,86	7,35			6,294	0,00882	0,0666	0,64
3			10,6	30,8	8,55	8,65			6,846	0,01038	0,0660	0,70
			12	33,4	9,27	9,35			7,420	0,01122	0,0658	0,79
4	95		6	19,4	5,30	5,91	8,31	9,393	4,242	0,00709	0,0950	0,57
			7,2	21,6	6,00	6,22			4,804	0,00746	0,0916	0,66
5			8,4	25,3	7,02	7,44			5,621	0,00892	0,0904	0,76
			9,6	28,3	7,86	8,12			6,294	0,00974	0,0875	0,84
6			10,6	30,8	8,55	8,89			6,846	0,01066	0,0896	0,95
			12	33,4	9,27	9,38			7,420	0,01125	0,0875	1,05
7	145		6	19,4	5,30	5,98	9,56	10,806	4,242	0,00717	0,1133	0,68
			7,2	21,6	6,00	6,37			4,804	0,00764	0,1083	0,78
8			8,4	25,3	7,02	7,88			5,621	0.00945	0,1047	0,88
			9,6	28,3	7,86	8,39			6,294	0,01006	0.1041	1,00
9			10,6	30,8	8,55	9,12			6,846	0,01094	0,1037	1,10
			12	33,4	9,27	9,43			7,420	0,01131	0,1033	1,24

Interpretation of results was performed in graphical form as follows: A first step is to highlight the evolution of lateral force F due to Coanda effect depending on the power consumed by the rotor bearing the six-power variation of the fan beam intubated in the tail , was added to this step change blades with three values. Figure 5.16 highlights the changes in lateral force due to Coanda effect to adjustments of power tools (three values: P = 70 [W], 95 [W], 125 [W]) applied to the rotor portal, maintaining constant width = 2mm to slot the same value of step blades p = 4^0. For each amount of useful power applied to the rotor bearing was varied six-speed adjustable fan PC Power intubated in the beam tail.

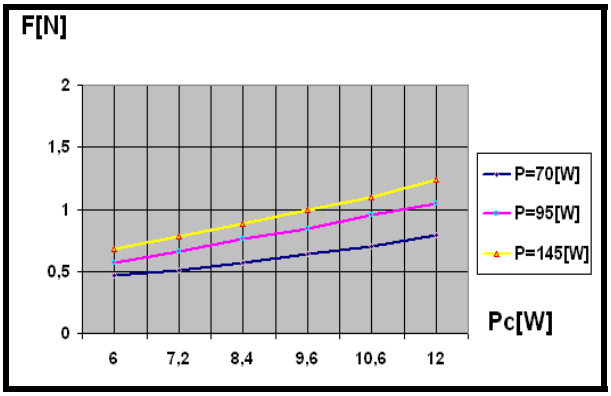


Fig.5.16 Variation lateral force F due to Coanda effect to maintain constant: p = 4^0 and = 2mm

It can be observed approximately linear increase in lateral force F for each value of power P, and could approximate the family of linear functions useful GN-power applied force determining correspondence.

Example: - P = 95 [W] to maintain constant step p = 4^0 and = 2 mm is obtained with a linear function that can find value GN lateral force F due to Coanda effect: Where do I noted the power of P_C fan beam intubated tail with index variable.

E_f efficiency of a propulsion device as the ratio of force produced (generated) of propellant and power consumed by it: in our case F is the lateral force developed by Coanda effect and Po is power consumed by the fan tail of beam Pc. este forța laterală dezvoltată de efectul Coandă şi P_o este puterea consumată de ventilatorul din grinda de coadă Pc. Se poate spune în cazul nostru de indicele E_{fc} ca fiind eficiența grinzii de coadă. S-a aplicat formula de calcul prezentată mai sus şi conform rezultatelor prezentate în tabelul 5.1 s-au trasat graficele corespunzătoare fiecărei puteri a

rotorului portant prezente în fig.5.17, s-a observat scăderea eficienţii grinzii de coadă odată cu creşterea forţei produsă de aceasta.

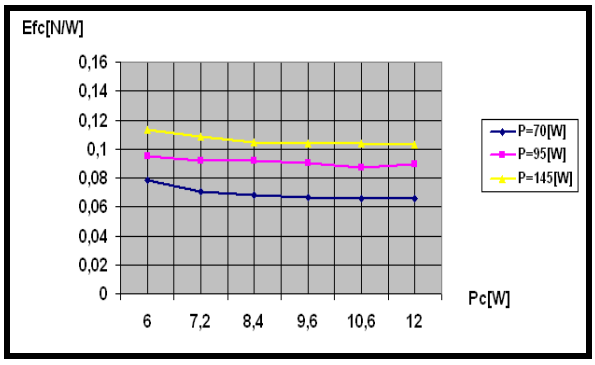


Fig.5.17 Variation of tail-beam efficiency EFC by lateral force F and power consumed in the three steps of PC operating rotor blades portant step in the value of $p = 4^0$

6. CONCLUSIONS

In the conclusion we can state that for the same energy available P_0, the D_f *force* gain can be obtained by decreasing the speed $V_D<V_M$, similarly to an increase by ejection of the mass flow *evacuated.*

In order to obtain the highest force possible for an available used energy it is preferable to put into motion the highest amount of fluid possible with the lowest speed possible instead of a small amount of fluid put into motion with a high speed.

This study was conducted in the idea of highlighting the usefulness of the devices developed force using Coanda effect, the main aim being to obtain a lateral force in the Coanda effect, the possibility of control where needed, time required to stabilize the portal created by flying helicopter rotor monorotor. results were obtained with values close to those obtained numerically by computational, respecting the geometric dimensions of the beam tail and fluid velocities in beam tail rotor that product flow rate carrier - shows the smooth growth index values E_{FC} a sharp increase in force F which requires a finding of finding optimal positioning slot; can do a pretty fair approximation of a helicopter-model 1:1.

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EUROCORPS – A COMMON MULTINATIONAL FORCE

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Abstract: *The purpose of this article is to provide information about the Eurocorps, a defense partnership that began with military cooperation between France and Germany and was intended to lead to greater military integration among European nations and, perhaps eventually, greater integration of the European community as a whole. The article begins with a short introduction of the founding of the Eurocorps by its framework nations and the reason for its creation. It then lays out the organization of the Eurocorps, known in military parlance as the Task Organization, including its command and control elements, support elements, and dedicated and earmarked units. The article then discusses the Eurocorps missions, and the resolution of conflicting interests for European Defense. Finally, the article concludes with a summation of the current state of the Eurocorps and what role it will play in the future of European defense.*

Key words: *Eurocorps, EU, NATO, European Defense, European community.*

1. INTRODUCTION

The Eurocorps has its origins in a French-German initiative to step up military cooperation between those two countries. On 22 May 1992, France and Germany adopted the La Rochelle Report, which served as the founding act of the Eurocorps. A few weeks later, as early as July 1st, a temporary staff installed itself in Strasbourg in order to set up the Eurocorps staff.

On June 19, 1992, the Petersberg Declaration of the Western European Union defined the WEU's role as the defence arm of the European Union and set the different tasks (or "Petersberg missions") that could be carried out under WEU authority (nowadays: EU authority). One year later in Rome, on May 19, 1993, the member states decided to make the Eurocorps available to the WEU [1].

After six months on January 21, 1993, the SACEUR Agreement defined the relationship between NATO and the Eurocorps. This agreement specifies possible Eurocorps missions within NATO, competencies for contingency planning, the commitment of the Eurocorps under NATO command as well as the relations between NATO commanders and the Commander Eurocorps in peacetime [2].

The Franco-German initiative quickly aroused the interest of other countries. This was particularly true for Belgium that wanted to integrate its forces into an army corps. It was looking for a way to demonstrate its willingness to contribute to the construction of a European defence and security identity, while at the same time preserving its role within NATO. Since the Eurocorps offered such a solution, Belgium joined on *June 25th, 1993*.

The first Commanding General of the Eurocorps, *General leutnant Helmut Willmann,* assumed his appointment on October 1, 1993. The inaugural ceremony was held in Strasbourg on November 5, 1993 and was co-chaired by the defence ministers of the first three participating countries (France, Germany and Belgium).

Spain joined the Eurocorps on *July 1, 1994*, becoming the fourth member. A symbolic moment for Eurocorps and European history was the participation of the Eurocorps in the French National Day military parade on 14th July 1994 when Eurocorps soldiers

marched down the Champs Elysées in the centre of Paris. One week later the Eurocorps paraded in Brussels for the Belgian National Day. Luxembourg joined the Eurocorps on *May 7, 1996*, as the fifth Member State.

From the beginning, the Corps, becoming the first building stone in the European Defence structure, has been put at the disposal of the Western European Union (WEU) but also of NATO. From the launch of the European Security and Defence Policy (ESDP) onwards, it has been put at the disposal of the European Union as well.

The Eurocorps comprises more than 55,000 military units from Belgium, France, Germany, Luxemburg and Spain. Its headquarters is located in Strasbourg [3].

2. ORGANIZATION

Member states have agreed to earmark a number of units for the Eurocorps:

French-German Contribution

- the French-German Brigade garrisoned in Müllheim (GE)

French Contribution

- Etat-Major de Force numéro 4 (EMF4) in Limoges (equivalent to a divisional HQ):

1. one armoured brigade
2. one mechanised infantry brigade
3. if necessary specialized support units

German Contribution

- the 10th Armoured Division, with its HQ in Sigmaringen, composed of:

1. the 12th Armoured Brigade in Amberg
2. the 30th Mechanised Brigade in Ellwangen

Belgian Contribution

- the Operational Command Land, with its HQ in Evere, composed of:

1. the 1st Mechanised Brigade in Leopoldsburg
2. the 7th Mechanised Brigade in Marche-en-Fammene

Spanish Contribution

the 1st Mechanised Division with its HQ in Burgos, composed of:

1. the 10th Mechanised Brigade in Cordoba
2. the 11th Mechanised Brigade in Badajoz
3. the 12th Armoured Brigade in Madrid

Luxembourg Contribution

A reconnaissance company (180 soldiers) based in Diekirch, composed of two reconnaissance platoons, an antitank platoon and a logistics support element. This unit will normally be integrated into the Belgian contribution during operations [4].

Except for the French-German Brigade and the Staff of the Multinational Command Support Brigade (MNCS Bde) that are permanently under operational command of HQ Eurocorps, the national contributions remain under national command in peacetime. They become fully subordinated after Transfer of Authority has been decided by member states. The type and size of units needed by the Eurocorps have to be determined depending on the assigned mission, likely employment and the expected operational outcome. In the case that all the earmarked national contributions are committed, the Corps would number approximately 60,000 soldiers. Beside its organic and earmarked units, HQ Eurocorps is also prepared to command units (up to division size) that non-Eurocorps countries might allocate for a specific operation. This participation of non-Eurocorps forces is known as the "5 + X Concept". (figure 1)

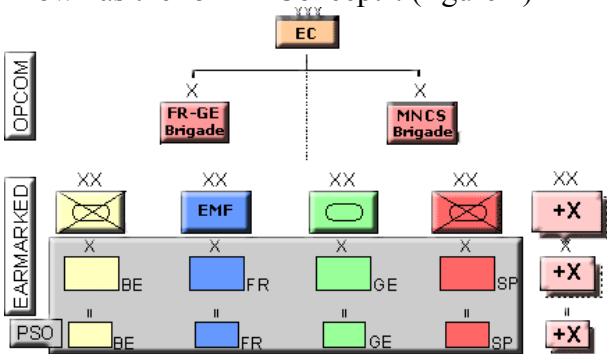

Fig. 1 Eurocorps structure

Eurocorps military staff (EMS) (figure 2):

Commanding general and Flag officers

The Commander of EUROCORPS (COMEC) is a lieutenant general (NATO 3 stars). The Deputy Commander (DCOM) is a major general (NATO 2 stars). The staff is directed by the Chief of Staff (COS), a major general or a brigadier general; he is supported

by three Deputy Chiefs of Staff (DCOS) for Operations, Support and Training & Resources, whom are brigadier generals (NATO 1 star). The Legal Branch, the Public Affairs Office, the Air Representation, the Navy Representation and, in operations, a Political Adviser, directly support the Commanding General.

The COMEC, the Legal Branch, the Public Affairs Office, the Air Representation, the Navy Representation and, in operations, a Political Adviser and the staff, together form the Headquarters, whose primary role is to plan and conduct operations ranging from humanitarian aid and crisis reactions to the defence of member countries and the Alliance. In operations, the COMEC commands major subordinate units and coordinates land operations supported by air and maritime forces.

The posts of Commanding General, DCOM and the other general officers as well as some key functions are filled by EC framework nations on a rotational basis. COMEC, DCOM and COS are always of different nationalities. DCOS Training & Resources belongs to the same nation as COMEC. Their tour of duty lasts two years.

Senior National Representatives

Within the EUROCORPS Head-quarters (EC HQ), each 'framework' (FN) and 'associated' nation is represented by a Senior National Representative (SNR). The personnel belonging to the FNs and associated nations is represented by one SNR each who is responsible for organic matters related to the personnel contributed to the HQ by his nation. The SNR also facilitates the flow of information between the HQ and his national staff. SNRs are also informed of issues or requests involving only their nation.

The EC framework nations' SNRs hold the posts of DCOM, COS, DCOS Operations and DCOS Training & Resources. The SNR of Luxembourg is the national representation of LUX at the Command group. The other SNRs are also double-hatted and fully integrated throughout the EC Staff. Despite their different ranks and positions, the SNRs have equal rights when acting as such.

Chief Of Staff (COS)

The COS is a general officer from one of the Framework Nations (Belgium, France, Germany or Spain). He is the main adviser of the Commanding General. He is responsible for the organization of the work and the coordination of the staff within EUROCORPS Headquarters (EC HQ).

The COS ensures the mission readiness of the whole EC HQ and is responsible for the initiation, dissemination and follow-up of the Commanding General's policies, directives and guidance. The COS orchestrates the HQ's daily routine and directs appropriate staff procedures in accordance with NATO principles and doctrine, and in accordance with the decisions of the framework nations. On behalf of the Commanding General, he exercises directing and coordinating authority over the HQ Multinational Command Support Brigade (MNCS Bde) and coordinates activities between the staff and other cells of the HQ.

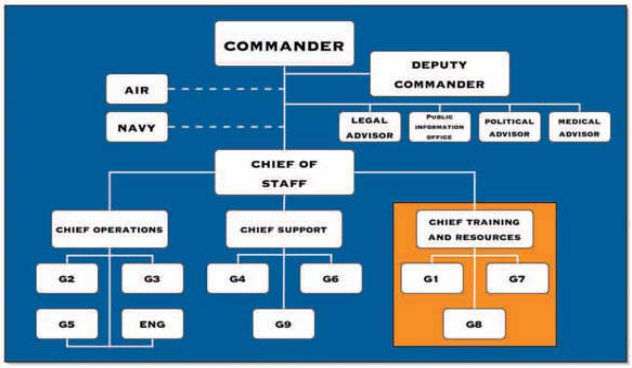

Fig. 2 Eurocorps military staff (EMS) organization

Operations Division

The Operations Division, led by the Deputy Chief of Staff Operations, is responsible for the planning, synchronization and execution of all EUROCORPS exercises and operations. Furthermore, the division is responsible for the international relations of EC HQ. The Operations Division comprises four Branches: G2, G3, G5 and Engineers.

Support Division

The Support Division, led by the Deputy Chief of Staff Support, provides EC HQ with logistics (G4), communications and all other IT related support (G6) as well as with all medical support (G Med) related to

operations. In addition, the division is responsible for ensuring all Civilian Military Co-operation (CIMIC) issues within EC's area of responsibility. Thus the Support Division gathers the specialist branches necessary for the planning and coordination in support of EUROCORPS' missions.

Training and Resources Division

The Training and Resources Division, led by the Deputy Chief of Staff Training and Resources, provides the EC HQ with personnel (G1), training & exercise policy, concepts & platforms (G7) as well as all support related to budget and finances (G8). With this new division the EC adapts its structure to the current NATO Corps headquarters. In addition, the division ensures the manning and organizes operations of the home base in case of a deployment of the EUROCORPS.

Multinational Command Support Brigade

Command Support comprises the capabilities allowing a commander to exercise effective control over his forces.

The MNCS Bde has the mission to support the EUROCORPS Headquarters (EC HQ) in Strasbourg in case of deployment. In exercises and operations, the MNCS Bde ensures the command of all support functions considered necessary to facilitate the command & control of the operations. The Brigade therefore has to deploy, operate and support all the EC Headquarters' echelons (command posts), permanently applying the force protection rules.

Besides staff support, these capabilities are: information management, communications, command and control information systems within the HQ and between the headquarters and subordinate units, other supporting functions necessary to ensure the deployment, the strengthening and the protection of the headquarters' echelons and finally Real Life Support (RLS) such as food, lighting, ablutions, fuel, office equipment and administration.

The Multinational Command Support Brigade (MNCS Bde) is under direct Command of COMEC and performs its daily activities with the HQ Spt Bn and the CIS Coy, that are its only subordinated units.

A document called 'EC Troops Concept' lists the dedicated and affiliated units that are expected to ensure the availability of the required capabilities in due time and at the right place. The Multinational Command Support Brigade in its new structure was created when the EUROCORPS was transformed into a rapid reaction corps. Summer 2001 witnessed the first steps towards the new structure with the arrival of the commander and the first personnel, who were mainly recruited from the existing EC Staff. After the end of exercise Cobra 01 in November 2001 the new structure started to take shape. By the end of February 2002, most of the personnel had joined the Bde Staff.

Studies were presented to define the command support concept, the missions and the needs of the Brigade in preparation for the evaluation process as a NATO High Readiness Force (Land) HQ. The Brigade passed NATO's evaluation test with flying colours and continues to improve its operational capabilities.

The MNCS Bde is responsible for planning, preparing and training for the support of the EC Headquarters' echelons operational deployment. It shares this responsibility with those units that are dedicated in peacetime.

The Communication and Information Systems Company (CIS Coy)

The CIS Coy was created in summer 2005. The CIS Coy as well as the HQ Spt Bn is subordinated units to the MNCS Bde. After the planning process of G6 branch MNCS Bde issues the CIS technical orders to all involved CIS units to ensure the connectivity and the information exchange with all linked units, HQs and organizations. The CIS Coy provides EC HQ with command and control support in peacetime, during exercises and in real operations. In case of deployment the CIS Coy works together with the dedicated CIS units, provided by the Framework Nations. The CIS Coy operates the information systems including the different networks inside EC HQ

and provides all EC HQ command posts and Home Base with permanent command and control support, if necessary 24/7.

3. MISSIONS

As clearly specified in the founding documents, Eurocorps is prepared to deploy and conduct combined joint military operations across the full operational spectrum. It is therefore ready to be committed for:

- Crisis Response Operations (CRO)
- So-called "Article V" or collective defence missions.

The Eurocorps can serve as a multinational headquarters for crisis management both on behalf of NATO and the EU. As such, the Eurocorps was deployed in Bosnia-Herzegovina (SFOR in 1998), Kosovo (KFOR III in 2000) and Afghanistan (ISAF VI in 2004-2005) [5,6,7].

In 2001, the Eurocorps applied to serve as rapidly deployable multinational headquarters for NATO (Deployable High Readiness Force Headquarters). The would-be headquarters had to meet a number of criteria and prove their operational capacity in an exercise. The Eurocorps passed its test and now enjoys the status of rapidly deployable corps headquarters at the service of NATO (NATO Rapid Deployable Corps Headquarters). In that capacity, the Eurocorps was on stand-by as headquarters for the land component of the NATO Response Force (NRF) from July 2006 to January 2007. The NRF is a multinational rapid intervention force of NATO that has to be available within five days. Its composition and its command are fixed by a rotation scheme. Although the NRF was not deployed in this period, the preparations in the first half of 2006 - with the full-scale exercise on the Cape Verde Islands as the successful final piece - as well as the actual stand-by period, resulted in a very high level of preparedness and interoperability between the Eurocorps and NATO.

In the future it must be possible to use the "know-how" and the preparedness built up this way on behalf of the European Union as well.

From 2002 onwards, any NATO and/or EU countries that so desire have been able to contribute to the staff at headquarters in Strasbourg. Turkey, Greece, Austria and Poland have integrated officers into the Eurocorps staff.

4. FUTURE PLANS

During the next years EUROCORPS will undergo the NRF certification again. They are looking forward to carrying out this very important "NRF 15" mission that they are already training for. All the numerous exercises and training activities will serve only one single goal: the full commitment of EUROCORPS to NRF. This will forge our cohesion and improve our skills and procedures. Afterwards, from July until December 2010, it will be NATO's answer to any crisis occurring in the world. Regardless of any possible commitment, this period is an outstanding opportunity to train the capabilities of EUROCORPS in the function as a Land Component Command, ready to conduct all kinds of operations in a joint environment, which is nowadays a standard feature of all operational deployments [8].

Looking further into the future we already know that Headquarters EUROCORPS will take over the command of ISAF for the second time in 2012. This mission will put HQ EUROCORPS into the spotlight again. An intensive preparation phase scheduled to start in 2011 will even increase the capacities of the Headquarters to meet the requirements of NATO's most challenging mission. The Command Group is looking forward to experiencing the time ahead. NRF 15, the ISAF preparation, the new tasks linked to the Treaty of Strasbourg and the EUROCORPS teamwork are going to be the main points of effort. In the next time it will prove that EUROCORPS is a skilled, professional, experienced and highly motivated HQ, anytime available to the Atlantic Alliance as well as to the European Union.

5. CONCLUSION

Nowadays, Eurocorps is an instrument at the service of the European Security and Defence Policy (ESDP) and one of the most reliable headquarters available to NATO. The ESDP has been given a prominent role in the Lisbon Treaty and has been renamed the Common Security and Defence Policy (CSDP). CSDP will remain an integral part of the Common Foreign and Security Policy (CFSP) and major innovations are introduced, which will create opportunities for bringing the Eurocorps closer to the EU.

In the strictly defence area, the Lisbon Treaty envisages a *solidarity clause* and a *mutual defence article*. If a Member State is the victim of an armed aggression on its territory, the other Member States shall have an *obligation* of aid and assistance by all the means in its power. This obligation does not affect the *specific character* of the security and defence policy of certain Member States or NATO agreements. The Union can mobilize all the in-struments at its disposal, including the military resources made available by the Member States. This clause may be used to prevent a terrorist threat to protect democratic institutions and the civilian population and to assist a Member State at the request of its political authorities. There are four decisions proposed in the area of ESDP/CSDP that might have an impact on the capabilities and future tasks of Eurocorps. *First*, the European Defence Agency has been given the added role of promoting harmonization of operational needs. *Second*, a wider definition of the 'Petersberg Tasks' will come into force. All of these tasks may contribute to the fight against terrorism.. *Third*, the Lisbon Treaty envisages the possibility of entrusting to a group of member states with a certain operational task, confirming what has already been happening in EU-led military operations. *Fourth*, the Lisbon Treaty introduces *permanent structured cooperation in defence matters*. A key criteria for establishing this will be the ability of a group of Member States to provide combat troops that can be deployed outside the EU with all the necessary support elements (transport, logistics etc), at brief notice (five to 30 days) and for a period of four months.

The Eurocorps, is the expression of the French-German reconciliation and in a broader sense of the European reconciliation. Furthermore, it is an operational and unique military unit by demonstrating on a daily basis the capability and the will of soldiers to work together efficiently at Europe's service.

Indeed, from its creation on it has been tasked to encourage the interoperability of units coming from five different countries, or possibly more soon, and it has developed a real expertise in this matter. It is a pioneer of such European forces with a multinational vocation, because it derives its legitimacy from its 5 Framework Nations (Belgium, France, Germany, Luxembourg and Spain).

Being aware of such a future role for the Eurocorps, the Framework Nations are considering the possibility to include it into the EU Force Catalogue as a Force Headquarters (FHQ).

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THE COMMAND AND CONTROL IN NETWORK CENTRIC WARFARE

COLONEL (Ret) HORNEA IONEL, PhD

The nature of command

The fundamental nature of this process, as well as the characteristics and the conditions, in which it is operating, is to promote the understanding of this concept and as a foundation for a continuous approach to C2.

The first fundamental element is to define the main characteristics of any military action, irrespective of which phase it is – peace, crisis or war – is ***the Security Environment*** *Estimate.*

Another problem is to analyze the ***Relation between the Command and Control, which,*** *in the traditional way, is presenting the vision about this process, starting from the highest to the lowest level of the organization. In the approach suggested is underlined the importance of the feed-back process as a characteristic of the control, which have to be understood as an informational flow, coming from any direction and giving information about our own troops' situation or about the opponent's force situation. In this way,* ***the Command and Control System (CIS)*** *is not strictly a tool used by the Commander / Higher Commander to deliver their orders to the subordinates, but a tool that is taking into account the frequent changing situations. In conclusion, an efficient Command and Control process may help us* ***to generate rapid, specific, decisive and secured actions.***

Another problem underlined is that the main parameter of the Command and Control Environment is ***the "fog of war"*** and ***the time***, which take in consideration the tensions generated by the confrontation between the fog of war and time. From different point of view, these are the fundamental challenge of the Command and Control process.

In this respect, the **Revolution in the Military Affairs (RMA)** is the main element that completes the mean of the networking C2 process. Their elements which characterises C2 are:

a. the ***RMA characteristics*** and the elements – (1) the modern ***conventional weapons***; (2) the ***sensors revolution***, facilitated by the computerization of the individual programs and of the weapon systems; (3) ***Post Modern Battlefield*** , underlining the difference between the changes that are coming from the Evolution and are given by the Revolution.

b. the ***Informational Revolution*** based on the important technological progress that increased the ability to collect huge quantities of information and had an impact on different organizations.

Certainty, among these factors, the ***human factor*** is, the same, an important elements of the concept, with a huge ***impact over the organizations,*** underlining the following:

- (1) the future shape of the military organization has appeared in the Early 1990's, during the Golf War;
- (2) now, the commanders can monitor the staff's activity of any organization from thousands of miles;
- (3) to carry out a War in the Post-Modern Period will require important technological innovations in the field of the organizational design, particularly ***passing from the hierarchical structure to the network based structure***.

Because the outcome of each ***Command process is to make a decision*** I want to underline that the ***internal feed-back*** of the Command Team can be essential to develop an effective decision making process ant the delivering models and the information superiority of the Command Team are

essential influenced by the ***communicating models.***

The 21st century's challenges for the command and control

One of the problems to which the Command and Control process has to respond, from the point of view of the early 21st Century requirements is **W*hy not the Command and Control terms?*** In this respect, the approach proposes to start from current reality: the situation for what the Command and Control Element is the best adapted. Has it been changed by the realities of the Information Age? Starting from this hypotheses, I want to remind the conclusions of the a conference which took place years ago in Scotland, where a respectable military historian has gone too far with the critics over the vanguard concepts, regarding the power of the network based actions, saying if the military adopt these methods, their organization will not be for a long time a military one.

The ***Approached Space of Command and Control*** presents a personal view about the implementation of the Command and Control functions, that is supposing a three dimensional relationship: (1) the allocation of the decision rights; (2) the information sharing and (3) the interaction model between the participants.

Another approached element, as a common element of the mission capability package, is the ***Maturity Model of the Network Based Capabilities.*** It defines five maturity levels of any hypothetical way to translate those capabilities into an organization, underlining the assumption that such a kind of C2 approach and the organizational way were necessary to transform the complexity of War and the high intensity operations into an elementary compilation of the requirement that, if they are solved for every person, can collectively secure the successful accomplishment of a large scale mission.

The concept of the ***Command and Control in the Information Age*** approaches this problem, starting with any fundamental consideration, aiming to clarify the correlation between the ***Hierarchy and the Informational flow***, underlining that: (1) information is of a strategic value; (2) the sharing way of this thing troubles the ability of the organization to respond to the challenges it confronts with; (3) it is not necessary to consider solving the Command and Control problem until it is not rethinking as a major changing of the force's capabilities and the operating concepts.

These elements approached in the ***Defense Planning Based on Capabilities*** aim to achieve the shift to the problems, starting from the hypothesis that so as the military revolution will reflect new capabilities, so the new capabilities will reflect the inefficiency and quickly decline of the old capabilities. On the other hand, these underline that this approach has to take in consideration also the ***technical-military and geopolitical uncertainty***. However, the answer is the starting point principle for the military, not at all new for the economical and the political strategists – ***a policy can be considered that does not exist if the commitments are not balanced by the proper resources***. For this reason, the solution suggests that the defense planning art is ***the art to assume the commitments, to show to the potential opponents not only our determination,*** but and the useless of using of the military force over our political objectives.

The ***Command and Control functions*** underline that while the C2 process is not a matter of course, it remains a tool that generates value. Going away from this point, I try to suggest that an inspired Command and Control process can generate a failure in the outcome of an operation and the failure in accomplishing a mission, as well as an incompetent C2 process can be associated with a victory.

Management and self-synchronization

In this respect, I want to underline that the main problems to support the functions of the Command Team is to use the results given by the analysis of the essential requirements to increase the outcomes of the Command Team. For the beginning, this approach goes over the ***participative designing method***, estimated to be able to use better the centralizing designing criteria.

Follow up this idea, we have to have in mind the seven main categories of the identified problems: ***to make a decision; technology; the problems of the Command Team; information / Intelligence; human factors; communications.*** For this reason, I identified some aspects about the two problems: (1) ***Communications*** – as a vital element; (2) ***the main structure*** of the decision making process.

The great role in the future conflicts will be play by the correlation between ***, control, and self-synchronization,*** because it underlines the role of self-synchronization, as a method for delivery the decision rights, being associated with specific partners' interaction models.

One other aspect of the planning process is to ***generate the plan of the waiting events***, which presents the two important phases of the decision making process, a fundamental component of the Command and Control process: (1) *Estimate & protection* – comprise monitoring and permanent refreshing of the information to allow a crossed evaluation with the expectations; (2) *Analysis and feed-back in the decision making process* – the comments made to be used as a feed-back in the decision making process.

The ***analysis of the command function, as a multi-user function*** aims to identify the implicit and explicit requirements of this function, such as:

- (1) to adapt the resources to the planning period, taking into account the personnel and the technical attrition – the ***explicit requirement***;
- (2) the achievement of the theoretical model, based on a very good awareness, and the information will support the explicit requirements to identify the shortfalls and to upgrade the model – the implicit requirements that facilitate or contribute to the defining the ***explicit requirements***.

In the close connection with the above element is the ***importance of the tempo, self-synchronization and coherence***, which presents the Command and Control process in the Network Based Operations, from the perspective of the elements that can influence it, identifying three factors of success: the ***tempo, the self-synchronization and the coherence***:

a. ***The tempo*** is presented as a condensed form of the knowing loop - *Observation, Orientation, Decide, Action (OODA)*- the time pressure has a negative impact on the decision making process

b. ***The self-synchronization*** – ensures the adaptation of the plans to respond to the conditions required by the actions, to produce a sharing planning and execution aiming to the desired effects, using distribute groups, as well as to combine the understanding of the Commander's intent and ensure the condition for the decision making process.

c. ***The C2 problems in the Network Base Operation*** – the network is the tool for a rapid and cheap communication for anybody that has the access to the network.

Regarding ***the Command and control (C2) in the future War***, I wanted to present the elements that play an essential role in the implementation:

a. ***The structure of the C2 process - the implementation of the "C4I technologies for the warrior:*** defines these elements as an implementing and sharing decision process, aiming to obtain a maximum efficiency in using the forces both in the peacetime, in the crises and in the war, using the OODA loop. In conclusion, *if you can analyze, decide and act quickly, you will win*[1].

b. ***The Operational Command – a vital connection between the strategically and tactical level:*** underlines a problem that caused many discussions, starting with the following hypotheses:

- ***the necessity to maintain the operational functions*** – it is improbable that anybody from the strategic or tactical level to be able to perform the operational responsibilities in an efficient manner;
- it is possible ***to have a confusion*** which will ***not be followed by the unity of command;***

[1] General Ronald R. Fogleman, USAF, "Information Operations: The fifth dimension of warfare," Defence problems, vol 10, No 47, pg. 2.

- the use of the technology to substitute the Commander at the operational level within the C2 channel is not possible.

In my opinion, the ***Command and Control Joint Integrated Concept*** (***C2 JIC***) is a challenge for those who want a direct answer about how all those hypotheses presented above can be put into practice. For this reason, the ***capabilities and requirements*** represent a way to establish the requirements (through the eight capabilities, divided into 55 requirements – 4 to 10 per each capability), which mention all the C2 functions identified, such as a part of the future Battlefield Environment, estimating that the implementation of each requirement at the lowest level (in accordance with the standards) will get the C2 JIC central idea.

In connection with the capabilities we speak about the ***scenarios for the experimental testing*** approaches a much-disputed aspect at the level of the new NATO member states – the usage of the scenarios to design and test the concepts and the plans, underlining the factors that contribute to the delivery of those:

a. ***Overview***

b. ***Strategic decisions***

Following these ideas, the basic elements to develop any scenarios are:

a. ***The fog of war*** and ***strategic processes*** are underlining that, the *subjective likelihood is unverifiable, arbitrary and non-understanding.*

b. ***Defining the strategic problem:*** underlines that the development of the *scenarios* has to be, invariably, a requested activity. Only by hazard, any scenarios can be relevant for another test-requirement.

c. ***Articulation: a clear security environment – scenarios.***

The design of the C2 Architecture

In my opinion, to develop this theme require the concession between the components of the structured designing process and the practical elements of designing the process of Command and Control Systems, both at the NATO level and at the member states' level, materialized through ***defining the Command and Control Architecture.***

The active architecture and ***General framework*** represent the main problems connected with this concept whereby propose a practical model to implement, starting with the requirement in modelling and analysis. The establishment of the metrics of the success was anytime a challenge, especially in the command and control area, where the missions and capabilities are directly connected with the results of the experiment, made in accordance with the real scenarios. The projects were confronted with the dilemma – ***general mission vs. capabilities*** – and after this with the necessity to adapt the results of the evaluation to the C2 versatile environment.

The proposal stated by this section is that the Services of the Romanian Armed Forces have started, through the PPBES Programs, the implementation of a C2 Active Architecture with a direct impact on their capabilities, in order to increase the efficiency in using the resources, having in mind the current situation of diminishing the IT budget and a rapid increasing of the complexity of the technologies. Concluding, the integration will be achieve as it is now, at the lower part of the entire integration process.

The size and the value of the integration mechanisms are the main elements of this process. The *first dimension* involves a single structure and their operations at a unique level, which can aim the tactical one. The *second dimension* can involve only the same organization (the Army), but the aim of the integration increases on the vertical to include the operations of the Army from different levels. *The third* dimension of the integration involves the architectural initiatives, which connect many organizations (national and/or multinational) on the horizontal, at the same level. *The fourth dimension* of the integration involves the architectural initiatives which connect many organizations and many levels, where is necessary a clear formulation and examination of the joint relationships, both on vertical and on horizontal size.

For this reason, I believe that it is necessary to underline ***the C2 relationships***

and the procedures at the NATO level, underlining the aspects and the conclusions of this process. From this perspective we have *to push the control at the lower levels and to accept a decentralized decision making process at the operational and at the tactical levels* – conclusion which has to become a basic requirement for the design of the C2 process and in the Romanian Armed Forces. ***NATO Communications and Information Systems*** present the NATO tendency in this area, the implications on the current operations as well as those in the resources allocation by the nations in order to implement the new Communications and Information Systems requirements. The main problem remains the ***Interoperability. Suiting the standards CIS, NC3TA*** is approached both from the point of view of the importance at the NATO level and of the nations, but especially from the point of view of the necessity of the acceptance of the standards elaborated by the Alliance in this area.

Another main problem is ***The battlespace entities and the virtual collaboration,*** which underlines the importance of the understanding of the correlation between ***the speed*** and ***coordination*** and the importance of ***the Commander's understanding capacity*** to reshape the Command and Control process, in accordance with a basic requirements of the Network Centric Warfare, that allow the implementation of the principle of the mass effects and not of the forces – ***the virtual cooperation.*** This approach focus on the characteristic elements which allow to reshape the Command and Control, like ***decision making process; the understanding and visualization of the battlefield; the Command and Control Architecture and the way to increase the collaboration.***

Starting with the necessity of an ***effective collaboration*** during both the National Operations and the Coalition Operations, in the context of the implementation of Network Centric Warfare, trough the EBAO concept, I consider the increase of cooperation as a result of the action of the factors that can help or brake this process and, in the same time, the network characteristics, underlined in the end: ***the effective collaboration of the combat forces in the operation will be for a long period an important objective, with a significant impact on the efficacy of operations.***

CONCLUSIONS

To improve *the Command and Control process* at all levels is becoming a main factor in ensuring the progress in the defense area in all modern Armed Forces, this confers the idea that, the ***progress in the command of the forces was*** currently ensured through the implementation of the ***new technologies*** and not through finding the way to move over the existing limitations.

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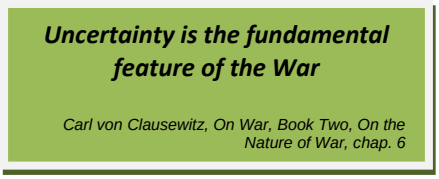
Joint Operation – the place, the role and the missions of the Air Forces in this type of operation

COL (Ret) Ionel Hornea,

The characteristics of future conflict



The great dilemma faced by today's military and civilian professionals engaged in the definition of a new type of conflict that mankind must lead, in order to deal with the challenges of the future, is its character. Here is where the great dilemma persists; arising even in the new Era in features that Mankind has entered: how much the War will match the characteristics of this Era, in which the information has the same role that it had the capital and labor in the previous Era (the Industrial Era). This dilemma is increased when analysis expands on its stage of development that States:"In other words, asymmetry in the field of development, moves or not and in military affairs?" The answer, sometimes even nervous, it will be safe and will be followed by a lot of arguments, some of which are more plausible, but also more partisan. The most recent example are discussions that occurred between the Heads of the Armed Forces of the developed states on defense budgets for 2011, where it was argued, based on the arguments provided by the wars in Iraq and Afghanistan, that the Future belongs to light classic weapons with high-powered impact or, mostly, to the capacity of collecting and processing the information.

And then, the answer might be very shaded, starting from the idea that the asymmetric and joint are the features that describes the best the model for future conflicts, in which the action will be given to the way the *information management is achieved*. More clearly, this response will depend on how fast the real-time connection between the information collected from the battlefield and shooter is. And here comes into account all the chain of Command and Control, and, what appears to be the most important element, the capability to lead the forces directly, passing over the classic decision chain. *The online Age destroyed the command and control management, just as it destroyed also the "dial-up connection"*. It is, for the soldiers, a clear signal that in the New Era doesn't work all the military principles of the previous. Once with the changing rules of production, it became clear that the default property, the entitlement and the exercise of power have changed, too. And, how the principle of Clausewitz's – War is a continuation of politics by other means - continued to maintain the validity of the present judgment, the present military experts, but also those of the Future (because holding power will remain the basic concern of the human relationship is renamed - I will say slave-owner, the owner-collaborator or who know how) will return to the design of a Task Force Army, available to power, which will guarantee the achievement of the medium-term goals and, why not, long-term (let us not forget what it meant the Nuclear Forces for the powers who have held it).

The Asymmetric Warfare

An asymmetric War is the war between belligerents whose relative military power vary widely, or whose strategy or tactic differs significantly. It can describe a conflict in which the resources of the two belligerent parties differ in essence and in the fight and that interact, trying to exploit each-other's weaknesses. Such fights often involve strategies and tactics of unconventional war, the "weak" combatants trying to use the strategy that would ensure compensation for quantitative[1] or qualitative[2] deficiencies. The term dates back to 1975, when Andrew J.R. Mack used it in an article called" Why Big Nations Lose Small Wars [3] ", in which "asymmetric" refers simply to a significant difference in power between the actors of a conflict. Though the *"power"*, fin general terms means a physical power, such as a great army, a sophisticated weapon, an advanced economy, and so on. Looking at his Mack has been largely ignored in the period, but at the End of the Cold War has lit renewed interest among academics. By the end of the 1990s, new research, based on Mack's intuitions, began to emerge, especially after 2004, when developed; militaries (more of the US Military) began, once again, to take seriously the asymmetric war-related problems.The authors of the studies in the field, tend to focus more on the complexity which characterizes the way of obtaining victory by weak actors in war: *where "Power", conventionally understood, leads to victory in the War, then how is the most important aspects of victory "Weaker" either "Strong"?* The main explanations include (1) strategic interaction; (2) the willingness of the "Weak" to suffer or incur higher costs; (3) the external support for the weak actors; (4) reluctance of powerful actors to escalate violence; (5) the dynamics of the internal group and (6) the inflated war goals of the power actors. Asymmetric Conflicts include both inter-state and civil wars too, and in the last two hundred years, on the whole, were won by powerful actors. However, since the 1950s, weak actors have won the majority of the asymmetric conflicts.

The tactics used against an asymmetric opponent during the battle, may not be any set of tactics from lists checklist for asymmetric warfare, since each is unique. Tactics are whatever we do against an opponent when we arrange forces to counter that opponent.

Doctrine for Asymmetric Warfare
Military review, July-August 2003

From the strategic point of view, in most conventional wars, on the whole, belligerents are deploying forces of a similar type, and the result can be predicted, based on the amount of force employed, as well as their quality (e.g., an enhanced Command and Control of their forces). There are situations where this prediction cannot be achieved, because the composition or strategy of the forces makes it impossible for any of the parties engaged in combat. An example, of the same effect, was the difference in between the Ground Forces of the French Army and Maritime Forces of the United Kingdom, during the French Revolution and the Napoleonic Wars. This conclusion was expressed by Admiral Jervis in 1801, during the campaigns, which claimed that "I can say that the French not to come. Just say that they will not come on the sea[4] ", as well as in comparison to underline that a confrontation with Napoleon Bonaparte could be described as one of an elephant and a whale [5] .From the tactical point of view, success is dependent, on at least, some of the following assumptions:

• one of the part may have a technological advantage which exceed the numerical advantage.

• training and tactics, as well as technology may prove decisive and allow a smaller forces

[1] Such strategies can be not necessarily military.

[2] This is in contrast to symmetric war, where the two have similar military power and resources and is based on the tactics that are generally similar, differing only by details and implementation.

[3] "Why Big Nations Lose Small Wars", World Politics

[4] Andidora, Ronald (2000). Iron Admirals: Naval Leadership in the Twentieth Century. Greenwood Publishing Group. pg. 3, ISBN 0313312664. http://books.google.co.uk/books

[5] Ibid 4.

to defeat a much larger one. For example, for many centuries the use of the sites hoplite (heavy infantry) by the Greeks has been superior to their enemies (Battle of Thermopylae is a well known example).

• If the lower power is in a posture of self-defense; that is, under attack or under occupation, it is possible to use unconventional tactics, such as "struck-and-runs" type and selective hiring battles in times in which superior power is slower, as an effective means of harassment without violation of the Law of War. Perhaps the classical examples of these historical doctrines can be found in the American War for Independence, in the resistance movements of the Second World War, such as the French Resistance and Soviet or Yugoslav Partisans, and Irish Republican Army.

• in the case when the lower power is in an aggressive position, however, and/or resorting to tactics prohibited by the laws of war, success in these situations depends on the power of abstention from the use of such tactics (e.g., War Zone Law prohibits the use of a flag of truce or a medical vehicle, clearly marked, as to cover an attack or ambush, but a asymmetric fighter using this tactic prohibited, can gain the advantage in its favor).

Air-Land Battle

Air-Land Battle was the framework concept, which was at the basis of the Doctrine of the US Army and of the European Forces in 1982 and by the late 1990s. This Doctrine has highlighted the close coordination between the Ground Forces which act against FEBA [6] trough a defensive aggressive maneuver with the Air Strike Forces, in depth. The concept is replaced by the doctrinal term called "Active Defense" in 1976, which in turn was replaced by the concept of "Network Based War". The Vietnam's War has shown not only that he had a very important role in the seizing the Conventional Armed Forces, but also to focus on the European threat, as a basis for any future conflict, it was obvious inappropriate. At the End of the 1960s and 1970s the endowment of smart weapons allowed the conventional forces to attack directly target points such as bridges and roads, increasing dramatically the ability to deny the enemy, while at the same time, the aviation to operate more securely, at higher altitudes. This had a real impact, also, during the Vietnam War, when they were still very new, but their potential was obvious. As a result, air planners began to look for ways to represent the best of these new weapons, while doctrinal specialists have started to work on a concept of the expanded battlefield. General Starry[7] (which in 1977 took the TRADOC's Command) stressed the close coordination between the Army and Air Force to produce an integrated plan for attack, which will be using the Ground Forces effectively for a flash counter-attack, while the Air Forces, Artillery and Special Forces operators will stop the movement of the reserves to the front line. The overall message transmitted by the concept of the *Air-Land Battle*, in 1981 was that Land Forces must leave behind the term "limited" to win the fight only in the traditional "main battle area". Since 1984, the *Air-Land Battle* became the principal model also in NATO, but has required to upgrade all categories of C3I equipment of the Services, as well as similar updates [changes] in the structures of Command and Control, to enable the processing of the massive amounts of

[6] Forward Edge of the Battle Area

[7] Donn A. Starry, "Extending the Battlefield", Military Review , March 1981

information.As team members, the Air Force officers have to understand how the Armed Forces will apply the principles of war. In this regard, regardless of the platform used, the Air Forces will provide capabilities in the related third dimension, using the same principles of war – the **unity of command, the goal, offensive, mass, maneuver, the economy of force, security, surprise, and simplicity** — guidelines that commanders can use to set and select courses of action and operating concepts[8]. They do not exclude a solid and a professional analysis, but their full neglect means playing an unnecessary risk. Another basic requirement that must stand in front of the decision makers in the use of such principles, that independent, merging through their effects. The development of an Air Strategy depends on the ability of the pilot to see these principles from a three-dimensional perspective and to integrate their interlinked application.

The **unity of command** ensures the concentration of effort for each objective under the responsibility of a single commander. The air perspective at the operational level requires an act of command to get the most efficient and effective use of force. Coordination can be achieved through cooperation, but, however this is best accomplished by placing tha under a single command, with the authority to lead all forces in order to achieve a common goal. The essence of success in operations is a coordinated effort and cooperation towards a well understood goal. The *unity of command* is vital in the use of the Air Force, because that is the product of multiple capabilities and the concentration of command and control is essential in their effective merge.

[8] Air Force Doctrine, November 17, 2003, pg. 19

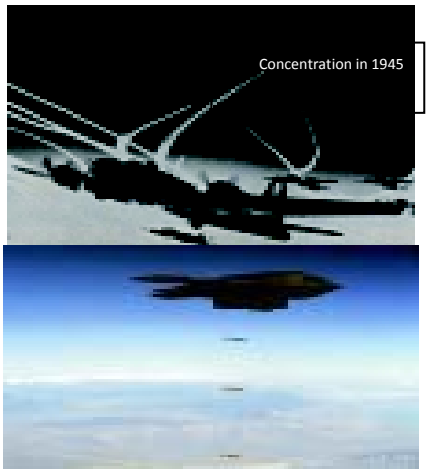
The objective. For Air Forces, the objective is important because of its versatility. At first, the Air Force can track tactical, operatinal or strategic objectives, in any combination, or, during the war, and they can e tracked simultaneously. From the air perspective the prioritiyation of the scale of the objectives is allowing to focus on a theatre or campaign priorities and aims to avoid conduct vigorous elements on fragmented targets.

Offensive (size, retention, and the exploitation of the initiative). This principle is particularly important for air operations, because the Air Power is better used as an offensive weapon. In the war, while the defense may be dictated by the situation in war, the success is generally reached only through offensive actions [9] . Through prompt and sustained offensive actions designed to achieve the strategic and operational objectives, the Air Force causes the enemy to react, rather than to act, and determines the rest of the conflict.

Concentration (the masses**)**. Air Forces are the only ones who have the ability to launch an attack in locations with a large dispersed and mass fighting power towards the goal. From the perspective of an air force officer, mass is not only representing the quantity of forces and materials. **Concentration is an effect which it carried out by the Air Force, by the effectiveness of the attack, not merely by a numeric overwhelming participation.** Today's the Air Forces have changed the concept of masses of forces. Speed, range and flexibility of the Air Force, as supplemented by the accuracy and precision and the lethality of the advances

[9] Defensive air Campaigns, even great success, such as the Battle of Britain in the Second World War, were based on hiring selective offensive.

weapons, and the progress in information technology, allow them to quickly focus than the Land Forces. In the Past, hundreds of planes attacked one or two main objectives, on a daily basis. Today, a single accurate weapon, information-oriented, based on the superiority of the battlefield, can cause often destructive effects that you got with hundreds of bombs in the Past.



More bombers : one target **One bomber: more targets**

Manoeuvre. The ability to integrate a strength and direct impact of strategic or operational weight centred towards an opponent is a key benefit of air forces high manoeuvrability. Air manoeuvre allows you to engage the opponent anywhere, in any direction, at any time, forcing it to be everywhere. Even if it involves an air carrier or aircraft in a larger or asmaller number, versatility and power of responsiveness of Air Forces allow the simultaneous concentration and manoeuvre. Application of this principle has played a decisive role for US Diplomacy in the development of manoeuvres both in Theatre of Operations in the Western Balkans, as well as those in Iraq and Afghanistan.

Economy of forces. This principle requires the Air Force officer to maintain a broader operational vision for the establishment of clearly articulated objectives and priorities. The Economy may require a commander to establish a balance in the use of air forces to attack, defence, delay, or such delusion, based on the importance of the area or the priority of the objective [objectives]. Also, the priorities can be quickly changed; our troops in contact could lead to a change in the priority of a type of assignment (e.g. prohibition) to another (e.g. air support directly).

Although, this principle suggests, in a sense, the use of an overwhelming force, he recommends also to guard against the inherent use of this, excessive "unduly". This is particularly relevant when the excessive use of force can destroy winning or maintaining legitimacy and support for an operation. The objectives vaguely defined may result in the fragmented application of the Air Force and leads to the loss of critical effects.

Security. According to the fundamental requirement of this principle, our forces **do not allow the opponent to obtain an unexpected advantage**. This principle also improves our freedom of action, by reducing the vulnerabilities of our own forces. Winning or staying in control of the air space, and informing, provide own forces a significant advantage.

Air Forces are most vulnerable to the ground. Thus, **force protection is an integral part of their use**. Fixed bases are particularly vulnerable, they don’t have to resist only to airborne and ground attacks, but also they have to support concentrated and extended activities in the air against the enemy.

Important for the security is understanding that it **includes both physical security and information security**. They have always been a part of war on land, sea and air, and now, with the proliferation of technologies, become even more important for the purpose of a conflict.

Surprise. It is a level of the security principle, because it is attacking the enemy at a time, instead of or in the manner for which it is not ready. Speed and range of Air Forces, coupled with its versatility and flexibility, allows them to carry out surprise much faster than the Land Forces. The ability to surprise is one of the biggest advantages of Air Forces[10].

Simplicity. It aims, in joint operations complexity, to prohibit unnecessary complication of the preparation processes, planning and conduct of operations. Common equipment, common understanding and doctrines of the services, as well as the familiarization with the procedures through joint training, can help solve the complexity. Simple plans and organizational relations and unambiguous command are central elements lead to it reduction.

THE ROLE, TASKS AND FUNCTIONS OF AIR FORCES

To describe that the Air Forces generally offer to the nation, you first have to explain the distinction between roles, missions and functions. Although these terms are commonly used, individually, each has a specific meaning.

In brief, **the primary function of any services is to organize, train and equip forces to perform a role** — to be made available and employed by the commander to perform a mission in order to achieve a particular effect. On the basis of the desired effect and mission assignments, the pilot carried out a series of separate tasks that gives the cumulative lead to effects desired.

ROLES

Roles are broad and enduring goals laid down by law for each category of force. The role of Air Forces is to organize, train and equip forces in pursuit of and in support of the Offensive and Defensive Air operations[11].

MISSIONS

Missions are tasks assigned by the Minister of Defence or by the Chief of General Staff to the JFC, designed to be employed in combat operations [12]. JFC Commanders take these tasks and establish the mission, objectives and the Concept of Operation and, in turn, they assign specific tasks to subordinated commands. Sizing of these tasks to meet the guidelines of the commander and the desired objectives, Air Component Commanders, in

[10] The second world war gave the examples from this point of view: the attack on the British HMS Illustrious portavionului under naval from Taranto on 11 November 1940 (the British lost 2 out of the 21 aircraft attack, 3 ships fighting; 3 carrier vessels were damaged; 2 small immersed flotillas); the Japanese attack at Pearl Harbor. In recent history: this raid on Libya U.S.; the first day of Operation DESERT SHIELD).

[11] Ibidem 7, pg. 35

[12] The wording belongs to me – in the U.S. Air Forces Doctrine (November 17, 2003), pg. 35, it is stipulated that these missions are set by the Chairman or by the Secretary of Defense.

turn, develop the mission of each component, as well as the goals and Concepts of Operations.

FUNCTIONS

The functions of the services are those specific responsibilities which allow them to perform their legal roles, and relate to the "organization, training and equipment" activities [13]. The doctrines developed at the level of Ministry of Defence involving these responsibilities *("recruitment; organization; supplies; training; equipment; maintenance; mobilization; demobilization; administration (including morale and living conditions of the staff); maintenance; implementation, adaptation, and repair of military equipment, building, maintenance, and repair of buildings, structures, and utilities; acquisition, management and pulling out of use; and management of natural resources or estate").*

The Ministry of defence cannot determine exactly how these functions should be carried out. These details are left to the discretion of the services, which is based on the available technologies and operational experience; most of these are eventually cast in the doctrine of the category, in accordance with the ministerial guides.

One way to think about the **difference** between functions and missions **is to make the distinction** between the functions that a category of force they run under the auspices of the administrative branch of the chain of command and those to provide forces for Joint Force Commander, by means of the operational branches of the chain of command. On this line of demarcation, it is useful to distinguish between **"organizational"** functions (activities necessary to develop and supports air force as a corporate entity) and the **"operational"** (activities, involving the use of contaminated air force in order to achieve the specific military effects).

Every art has its rules and maxims. One must study them: theory facilitates practice. The lifetime of one man is not enough to enable him to acquire perfect knowledge and experience.

Organizational Functions

Organizational Functions covers the range of activities, which provides the institutional infrastructure to support modern Air Forces. This includes such tasks as *recruitment, training and education; research, development and acquisition; drafting and presentation of the budget; administration; logistics support; conducting operational assay and evaluations; determining forces requirements and drafting recommendations with regard to the requirements to support the objectives of the national security; maintenance of vehicles, systems and aircraft.* By default, these functions are the creation and maintenance of forces and organizations necessary to fulfil the role assigned. Specifically, Air Forces "are responsible for the preparation of the force for the purpose of waging war and effective military operations increased less than war, and ... to expand the Air Forces peace time competence required to meet the needs of war"[14]

MAIN ORGANIZATIONAL FUNCTIONS

- The Organization, preparation, equipment and supplies forces **to carry out prompt**

[13] For USAF these responsibilities are established by 10 U.S.C. § 8013 (b). Here we will see the clear distinction between administrative nature of the categories of forces and the responsibility for preparing and a mission (doesn't met the level of operation) – belongs exclusively to the OPERATIONAL HEADQUARTERS. Another aspect is those for who established the Operational Headquarters the missions: only for subordinate commands. In any official document is not used the concept (the idea) of force.

[14] DODD 5100.1.

and sustained offensive and defensive air operations – in particular, the forces for defence against an attack from the air, in accordance with the doctrines laid down, winning and maintaining general Air Supremacy, defeating enemy's Air Forces, vital air control of zones and location of local Air Superiority zones;

- The Organization, preparation, equipment and supplies forces **for close-air missile and Air Defense** operations;
- The Organization, preparation, equipment and supplies air forces to directly and logistical support for Land Forces and other forces, **including air transport, air support, air replenishment operations, air photography, air tactical recognition** and **air interdiction** for land forces and enemy's communications;
- The Organization, preparation, equipment and supplies **for airlift of the Land Forces**;
- The Organization, preparation, equipment and supplies forces to provide **means of transport and support** for the central structures of the Ministry of Defence;
- The Organization, preparation, equipment and supplies for support and promote S**pecial Operations**, **Psychological Operations** and **Electronic Warfare operations**.

OPERATIONAL FUNCTIONS

Operational Functions associated with the services are written broadly and don't prescribe the operational models to perform these tasks. This allows to services the required flexibility to develop the best operational models on the basis of the available technologies and experience. These functions are the following operational level intellectually description of how Air Forces carry out their new role.

The **Operational Functions** are related to the development of specific effects. Those effects are results, events or consequences resulting from the specific actions; these effects should contribute directly to obtain the desired military and political results. This requires commanders and planners to switch explicitly and comprehensively, as much as possible, every tactical action with strategic and operational objectives. This link is the heart of Effects-Based Operations (EBO), which are actions against enemy's systems, designed to achieve certain effects that contribute directly to achieving your goals. In this respect, commanders and planners must have a clear understanding of National Security Objectives and campaign and those actions necessary to create effects that result in cumulative aims pursued.

As regards the description of these key functions of Air Forces participation within the framework of the joint force, a function must meet the following criteria:

- must be planned and performed at the operational level by a headquarters component;
- must be an operational requirement and not an organizational task (administrative);
- must create an effect at the operational level;
- must describe an operation clearly delineated, rendering the air of a joint operational headquarters (JFC).

Based on these criteria have derived a list of **key operational functions**:

- Strategic Attack
- Air Refueling
- Counterair
- Counterland
- Countersea
- Airlift
- Special Operations
- Information
- Surveillance and Reconnaissance
- Information Operations (IO)
- Combat Search and Rescue (CSAR)
- Navigation and Positioning
- Command and Control (C2)
- Weather Services

From this list, due to their complexity and their characteristics being able to retrieve in any type of action or conflict, as well as to take the rapid and full new trends what develops concepts for the future character of the war, still I'll briefly refine only (1) Strategic Attack, (2) Counterair, (3) Counterland and (4) Countersea

Strategic Attack

The S*trategic Attack* is defined as an offensive action carried out by the Command Authorities, aimed at generating effects which leads directly to achieving our National Security goals by impaired command channel, resources intended to support conflict and the opponent strategy. The strategic attack is a concept, not just a function. As a concept, is based on the idea that it is possible to affect directly the sources of power and the will of the opponent to fight, not to engage and defeat its military forces. Strategic Attack can also be used to prevent an attack by the enemy on our vulnerable points, essentially to deny his war aims.

As it is today, strategic attack **is more than just a function** – it is also a different approach to thinking about the war. It is a way of the manifestation of the air force officer perspective: **thinking about the defeat of the enemy as a system.**

Counter air

Even if the strategic attack describes the best total vision of Air Force officer for hitting the enemy, **counter air** is essential for successful premise. It consists of **operations designed to achieve and maintain a desired degree of Air Superiority, destruction, damage or break-up of the enemy forces.** Those two elements of counter air, O**ffensive Counter Air** and D**efensive Counter Air**, allow easy use of airspace and off air offensive and enemy missile capabilities, in order to reduce the threat represented against own forces. The entire offensive and defensive counterair effort should be controlled by an Air Force officer, in accordance with the principle of unity of command and of the centralized command and decentralized execution to ensure that the requirements of the concentration of force effort and economy are met. Normally, air superiority should be the first priority for the Air Forces of a Joint Operational Headquarters.

Counterland

Counterland is defined as **an air operation against enemy Land Forces capabilities to create effects that will ensure the attainment of Joint Operational Command aims**. The main of the counterland must be prevail battlefield airspace and prevent the opponent from doing the same thing. The direct or independent attacks from the air on the opponent's forces are key element to the success of the initiative during the first phases of conflict. Counterland offers Joint Operational Headquarters for **two separate air operations** for engaging the enemy's Land Forces: **the Air Interdiction**, during this the air manoeuvre supports indirect ground maneuver or C**lose Air Support** (CAS), in which air manoeuvre supports directly ground action. CAS may offer a huge tactical advantage, by supporting land forces, can stop attacks and help to make breaches, cover the withdrawal or protection of the flanks. This type of support should be used in the crucial points and should be, normally, mass to allow the concentration of combat forces and jamming of defence.

Counter Sea

Counter Sea is a function of the Air Forces capabilities in the Maritime Environment. The tasks are identified by specialized surveillance at sea, anti-naval war, and protection of Sea Lines of Communications through Anti-submarine and Anti-Air Warfare, aerial mine laying and logistic supply of the naval campaigns. Many of these collateral tasks translate to primary functions as Air

Interdiction, Counter Air and Strategic Attack. As with the air functions, Counter Sea Operations are designed to achieve strategic, operational or tactical force goals. The objective is to gain control of the battlespace and to the extent applicable, dominate operations either in conjunction with Naval Forces or independently.

CONNECTING TO THE FUTURE

When we talk about the connection with the Future, I think this doctrinal maximum made direct experience that pilots and fighters, roughly, have acquired during the fighting in which have shed his blood and reinforced by technological progress.Using it [doctrine] properly can lead to success, and ignoring it can lead (and has led) to a disaster, because the doctrine should provide lessons from the past to orient the current operations, but more still needs to be sufficiently flexible to adapt to emerged changes. During this time that directs the current operations, doctrine provides a theoretical base for future developments in this field. A way to put this relationship ahead is to understand the different utilization of vision, operating concepts and doctrine. Placement in continuity of vision, operating concepts and doctrine provides a model for thinking about the future technologies, operating procedures and doctrine in a coherent framework.

From this point of view, **the vision** presented by a service's focus is usually on the key operating construction and desired operational capabilities, for a period of about 15 years, and even more, serving to focus on future technologies and on providing investment needed to achieve these capabilities. The best emerging technologies are those investigated by the game of war. As new concepts are imagined, it is important to examine, also, needed doctrine to support these capacities. Vision is the basis for war games, and the results may indicate doctrinal issues requiring further examination. **Doctrine** is focused on the near term operational challenges, and refers to the appropriate use of the capabilities and current organisation. The doctrine refers to how well to hire, stay organized and lead today

> ***Victory smiles upon those who anticipate the changes in the character of war, not on those who wait to adapt themselves after the changes occur***
>
> *General Giulio Douhe (1869-1930)*

capabilities, being best examined and validated through the exercises, which train the current forces and their staffs with the procedures and missions in force. Through the war games and experiments, doctrinal concepts can be tested to help adapt such imaginary capacities with doctrinal practices high resonating. Operational concepts define the point at which the performance of mature technologies can be reasonably defined (for example, quantified by range, speed, efficiency, etc.) and their use can be properly described as a final system that can be examined in the framework of a model that places them in a realistic and reasonable operational scenario. In this scenario can be applied to metrics for assessing the relative new system, the impact of other elements in the scenario, such as the command and control structures, sustainability and its trade force.

Conclusions

- The potential of Air Forces is their

> **Wars are never won in the past.**
>
> *General Douglas MacArthur*

capability to plan and commit to a maximum of forces and means and articulate them in the context of joint operations.

The development of Air Force doctrine cannot be considered ending – it is a continuous process whereby:

- we must stick aware of lessons from the Past – watchful and responsive to future technologies and models that can modify the art of warfare operations in airspace. The doctrine should be interpreted continuously, depending on the current situation;
- the lessons of the last wars are always currently suspected because all conflicts were different — the application of the doctrine requiring informal analysis, because certain principles — such as unity of command, the establishment of objective and offensive — have been tested over time, others, such as, decentralized command and pre-eminence of nuclear weapons, not.

Ignoring the potential and scope of operations and the nature of Global and Strategic Airspace, we can commit the same sins as our predecessor. If the reality, that **adaptive thinking** what adversaries will seek using asymmetric strategies, anti-access capabilities and favorable zone for our influence and our engagement, will be ignored, we are risking the catastrophic surprises. Tomorrow, a new set of conditions and requirements will prevail. In fact, the new conditions and requirements are already emerging. The best way to prevent is an institutional commitment to learn from the experience gained and exploit such ideas and new and relevant technologies, becoming thus our future managers, simultaneously with constant maintaining of the fundamental principles.

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VITAL INDEXES OF ORGANISM IN TERMS OF PERSONNEL SAFETY ON BOARD OF THE AIRCRAFT

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Abstract: *The analysis of harmful physical and chemical factors which can negatively affect vital indexes of organism of passengers and crew of airplane in the different terms of flight is presented in the article. On the basis of analysis requirements are resulted to the sanitary hygienically terms aboard an airplane, which to the not contradict norms of flightworthiness of civil airplanes and guarantee safety of vital functions of crew and passengers aboard the airplane of any state of the world in obedience to the requirements of international organization of civil aviation.*

Keywords: *factors, organism, airplane, safety.*

1. INTRODUCTION

The modern aircrafts flight is on the 10^{th} upper layers of the troposphere zone. One main and difficulty task is to provide normal living condition of security for the crew and the passengers by the flights on the upper layers.

The given task includes the analysis of the result of investigation of specialists at the airplane side and specialists of the aviation medicine.

In the troposphere the pressure, temperature and air density changes dependently to the geographical coordinates of the airplane, height from the sea level, daytime and season.

On the height of 7 km the air can be considered as dry. Dry air consists of 78 % nitrogen, 20,95 % oxygen, 0,93 % argon, 0,03 % carbon dioxide, 1,8 x 10^{-6} % neon, 5,24 x 10^{-5} % hydrogen, 1 x 10^{-6} % ozone.

2. HUMAN ORGANISM LIMITS

While breathing in the teeth ridges of lights takes place the satiation of blood oxygen in accordance to the law of diffusions. The reverse process (exhalation) leads to the leading out of carbon dioxide from the human's organism. The main factor, which defines the diffusion of oxygen from the alveolus air into the blood, is partial pressure.

Normal vital functions of the human can be provided by the partial pressure of the oxygen, which is supported while inhalation on the level pO2 = 22, 2 – 16, 6 kPA.

The minimal partial pressure of the oxygen in the alveolus of the pulmonary, when the blood is entirely with 80 – 85 %, is the pressure, equal to 6 – 6, 7 kPa. Such partial pressure corresponds to the height 4, 5 km while breathings the atmospheric air. That's why, slights to the height 4, 5 km can be done in the aircrafts with the non-hermetic cockpit. The flights higher 4, 5 km are "height". Pilot's cockpits and passenger saloons of such aircrafts are impermeable. The decline of the air pressure, except for oxygen starvation, calls the processes of disbars in the human's organism, which can be seen in different forms.

While height flatulence, increased by the expansion of gases and display of higher pressure in the gastro enteric highway, also the

sickly feelings in ears, frontal and maxillary sinus, can be appeared.

Aeroembolism or decompress sickness can appear in the view of arthritic and muscles pains while arising on the height 8 - 13 km pains appear, because of selection of nitrogen, which is dissolving in the cellular structures of fabrics of a human, if the air pressure is declining. Under the normal earth conditions blood and fabrics of human organism rich index 1 – 1, 5 L of dissolving nitrogen. While free declining as air pressure, the partial pressure of the nitrogen, dissolving in the organism, is places in the equilibrium with the partial pressure of atmospheric nitrogen, which is selected while diffusion without any painful signs. Sharp arising of the air pressure leads to the appearances of the greater gradient of pressure and there nitrogen begins to select in the view of finely dispersion bubbles from blood and fabrics of organism of the human. The movement of the bubbles through the structure of the fabrics of the organism calls the mechanical action, which irritates the corners of the nerves and blood vessels. To the height of 7 km, the pain doesn't appear, the man carries rapid declining of the air pressure worse, than it's arising.

3. COMPLEX BIOCHEMICAL ISSUES

In the process of life activity human body produce energy, which is allocated in the form of heat. Intensive course of processes of heat exchange depends on temperature, humidity and air circulations, clothes, a pose of the person.

Biochemical processes proceed in human body nearby temperature of 37 degree. If environment has temperature at which the quantity of heat which allocates an organism, is in balance with quantity of heat which develops an organism, is in balance with quantity of heat which is selected by environment, it means that environment and temperature-comfortable.

These requirements are realized by air circulations systems and regulations of air pressure aboard. The systems provide hygienic conditions of flight work of crew in a cabin and comfort of passenger cabin. They should correspond to conditions of expenses of air, pressure, speed of its changing, temperatures, humidity, gas structure, speed of movement in a cabin and passenger cabin both on the earth, and at all stages and flight modes.

Air on outlet of the air circulations system in the cabin of aircraft should correspond with the sanitary-hygienic requirements. Mass concentration of oxide carbon should not exceed 20, oxide nitrogen-5, fuel vapours (counting on carbon) - 300, vapours of aerosols of synthetic oils-2, vapours and aerosols mineral oils, aldehydes 0, 6. At the definition of the demanded volume of air fresh supposed concentration of carbonic gas CO_2 by which is formed by breathing is dominating. At long staying of the person in closed space of passenger cabin and cockpit a admissible volume concentration CO_2 should not exceed 0, 1-0,125 %.

Air supply in cockpit on one passenger should be not less than 24. Air expenses are considered from conditions of maintenance of a temperature mode of cockpit, it should be above minimum admissible CO_2.

Table 1 The information on quantity of air on one passenger and concentration CO_2 in passenger cabin

Type of airplane	**AN-140**	**Jak – 42**	**IL – 62**	**IL – 86**	**TU – 154**
Kg/h	25 – 30	37,5	35 – 37	40	25 – 34
CO_2, %	0,125	0,1	0,1	0,095	0,105

As to ozone it concerns harmful factors, which can influence to condition of crew of aircraft at piloting in southern and northern widths of poles.

4. OZONE PENETRATION

Average mass concentration of ozone in air space in the plane cockpit at altitude higher 7000 metres and time flying about 3 hours shouldn't exceed 0,1 mg/m^3 in all fly time.

Ozone penetrates into troposphere from stratosphere in the result of dynamic circulation processes.

There is air researches in a sealed cockpit which where conducted by V. V. Osechkinim on planes IL – 18 (height 7 - 10 km) and IL 0 62 (height 10 - 11 km) on north routes, shouts that, atmospheric ozone could penetrate into cockpit with in 3 – 5 times exceed admissible boundary values of permissible limit concentrations (PLC).

It is fixed penetration of atmospheric ozone into seal cockpit of aircraft of Boeing during the transatlantic flights on height 12 km, level of concentration where exceed values of PLC.

Ozone is unstable chemical substance; it is getting easy destroyed by heat. Temperature condition in compressor of IL – 18 and IL – 62 engines are insufficient for complete destruction of ozone that explains it's presence in air in cockpit and cabin.

Ozone is destructed under high temperature, as might've been proved by flights of aircrafts of TU – 144 and "Concorde". Temperature in compressors of engines reached 500^0C and concentration of ozone did not exceed allowed level – 0,1 mg/m^3. By recommendation of ICAO if aircraft with subsonic speed enters the ozone layer it has to change height of flight and notify ground services about where aircraft is.

If in cockpits air exist some substances of straight up for biological concentration of them available concentrations shouldn't exceed one.

On all stages of plane flight in cockpits should keep temperature in bounds 17-25^{0}C. Changing of temperature in cockpit shouldn't change parameters of air in salon.

Degree of saturation of air by water vapours has great meaning for heat exchange of human with environment. Drop of humidity shouldn't influence on crew.

Relative humidity in seal cockpit depends of height and flight time. In seal cockpit of IL-62 plane, by 7 hours flight an height 10 km and 180 passengers on a board relative humidity is 12-15 %, in seal cockpit of plane Jak-40 on height of 5 km after 1,5-2 hours, relative humidity achieves 27-30^. Dryness of mucous nose, throat, eyes, observed with relative humidity near 40 % and such humidity doesn't call bad symptoms, which could be when humidity go to 20-22 %. Normal average humidity is 40-69 %, maximum pressure limit – 15 %.

Minimal barometrical pressure in seal cockpit should make partial pressure of oxygen in air, by which passenger and crew are breathing equal 15, 7 kPa. This partial oxygen pressure corresponds to the common barometric pressure in seal cockpit, equal to 75, 6 kPa.

Such pressure creates some deficits of the oxygen in the air environment of a seal cockpit that regenerates by the compensation abilities of the healthy human with less decease in his physical state.

That's why barometric pressure in the seal cockpit shouldn't be less than the altitude pressure 2.4 km (cockpit altitude) in all flight altitude range.

In the case of air cooling system failure or at the pressure related system malfunctions cockpit altitude should be stay not more than 3 km.

Important role for the comfortable flight conditions is the speed of barometric pressure changing in a seal cockpit, that all modes of ascent and descent should be not more than 24 Pa/s (18 mm. mr. cl.) This limit is defined due to human bode ability of equalling the pressure of cavity of middle ear with the environment pressure.

If the overall of pressure changes from lower to higher, then unpleasant feeling begin to show up at speed of change of pressure equal to 160 – 210 Pa/s (1,2 – 1,6 mm. mr. c. per sec) cockpit.

The amplitude of pressure fluctuation 2.4 – 2.7 k Pa (18 – 20 mm. mr. cl) at it's speed of changing from 0.9 to 1.7 k Pa/s (7 – 8 mm. mr. cl. per second) unpleasant sensations of pain in the ears and headache also. That's why suck a rate of pressure change, which is not more not than (0.64 k P/s per sent 5 mm. mr. cl./s) rate of pressure decrease 1,33 k Pa/s (10 mm. mr. cl. per second) Speed of air movement in the cockpit must not exceed 0,4 m/s.

5. CONCLUSION

Given data of the mass concentration of carbide oxide; nitrogen oxide; vapours of fuel and lubricating oils, and such physical

parameters, such as temperature; relative air humidity; pressure; speed of change of barometric pressure and speed of moving on the aircraft in the cockpit corresponds to the sanitary-hygienic terms of norms of flight worthiness and guarantees the security of life activity of the crew and passengers on the aircraft all over the world, according to requirements ICAO.

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THE ROLE AND IMPORTANCE OF UAV WITHIN THE ACTUAL THEATERS OF OPERATIONS

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***Abstract**: The actual theaters of operations are not limited only to the battlefield, but they are more diversified, thus we can mention fighting against the international terrorism phenomenon, the social conflicts (of religious, political, economical and separatist nature) within some countries of the world, supplying some political-military conflicts within different states and areas on the globe. The armed interference must be done based on some highly accurate information that must be gathered without endangering the human lives. This is the role the unmanned air vehicles (UAVs) presently play; they can perform both the function of surveillance, information gathering, data storage and their transmission to the ground stations, and the function of interference, when needed. This paper presents, within the above context, the status of the actual theaters of operations and of the UAVs that perform different missions within these theaters, together with their role and importance in performing the battle actions.*

***Keywords**: UAV, theater of operations, conflict zone, intelligence, surveillance, reconnaissance.*

1. INTRODUCTION

The unmanned air vehicles (UAV) have reached an unprecedented level of development and distribution and in the next two decades they will probably take the lead on the battlefield. From a strategic point of view, USA have issued a long term development plan since 1997, which they have subsequently upgraded, thus we can now speak about a UAVs hierarchy depending on the destination, action area, intervention means within the battlefield and the conventional echelon that operates them.

If in the first Gulf war a single UAV had been used, eight years later their number reached three vehicles used by the allied forces in Iraq, especially for aerial research and surveillance {7}. Initially, in Afghanistan there have also been used three UAVs, the essential difference being that there the first RQ-1 Predator (Fig.1) had been used, having been engaged in battle missions, together with data gathering or surveillance missions.

After an analysis developed at the American army level, there have been determined that in the year 2006, 46 percent of the UAV-related capacity requirements have not been accomplished, especially in what concerns the location of the ground targets and leading the precision attacks on these targets.

Fig. 1 RQ-1 Predator Unmanned Air Vehicle

The purpose of this paper is to review the unmanned air vehicles, the status of the technological development in the field (especially in the European Union country members) and to present the role and importance of UAVs within the current theaters of operations, as well as the

capabilities this type of airplane may have, through the comparison between the strategic mission and the current technological level.

2. THE CONFLICT AND WAR ZONES STATUS AND DISTRIBUTION AREA

We can talk about [1, 2, 3]:

a) "major" current wars and conflicts, defined as those where the victims number overcomes a few thousands of people and in which at least one nation is involved (internal wars or conflicts), or at least two nations (international conflicts), and/or have the capability to generate a multi-national regional conflict;

b) "minor" wars and conflicts, which have a relatively low impact on the world or the region they take place. Generally speaking, these conflicts may cause at most 1000 victims, they involve one nation (internal conflict) or two nations at least (international conflict), and they do not have the capability to provoke multinational regional conflicts;

c) recently ceased or suspended wars and conflicts – those where the fire have been ceased, a peace treaty was signed or a permanent hostilities ceasing took place. Many of these conflicts may easily be resumed. Mainly these are conflicts that remain at this level for at least ten years;

d) major acts of terrorism – a category that is still not completed, but that develops in the form of major acts of terrorism across all continents. These attacks are staged either by some countries, or by terrorist organizations.

In the first category we have: the Afghanistan war, the Israeli-Palestinian conflict, which may degenerate into an international conflict; the Algerian civil war, started in 1992 and still developing; the Basque separatist conflict, started in 1958 and still active; the civil war in Burma (Myanmar), started in 1948; the civil war in Burundi, started in the year 1994; the Colombian civil war, started in the year 1964; the second Congolese war (considered to be a regional war), started in the year 1998, when the Congolese rebels, backed by Rwanda, Uganda and Burundi, tried to overthrow the president, which was supported by the rebels in the above three countries, together with the armies of Angola, Zimbabwe and Namibia. The estimated number of deaths in this war is over 1 million people, mostly civilians. We may continue with the second war in Chechnya, the war in the Gaza Strip, the war in the no-flight area (the Iraq coalition conflict), the Israeli attacks on the Syrian forces in Lebanon (high risk of developing into a regional war), the civil war in Cote d'Ivoire, the Kashmir conflict (high risk of regional war), the Liberian civil war, the civil war in Nepal (1996-present), the conflict in the Northern Lebanon (2007), the conflict in the Northern Ireland (1969 – present), the conflicts in Philippines (the Moslem rebellion (1969-present) and the rebellion of the new popular army (1969 – present)), the civil war in Rwanda (1994-present), the civil war in Sri-Lanka (1983 – present), the civil war in Sudan (1983 – present) and others, presented on the planiglobe in Fig. 2.

Within the category of "minor" current conflicts and wars, we mention: the independence war in Bougainville started in 1989 and currently developing, the separatist war in Cabinda (Angola), started in 1984 and ongoing, the border conflict between Chad and the South-African Republic, started in 2002, the Hmong insurrection in Laos started in the year 1975 and ongoing, the minor wars in India (Naga rebellion, Mizo rebellion, Naxalite guerilla warfare, Tripura, Assam, Bodo rebellions), the minor wars within the Indonesian zone (West Papua rebellion, Aceh rebellion, the ethnic violence in Ambon, the sectarian violence in Sulawesi) and many others that are also represented on the planiglobe in Fig. 2.

Among the wars or conflicts in the c) category, we may include: the civil war in Angola (1975-2002), the civil war in Cambodgia, the civil war in Congo-Brazaville (1997-2000), the civil war in Fiji, the Kosovo war (1998-1999), the Israeli occupation of the South Lebanon (1998-2000). We may add to these the wars and conflicts represented on the world map in Fig. 2.

Within the d) category of the major acts of terrorism, we may note: the terrorist attack on the United States in the year 2001, the attack on the Israeli tourists from Kenya (November

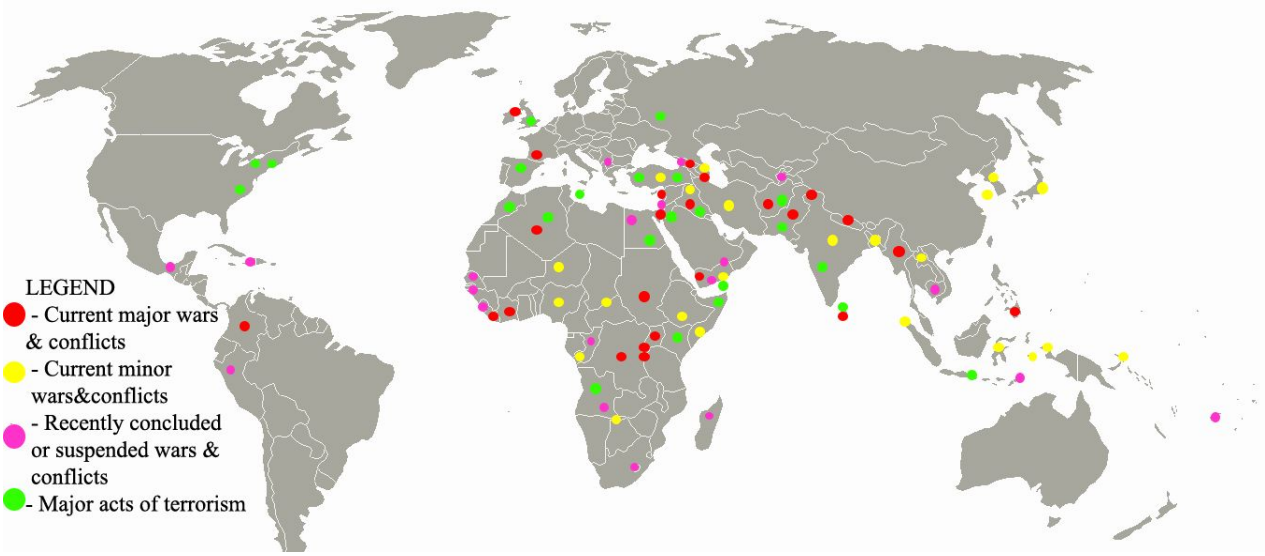

Fig. 2. Map of conflicts and war zones

28th, 2002), the bomb attack in Bali (October 12th, 2002), the bomb attack on a synagogue in Tunisia (April 11th, 2002), the terrorist attack in the capital of Spain of March 11th, 2004, when 121 persons were killed, the terrorist attacks from the London public transportation, one on July 7th, 2005, when 56 persons were killed, out of which 4 terrorists, and the second on July 21st, 2005. All the above attacks were planned and executed by the terrorist organization Al-Qaeda. More recently, we may speak about the terrorist attacks on two subway stations in Moscow (March 29th, 2010).

In conclusion, in the first decade of the XXIth century, 23 "major" conflicts, 79 "minor" conflicts and 175 conflicts that may be included in the violent political category, took place and are still developing.

We tried to present this situation to form an opinion about how important the UAVs existence and operation may be for preventing and combating the military or civil conflicts, whose victims are many innocent persons.

3. THE ROLE OF UAV WITHIN THE THEATERS OF OPERATIONS

UAVs are designed and manufactured depending on their mission and they may perform one of the following roles [5, 6, 11]:

- **surveillance** representing a monitoring process of the humans', objects' or processes' behavior, to be compared to the expected or required norms (for example, detecting some nuclear, biological or chemical activities or phenomena);
- **intelligence** considered to be a military branch of knowledge, which concentrates upon the gathering, analysis, protection and the dissemination of the information about the enemy, field and weather in the military operations area or within the area of interest;
- **reconnaissance** having the purpose of inspecting or scanning an area to gather information;
- **communications,** in which case they can perform units connecting missions, including the connection to the higher command structures;
- **insertion** for the load delivery within specific target areas. For military purposes, we can talk about weapons airdropping (not necessarily lethal) and that could also include electronic war actions and target destruction actions. The electronic war actions may have two features: the attack against the enemy, for the electromagnetic jamming or by high energy weapons bombing of the convoys, and the protection of their own and allied communications, equipments or objectives;
- **target** represented by a UAV that can be used to simulate a fighter aircraft or a missile in the following purposes:
  - operators' training, in this case being considered as a **practice target**;

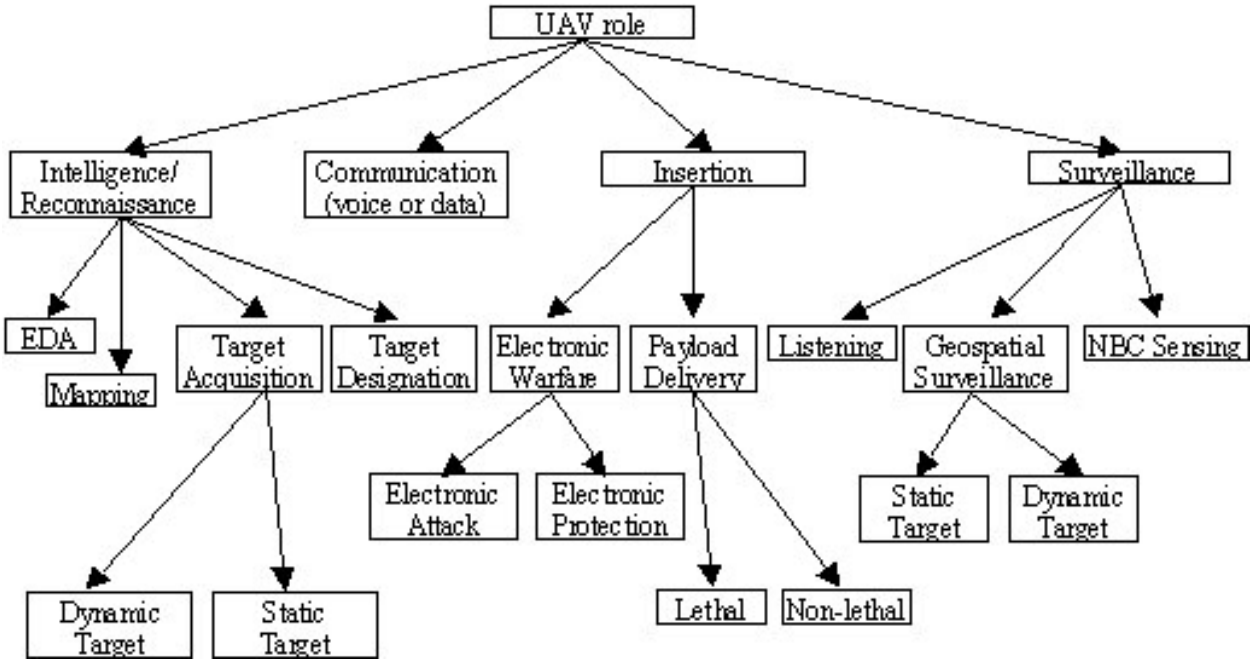

Fig. 3 The role of the UAVs within the armed conflicts

- the imitation of any kind of a person, object, phenomenon to mislead the enemy surveillance devices or the enemy report, in this case the UAV being used as **bait.**

In Figure 3 we present, in a simplified diagram, the roles of the UAVs used in the armed conflicts, regardless their nature, as they have been defined in the previous sub-chapter.

A UAV could certainly perform one or more of the above mentioned roles [5].

UAVs could be classified depending on the action range /altitude and as agreed upon within some industry events, in [4]:

- **handheld UAV** – 600 m altitude and about 5 km action range;
- **close range UAV** – 1500 m altitude and about 10 km action range;
- **NATO** – 3000 m altitude and the action range of about 50 km;
- **tactical** (TUAV) – 5500 m altitude and about 160 km action range;
- **MALE** (**M**edium **A**ltitude, **L**ong **E**ndurance) – up to 9000 m altitude and about 200 km action range;
- **HALE** (**H**igh **A**ltitude, **L**ong **E**ndurance) – above 9000 m altitude and unlimited action range;
- **HYPERSONIC** – high speed, supersonic (1 – 5 Mach) or hypersonic (above 5 Mach), flight altitude of more than 15200 m or sub-orbital altitude, having the action range of more than 200 km.

In Table 1 there are a few examples of currently used UAVs, to fit on the above classification and their main features [8].

All UAVs in Table 1, except for EuroHawk and the hypersonic UAV, which is still in the development stage, have participated to actions within the war theaters in Afghanistan, Iraq, Kosovo and to peacekeeping operations in some of the conflicts mentioned in the paragraph 2.

The UAV role has become a very important one. In the year 2005 alone, on the tactical level, UAVs have performed over 100.000 flight hours in the peacekeeping operations and the Iraq operations. Using the UAV within the fight no longer represents a formality, as they perform, together with the intelligence, surveillance and reconnaissance missions, the electronic attack, missions of impact, neutralization and/or destruction of the enemy anti-aircraft means, the communication and traffic junctions and networks, aerial research and even rescue missions, with all their versions. These UAVs cost from several thousand to tens of millions of dollars, and their weight is between several hundred grams and about 15.000 kg.

Table 1 UAVs currently used in the conflict zones

Name/ Country	Picture	Altitude (m)/ Range (km)	Role	Weight (kg)/ Length (m)/ Span(m)
Handheld UAV				
Carolo P50/ Germany		-/ 0.45	Surveillance	0.55/ -/ 0.49
Close range UAV				
Tracker/ France		2500/ 10	Reconnaissance	8.2/ 1.4/ 3.3
Raven B/ USA		305/ 10	Surveillance Reconnaissance Target acquisition	1.9/ 1.09/ 1.3
NATO				
PHOENIX/ Great Britain		2700/ 50	Surveillance	175/ 3.8/ 5.5
Tactical UAV				
Sperwer B/ France		6100/ 2000	Ground attack Target illumination Shooting correction	375/ 3.5/ 6.8
Shadow 600/ USA		4877/ 200		265/ 4.88/ 6.7
Medium altitude, high endurance (MALE)				
Predator A/ USA		7620/ 3704	Ground attack Reconnaissance and surveillance Target scanning, accompanying and acquisition	1020/ 8.22/ 14.8

HERON TP/ Israel		10000/ 350	Target acquisition Shooting correction Intelligence Surveillance	1150/ 8.5/ 10.6
High altitude, high endurance (HALE)				
EuroHawk/ EADS		19800/ 22236	Ground attack Reconnaissance and providing the connection between the military commanders and the real battlefield on a wide geographical area. Detection, location, reconnaissance, accompanying and identification of different ships	11612/ 13.5/ 35.4
Global Hawk/ USA		19812/ 22224	Ground attack Borders surveillance Intelligence Reconnaissance	11612/ 13.5/ 35.4
Hypersonic				
X-43A/ USA		30480/ 2235 m/s (6.57 Mach)		-/ 3.66/ -

4. TECHNOLOGICAL DEVELOPMENTS AND THEIR EFFECT ON THE BATTLEFIELD

The purpose of the technological developments is that UAVs to become almost completely autonomous and independent from the ground-made decisions.

The system must replace the pilot in what concerns the maneuvering, memory, logics, adjustment to new situations capabilities and his capacity to use the lessons learned during the previous missions.

This especially requires the development of the CPUs size and capacity, of the communication capacity and their connections for data transfer [10].

It is necessary the improvement of the high range sensors, which would allow the UAVs to reach removed targets and would provide the

capacity to keep its position in a certain sector. For this reason the improvement of the engines, aerodynamics and refueling during the flight is necessary [7].

Less important, but a major challenge for the industry, is the need and capacity to reload the onboard weapons systems with ammunition.

Here are some of the practical examples that will be the base for the technological development [9]:

- in the period between 2010-2015, there will be algorithms and processors that will allow the automatic recognition of a wide range of military vehicles;
- within 2025-2030 it is expected that the speed and memory of these processors to be equal to those of a human and the computers to be small enough to be used on a military UAV.

At large, these technological improvements mean that:

- in the next few years, the UAVs will be able to react to the technological faults, to the various flight conditions and to establishing the route during the flight;
- in the period 2010-2015, they will be able to participate to ground attack missions on the enemy territory;
- in the period 2025-2030, they will be able to participate to more complex missions, like the aerial transport and the missions that will simultaneously incorporate ground attacks and anti-aircraft operations.

This trend is already reflected by decreasing the electronic parts, which offers the capacity to switch from a large platform to a smaller one.

As a consequence, in the next twenty years, UAVs will begin to replace the fighter aircrafts.

This will obviously affect the battlefield, both for the users and for the future enemies.

The first positive aspect on the battlefield will be the reduction, or even the extinction of the current limitations of the airborne weapons. This includes the observation over a given sector, the reliability of the airbases, the high cost of the specialized aircrafts and the sensitivity to extreme meteorological conditions.

In the case of observation over a given sector, the commander's role is greatly simplified, as he doesn't have to worry about the rest of the crew, the time spent on alert on the ground or in-flight by a combat air patrol, waiting for an enemy which might never show up.

Finally, according to Moore's law, the increased costs of the specialized fighter aircrafts, both for their purchasing and for their operation, shall be decreased by lowering the cost of each and every UAV.

This shall affect the operational supply chain. There will be fewer sorties to plan to obtain the same effect, which will affect the ground support, as well as the optimization of the time required for maintenance. There will also be smaller quantities of material, especially fuel, to handle.

The air coordination and control shall benefit with respect to a reduced demand of the program, the routes, avoiding the forbidden sectors, the flight levels estimation, etc.

Because of their computers, the UAVs shall follow some accurately programmed or re-programmed instructions, which will lead to a better performance.

Finally, regarding the human resources, not only the flight crews will be exempted from the major operational commitments, but also the whole combat system. Each UAV needs less personnel for its operation and support.

The result is that, purely quantitatively speaking, the number of targets for the enemy to hit is greatly reduced. There will be neither a large concentration of fuel, nor big shelters, nor landing tracks. It will not be easy for the enemy to find the gravity center that he should aim for, because the targets will be dispersed all over the battlefield.

5. CONCLUSIONS

1. UAVs could replace the piloted fighter aircrafts in every operational mission, from reconnaissance and combat to refueling and transport. Their importance will increase together with the technological developments to be accomplished in the next 20 years [12].

2. In the last decades of the 20th century and within the main military operations of this

century, from Afghanistan and Iraq, UAVs have played an important role, and they have already replaced the piloted aircrafts in certain situations. That indicates not only that the rate of replacement will be even greater in the future, but also that current and future technological advances in the field of artificial intelligence will allow UAVs to be automated and to be used in any situation.

3. The use of highly sophisticated and accurate systems in combat missions will bring a series of advantages to the air commander who leads them, especially if he must face an enemy who has the same systems.

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CONCEPT, CLASSIFICATION AND ENHANCEMENT FACTORS OF SOCIAL CRISIS

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Abstract *: For the purpose of this paper, we considered relevant the analysis of social crisis from a conceptual level in terms of enhancement factors in the context of actual or potential threats.*

The crisis are events characterized by low probability and important consequences that threaten an organization in its deepest purposes. The time for action in this case is short. And the answer is composed of a set of conditioned responses, regarding as primary objectives: reducing and controling the specific means of corecion that can be used in the violent conflicts, blocking violence, reducing tensions, hostilities freezing, solving the political disputes, the creation of non-violent means for resolving the crisis.

For efficient managing of a social crisis only the effective information processors can take decisions, in a scientific manner, in orderto realise the targets by using some defined management techniques, individualized and structured from social peacetime.

Keywords: *social crisis, potential threats, management of crisis*

INTRODUCTION

In the context of current geopolitical and geostrategic situation nations are no longer concerned about the danger of aggression but rather preoccupied about large tensions and antagonisms and disputes arising from ethnic conflicts, terrorism and organized crime, the proliferation of weapons, unauthorized migration and economic disputes.

The shape that addresses serious problems facing mankind today implies the existence of a global vision, which integrates social trends, economic, military and environmental, taking into consideration all factors in assessing a political and strategic logic. Of course, to prevent these hazards and reduce enhancement factors and risks that may occur, it is necessary to maintain an effective response capability and a steady state level, regionally and globally.

To the threats of "niche" type insurgent autonomist, ethnic violence, fundamentalist jihads, separatist wars, urban guerrilla and rural crisis such as terrorist policy must respond to active involvement, even with military means [1]. Gulf War and Civil War Serbia-Kosovo, initially described with the term crisis or conflict, have shattered the initial state of euphoria peaceful period following the Cold War and turned into an open war, which continued a period of time, causing huge material damage and many casualties. The same thing happened in Iraq, Lebanon and more recently in Afghanistan. Knowing the causes of crisis must include all forms of manifestation of their analysis, impartial and appreciating it as accurately as possible, without bias or emotion, regarding the share of each type of contradictory economic, political, legal, ethnic, religious within those situations.

Crisis prevention has become a key concept in the debate until the new structure of peace and security in Europe. Theater of war in former Yugoslavia has shown us that Europe is not sufficiently prepared to handle crises that may occur within it. Despite the widespread opinion that it must urgently improve procedures for crisis prevention, the idea remains a sensitive issue and is not exempted from criticism.

The reservations expressed no concern of his goals but how to put it into practice. Some critics include those who tend to associate the ideas of crisis prevention and management associated with the establishment of a system

of collective security. They were concerned not only about the feasible extent of such a system, but also about the extent to which it is desired; there is fear involved in a war. These fears are added concern for the loss of national sovereignty. Those who make these criticisms do not expect the realization of the conditions involving the creation and effective functioning of a security structure. They reckon that the moral improvement in the political climate is, for now, far from being developed enough for a collective security system to operate successfully. Own national interests are still far from being located on the same plane with the concept of welfare and stability of the international community. Lately, the idea that a multipolar system with a larger number of crises is more unstable than one bipolar, is increasingly conveing.

Crises were a dynamic, in most cases, so fast that sometimes they run out of control. In the first decade of XXI century, the most dangerous crisis such as international terrorism, economic crises, social, political and likely will further cause serious disturbances of public order. Specifically, they could be the following: acts of terrorism of all kinds; separatist actions;-diversionary terrorist actions, sabotage, blocking civil or military, tract of land transport, shipping, rail and strategic communications, system national power; actions that are meant to destabilize the rule of law.

2. SOCIAL CRISIS MANAGEMENT

Among the most important factors boosting the social crisis we call politics, fraudulent appropriation of socially produced wealth and disrupting the violent forms of power relationships.

a) politics

The original source of any social crisis is politics, since it is the most obvious sign of disaggregation politic social system [2].

Politics alter the nation's productive function, also the ability to produce products and use resources according to the needs of people, organizations and communities.

Economic crisis, the consequence of actions politics, social processes generate dysfunctions, bringing to the surface incompatibilities between people and paving the political class and socio-political interests clash, threatening the social integration of people.

Management office politics destroys the nation, also the organizations with management functions, the rationality of the state, which is transformed into a "powerhouse" or an obedient to another center of power. Politicians are not able to process social information and political decisions, one-sided and partisan social processes generate dysfunctional, with consequences Crushers. They have a proverbial fear from the nation's military power, because social order deprives them of any opportunities to acquire wealth produced through social violence [3].

Politics – which are the expression of ideologies involved in crisis management (governance) the social - distort the political action, radicalise social action and cause tensions and conflicts. The actions of aggressive or ineffective politicians divide the nations into parties, contributing to the emergence of tiny parties, aggressive, which determined the trend of strong measures parties, parties that are assuming the exclusive role as the sole alternative, some parties maintaing the incompatibilities between the ideologies that build political power.

Politics generate the most favorable environment for the appearance of coups (different kinds). They are initiated, usually, from the top – by the politicians wich are hostile to the political power, with the help of the obedient political elites or even lower up by professional bodies (unions), supported mostly by opposition politicians and by the military .

b) fraudulent misappropriation of wealth produced socially

The inefficient or violent ways of managing social needs create critical situations for a nation in a context where politics control economics [4]. In this case, the keys of the economy (resources) are controlled by the government people that are driven by violent

or ineffective ideologies, which sends the economics into chaos [5].

The ways in which policy-makers manage economics create two overlapping countries: over, the legally country – meaning the socio-political groups that have the law and the strength - and the real country - meaning professional bodies, which produce and are deprived of resources. In both cases, in order to require political decisions, there are induced increasing doses of authoritarianism, it means that the constraint the rule and the freedom becomes an exception.

These situations generate tension against power or lower violence, defined as mass violence. It is individualized by riots or revolution and designed by the political power "reform" or overthrow the "old order". The rebellion and revolution are types of violence which are involving large masses of people and express in the highest degree, the existence of a social crisis.

The history of so-called revolution reveals that the masses are controllable, can be integrated under the control of hostile political power forces or can be changed into maneuver mass. The mass violence generate other forms of violence that are marked by: the foreign interference in intern affairs, diversion-terrorist actions from political power or socio-political groups that fightg for its fall, grooming and information actions, challenges and attacks against the state institutions.

c) disrupting in violent forms of the power relationships

The balance of power is structured in violent ways in the context of ideologies crisis. So, it is the inability of the socio-political groups that have the power to manage the nation by social decisions.

The crisis of ideologies becomes the source of aggression that aims the community spirit, causing an identity crisis, correlated with a management crisis - or the legitimacy crisis of the political power. Such situations create problems-effect onto the self-consciousness of "subjects" and create a socio-cultural crises that endanger the social integration of people (socialization) within the organizations.

The most prone nations to the violent restructuring of power relations are those dominated by an exclusive ideology or by a corrupt and incompetent political power, which generates totalitarian regimes. In such cases the nation is split into parallel societies, one of which is considered normal (official) and the others that are defying it. The intervention of the armed forces for the management of critical situations is, in essence, a usurpation of the decision power, which is the prerogative of socio-political factor. The individualization of the power centers that generate crisis allows identification of the weak socio-political groups [6].

The violent ways of structuring relations of power create relations of power between political power and body's production of social values (the people). They reflect the confrontation between processors of information that can not overcome the ideological positions.

The violent relationships of power individualize different "power centers" - internal and external and generate different types of confrontation and structure a new type of management, political-military leadership.

The loss of power resources requires the political power to resort at violence, so-called top violence. It is peculiar to a political power that is seized by the political. This oligarchy centralises decision, brings the nation out of decision and requires models that can not support and maintain than by force. Thus, the armed forces (army, secret information structures of the state and forces of maintaining public order) are processed in the police force, by which political power set up terror. The violent destructuring of power relationships generate, usually, military confrontation [7], between different national centers of power - the horizontal confrontation or between the political power and other domestic centers of power - the vertical confrontation.

A violent political power determines the involvement of armed forces in managing such a situation, by the delegation of power, but also by usurpation of political power. The clearest imbalance form of the power

relationships is found at the nations that support the establishment of totalitarian regimes, dictatorships.

The armed forces become managers of power in a socio-political contexts that impose strength measures or when political forces are not able to manage the nation.

The military factor may determine the balance of power in situations where the military elites are obedient or support some groups which are faced to gain political power or access to power. The determination of these relationships is made by influence, blackmail, replacement or acquisition of the civil power by force or usurping the power by violence.

Also, it may arise *the potential risk situations* [8], that degenerate into a serious crisis of the social, economic or political system, with damage to the state security and national defense.

We list a few of them:

a) Settling of accounts between mafia camps that engage in conflict and other non-employed persons for that the confrontation with the security forces is a simply fun. The engaging of children in such conflicts complicates the activity of forces. The participation and other criminals elements, combined with the actions of internal and external hostile forces may result in destabilization of some areas;

b) Mass discontent citizens from insecurity which dominates today's society. The failure to provide the physical protection of citizens and private and public property, combined with the rising unemployment, may lead to a general feeling of dissatisfaction and a local tension, followed by a major crisis;

c) Dissatisfaction of pensioners, which do not receive welfare, increases the tensions that may degenerate into extensive action of protest;

d) Test of trade union leaders to manipulate public opinion by "poisoning" with information that incite to violence;

e) An intense campaign of denigration of union leaders, who can not be manipulated, with *the purpose to remove and replace them* from the management functions;

f) The transition in unemployment of a large numbers of workers from the main industrial centers without retraining programs and providing opportunities to absorb of a labor force part;

g) Protest actions with religious reason, caused by non-recognition of some religions or sects;

h) Claiming of accommodation between state and private institutions;

i) Tensions between the majority population and Gypsies, as a result of destruction of crops, theft of agricultural products, theft from vehicles and homes, organized commando actions and challenge the population;

j) Tensions between social groups, ethnic groups, religious and so on.

Management, an economic concept taken by military and then by politicians to be transplanted in social, it is used with the different meanings.

In the situation of social crisis, so the subject that is generator of crisis, explained by the formulation of old policy, as well as the subject involved in crisis management (individuals, groups, institutions), use according to the interests and needs, all of its primary meanings: handled, handling, guidance, leadership, management, negotiation, settlement [9].

The concept of management should be used to name the designed activities and accomplished systematically to prevent and, if occurring, to solve the critical situations. Both prevention as well as their solution requires the ability to conceive the social solution, the only viable for the assaulted nation. The interventions with other purposes (to calm the situation, to deter, to punish those who revolt), can not be considered management activities of the social crisis. This is a false management and can be justified only to win time.

The managing of a crisis is dependent on the social processing capacity of the information. The political power over which violence occurs or that use the violence is involved; third parties - which may be internal or external power centers, generating or producing aggression against political power and people - through the social elites. The

information processors can be identified as politics, politicians, military leaders, military elites, social elites. All are available the three resources of power - knowledge, wealth and violence, but not all can use at the same intensity [10].

Managing the social crisis is, first of all, knowledge, from which follows provisions and operations, in which each actor or subject involved imposes the limits of action areas. Both sides do not devise the actions (operations) and their consequences on the use of exceeding the limits of war. Relevant is the aggressiveness of individuals, especially managers and socio-political violence groups [11].

The management (crisis management) [12] requires using in the social solution of human and material resources in the purpose of solving the conflict. Management excludes threat or use of force, which result in decision errors, risks and human and materials losses. On this plan is shown the importance of leaders (or managers), whose mission is the design and implementation of social solutions by management strategies.

The management of the social crisis should avoid the use of military violence and to turn the crisis into a conflict of power. This action involves specialized action of organizations with management functions and to assume responsibility for the measures taken and the consequences produced.

In the management of social crisis should be involved, by management techniques well defined, individualized and structured from social peacetime, legislative and executive organizations built by the people, as an expression of its power (democracy).

The legislative organizations (parliament) and executive (government) involve the control of the activities from the so-called area of the public policy defense, directly or through specialized committees, adopts the necessary legislation to crisis, examines how to comply with this legislation, gives credit of executive power to take desirable measures, control institutions with responsibilities during crisis.

3. SUMMARY

Crises are events characterized by low probability and important consequences that threaten an organization in its deepest purposes. Because of their low probability, these events defy any interpretation and require an effort of understanding and adaptive responses. Thus, to resolve a crisis in progress requires simultaneously action, that generates the knowledge, but also affects the conduct of crisis [13].

Theoretically, the environment, in the context of a crisis, can be characterized by: mistrust; polarization of social and political differences; the use of weapons; conducting an action challenging or an sporadic action, unorganized, with a low level of violence; perception of their interests as incompatible; intergroup hostility; repression, insurgency, systematic violation of human rights; the decline in perception of legitimacy of national government; national mobilization and so on.

Time for action in this case is short. And the answer consists in a set of conditioned responses, regarding as primary objectives: reducing and controlling specific means of coercion that can be used in violent conflicts; blocking violence; reducing tensions, freezing the hostilities; solving the political disputes; creation of non-violent means to resolve the crisis.

These objectives can be achieved through the instruments such as diplomatic, military, economic, social and political adapted to each case.

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THE SOCIETAL SECURITY CONCEPT IN THE VIEW OF EUROPEAN UNION

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Abstract *: Society can not be reduced to a simple rational calculation, it isnt the sum of its parts and can not be reduced in individuals who compose it. Society is thus both an association and a community is an entity with its own identity.*

The problem of cultural or societal unity and diversity in a democratic society has always been an interesting topic, and often difficult to address, whatever of context. Although at first sight it seems a paradox, the idea of unity in diversity and diversity in unity, has its strengths, if we take into account the religious and social principles, that people gathered around the interest for the same ideals. The concept of unity that could create a proper enviroement the for expressions of diversity remains to be solved.

In terms of the reality of diversity in an area that tends to become an unitary European one, the concept of societal security acquires new connotations related to traditions, culture, ethnicity, language and religion.

Keywords*: identity of human collectivities, societal security, religion, culture*

1. INTRODUCTION

The security of the human collectivities may be affected, as shown by factors of 5 domains: social, political, economic, military and environmental. These domains are not separated completely, somewhat overlapping and being in interdependence.

The ability to maintain the societal security is an acceptable current of evolution, including the traditional elements of language, culture, identity, religion and cultural habits. Political security refers to the stability of states, government system and ideology that gives legimacy. Thus, the socio-political cohesion of a state becomes the most important and prominent criterion.

The source of basic concepts comes from defining the society as human entity that is created through a process of living together of individuals or group associations defined by common attributes and who expresse their common feelings (race, ethnicity, language, history, geography) of identity, tradition, symbols and values [1]. The societal security does not mean the national security or state security (only part of it) but rather individual security.

The concept of societal security appeared in the European security school in the 80‘s, during the debate on redefining security, initiated by institutions such as COPRI - *Cotenhagen Institute of Peace Research* – from Copenhagen. So, the concept is derived from the practice of European integration, it reflects the dominant non-military agenda of security on the European continent and it is an alternative, together with other concepts and notions of European school security, to the Anglo-Saxon (U.S.) school. "The organizing concept of societal sector is the identity. The societal insecurity exists when the communities, of any kind they may be, define a trend or a possibility as a threat to them as community entities“ [2].

The societal security is one of the five components of security and the general approach was accepted by NATO as the general definition (Rome 1991) and is included in the current Strategic Concept (Washington 1999). The leading theorists in defining security are representatives of European schools from Copenhagen (Barry Buzan, Ole Waever, Morten Kelstrup, Pierre Lemaitre, etc.). The society generally means a contractual association and the community that

formed the society is a moral union. The literature of Germany, the concepts of society and community emphasize this distinction.

Thus, a society can not be reduced to a simple rational calculation, it isn't the sum of it's parts and can not be reduced to the individuals part of it. The society is both an association and a community, it is an entity with its own identity. In this respect there are differentiations between societies in the sense that societal proportion is greater (such as Western societies) and societies where the dominant is the proportion of community. It follows that a nation is a community of feelings that will occur organically / appropriate in their own state borders, so it was thought that a nation is a community which normally tends to generate their own state.

This understanding has been suggested by the classics of modern social thought by a relationship that is as follows: society = nation = state.

The idea of state is the most abstract component of the model, but the most central. Strong reasons justify this priority, so that the nations are by far the most powerful type of states from the international system. The importance of nation for the idea of state is suggested by the *national* concept. Following modern usage, the nation is defined as a large group of people having in common the same cultural heritage and perhaps ethnic and cultural, racial. If the national territory and the state coincide, we look to the purpose of state in protecting and expressing the cultural independent existing entity - the nation will define much of the relationship between state and society.

For, otherwise, not always the states are build on the structure of a nation, while the society should not be confused at all times with the state.

Even in authoritarian societies, where the state absorbs the civil society to store "scrap" of social life outside the control of the state. If the state is part of society, a nation is a society more than the state, it is the "other" part. Thus, the society is an alternative to state and the ultimate source of its legitimacy [3].

The spokesmen of the European school proceed, in this way, the definition of the concept of societal security[1] as follows: if the nation is a community looking for the state one can not equate the nation's security with societal security, simply because the societal security concerns the security outside or within the state. The nation security would concern, in this case, to the polical security. But we include the sense of identity, community and morality, which is provided by the nation, in the societal society; if we reduce the security to the groups security, we operate a fragmentation of security, we proceed to discrimination in the sense that some groups would benefit over others; in return, if we reduce for security to the individual security - or the amount of individuals who compose it – we return to the nuclear expert security concept. The fact that all individuals of a society are safe, considered individually, does not mean that the society benefits by security.

In this case, we can say that societal security refers to that part left uncovered by the national security accepted for the purpose of national security and individual security. It follows that the state security that is obtained by military means, diplomatic or economic and the security of citizens that is obtained by police means must be supplemented by the security of the society, meaning the societal security.

In this case we have the following equalities:

- political security = national security;
- individual security = physical security of individuals;
- security = security societal morality.

In the light of those mentioned above, which are held in connection with security and national security in particular is that national security is what the states make of it, this is closely linked to national and international circumstances of the states and therefore, can be extremelly flexible [4].

[1] Waever, O., Buzan, B., Kelstrup, M., Lemaitre P., *Identity, Migration and the New Security in Europe Agenda,* St. Martin' s Press, New York, 1993, p. 25

2. THE FOUNDATIONS OF SOCIETAL SECURITY

In the meaning of European school the entire equation of the national security contains: the **political security** of that national community, defined in terms of ethnic or civic, **individual security,** defined as meaning of the physical security of individuals, goods and their property and **societal security,** defined in the meaning of preservation of the moral foundations of the state and nation.

The societal security is defined, within the meaning of European school, outside the state, but can not be defined outside the nation. To understand the link between societal security and the nation, the nation's two main meanings, the *civic nation* (French) and the *ethnic nation* (German), it must be linked with the alternative theories regarding the nation, the nationalism and the ethnicity. According to the modernist vision (the constructivist point of view, represented by Ernest Gellner, Benedict Anderson and Anthony Giddens), the nations are constructed phenomena; they are all, a transient historical phenomenons that occurred in eighteenth and nineteenth centuries, and disappeared two centuries later [5]. According to the *primordialist* view (the perennialist point of view, promoted by the authors as Anthony D. Smith and Ilie Badescu), the nations are perennial bodies innate form of protonations, they are perennial realities of humanity and mainly, along with religion, they are a definition of identity [6].

The societal security is taking into account more defining components:

- the nation is a population that occupies an historical territory, it has myths and collective historical memories, a mass public culture, a common economy and a legal system of common rights and obligations for all members;

– the nationalism is a "political action", a program, a polical initiative which has the principle objective the creation of a nation, the protection against a threat or risk or simply a political mobilization to an objective that is considered "national";

– the ethnicity is defined as a subset of the nation, as a precursor to the nation or as a competitor or an alternative to it;

– the ethnic minority is defined as subset, precursor and nation competitor. The relationship *national majority - ethnicity minority* is relevant for societal security in terms of identity and of latent or manifest conflict between majority and minority;

– the national political identity nature or civic, within the meaning of the French Revolution;

– the cultural identity is an organic, ethnic, within the meaning of German romanticism.

EU has to include the religion in its institutional dimension. By ignor it, it only challenges the key aspects of its citizens life. It is required to enter into formal dialogue with churches and religious communities and take into account more than before what is religion itself. The Union can not simply take one of the existing systems. It necessarily requires a pragmatic solution to problems arising at this level [7].

As an "European culture" can not occur properly without the religious feeling, the problems will increase in an attempt to place near the religious the cultural elements and vice versa, since the two aspects are mostly used to manifest in a particular frame, and a certain change would likely lead to a loss of authenticity and value. In this context, we could talk about a common cultural Europe, but in terms of the reality acceptance in all European countries.

It requires training for some well-intentioned personnel in the interreligious dialogue problematic just to inform the ordinary people, to promote acceptance and integration of him in any new living environment.

What is missing is actually good will for the near us, things which no one can yet teach each person in Europe by the mere meetings of representatives from different fields. These should be extrapolated to most people for these whom these meetings take place, because in fact what matters is the reaction of the majority. Unfortunately, the model of contemporary society seems to promote more and more, an individualism, an egoism without

limits, that is leading to removal of the majority interest. The individual is currently becoming more concerned by the many opportunities to spend life and not a common one that could solve, in time, many problems.

As an expression that summarizes the human experience, the culture is involved in all the concrete forms of social existence, in all the mechanisms and key events that defines the society. As a result, the reporting culture to the structures of society is a requirement for understanding its value contents and to explain the functional mechanisms that ensure its historical development. In evolution, a human community can not exist without culture because it mediates the society‘s relationship with the natural world.

In an aspiring unit context, the problem of cultural unity and diversity or societal has always been an interesting topic, and often difficult to address, regardless of climate. This was accentuated even more in the democratic society, that is encouraging the private spirit, it is hard to maintain, by law, some constructive order to break the limits and borders between people. Although at first sight, it seems to be a paradox, the idea of unity in diversity and diversity in unity, it has its strengths, if we take into account of the religious and social principles, that people gathered around interest for the same ideals.

Undoubtedly, the diversity of ideas, personalities, the human feelings can not be questioned regardless of time or space. It remains to solve the concept of unity that could create a conducive climate for good manifestations of diversity. This was tried for centuries, but contemporary seems to focus ever more on this goal taking into account or not all cultural, social , religious or economic aspects.

The national cultures have a natural opening to universal, to dialogue and to values exchange with other cultures and spiritual spaces. The modern and contemporary ages have increased the communication of social values and the communication between cultures, with the extraordinary expansion of media system, such that the cultural interferences, the connections and the value exchanges have become the dominant realities today. On a cultural level, the contemporary world reproduces the structural report between unity and diversity, the cultures interfer and communicate with each others. This supports the specificity and warns us that "no part of humanity holds an applicable formula which is valid to entire humanity and that the amalgamation of a unique kind of life is unthinkable, as it would be an ossified humanity [8].

The different cultures that are brought face to face today, are in a mutual dependence, engaged in a common context that extends to a world scale. The discussions around the idea of European culture born the necesity for clarifications about the reality of diversity in an area that tends to become a European unit. We must bear in mind that the two issues kept each its value in trying to adapt to the actual requirements. Thus, the unity is necessar valid, the diversity is creative, the unity must be a real framework to show, the diversity stands out not but streaks in history, the unity is logical because it falls well defined principles, the diversity is a historical reality that can not be ignored.

We are witnessing a coexistence of different values and ways of thinking, of cultural and educational practices, to a joint mosaic of ideas and styles, which often arises the idea of multiculturalism.

It is therefore normally that in the social and cultural framework one should take into account necessarily the value criterion that can facilitate the strengthening of relations between people and more so, the principles of truth and justice that would see such in full action. In fact, the value is "the ideal expression of an agreement between myself and the world, which can be achieved anytime“ [9]. What matters is how it is established and garanted the value as a principle and a reality.

Although apparently contradictory, the unity and diversity are two inseparable aspects of human and thus the two poles where the culture is moving. Given this, the term of culture, with all that includes it should be written with the same entitlement to singular and plural [10].

In terms of unity and diversity, the culture includes a complex set of related institutions and media, around which is organized the cultural life and values enter in the social space. Among the most important institutions that mediate the relationship between culture and society we have to mention: the system of education, the scientific research institutes, the mass media, the libraries, the museums and so on. They are forms by which culture is socialized by exercising all its functions.

Therefore, the culture has an obvious existential function; *a society can not exist without culture. In it are encoded the human relations with the transcendence, wirh the history, nature, society, with others; through culture the man knows the world, knows itself and sets its goals; the culture responds to the individual and social needs.*

The crop diversity has not a direct correlation to the biological diversity of individuals, but in different social forms of ethnic groups. The geographical, sociological and historical circumstances, factors that are related to the internal aspect of a community and society, the particular form that the issue/object report takes in the existence of community, are generally speaking, the areas and plans that explain the cultural diversity.

In the social life, the human creativity developed in different ways, under specified conditions, under an indefinite range of factors. Therefore, the different cultures reflect the different ways for expression of the human condition.

3. SOME CONCLUSIONS

Any definition of culture will have an explicit reference to the societal, historical, the cultural defins the lifestyle of a people, viewed as a system of attitudes, values, ideas, behavior and institutions [11]. In this theoretically and practically mechanism, the exhibiting diversity should aim to create a coherent framework to support the cultural values regardless of conditions. Only in this way it can lead to a social and economic uniformity, wich requires created by the each society forces and not imposed or copied.

The near sudden and maybe forced closeness of some different values and cultural elements will not remain without consequences. The ethno-cultural conflicts may arise due to traditional differences in language, ethnicity, religion and so on. As actual Europe's image is presented to us, this problematic is actually the most important point in trying to create a peaceful atmosphere in this territory.

No doubt, the liberal arguments of democracy provide through law an equal protection of individuals, but this can not solve almost too early, all the issues related to traditions, culture, ethnicity, language, religion.

The logic of democracy suggests that the individual, rather than collectives, is subject to legal protection and political participation. The democratic theory argues that if there are ethnic and religious conflicts, they can be easily solved if the principles of political organization system raises tolerance and national unity beyond ethnic and religious privileges. So a robust liberal democracy may be one of the strongest defenses in the face of cultural conflict. However not all democracies are liberal and such systems can exacerbate the cultural conflict.

The liberalization and globalization may trigger a conflict when they are economically struggling and when they fall in a disproportionate manner to their distinct cultural groups. In conclusion, in certain circumstances, the economic liberalization can mitigate the cultural conflict.

In all these situations the most important thing is to encourage dialogue, regardless of the methods used for this purpose. That is why communication is the decisive factor in this integration process, because it leaves the reaching hope whatever the field considered.

The foundations of the human identity communities are the foundations of the societal security collectivities, but also the elements against whom the pressure may generate unsecurity and social instability.

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POSSIBLE AGGRESSIVE UNCONVENTIONAL ACTIONS AGAINST ROMANIA

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*New political and economical context has one common feature for the entire humanity: **insecurity**, on a **global scale**! Aggressive political and diplomatically actions against nations are commonly used. Romania, as a NATO border, is exposed to these actions due to its **geostrategic** importance (West Balkans and ex Russian border). This layout emphasizes on most common used methods of aggressive actions against a country. These actions takes place within local environment but also affect country's image and credibility outside border.*

*Ways of action and methods to fight against these threats are detailed in this paper. The author tries to draw attention on this very actual and **delicate** subject, due to the changing global situation and emphasize that in order to fight against this threat determination, professionalism and dedication is required.*
insecurity; global scale; geostrategic; delicate.

POSSIBLE AGGRESSIVE UNCONVENTIONAL ACTIONS

Unconventional aggressive actions are possible and can be used to create a distorted image of Romania and its reality. The cause is the development of some mass media organizations that through specific actions can affect vital centers of the national security or weaken population morale through roomers, mislead witch increase in satisfaction. Some nonconventional aggressive actions are: terrorism, uncontrolled spread of mass destruction weapons psychological aggression.

1. Terrorism

Terrorism definition is not an issue of consent between experts because of the cultural, political and social perception of the act of violence and political purpose of this act. A lot was written over this subject and over one hundred definitions were formulated. In this definitions some concepts are constantly appear: violence and force, political motivation, threat, terror, psychological effects, difference between objective and human looses, fear, coordinated actions, strategy, tactic. This phenomenon is characteristic to the asymmetric conflict and has appeared as a result of the desperate need to apply pressure over an entity (alliance, state, organization, minority, social group) with the purpose to convince the entity to comply with terrorist wish. Also terrorism is classified, in order to be better defined and explained. (Detailed in Appendix 6).

Officially, after The Second World War , Romania had no conflicts with other states, but in Security's archive specific documents were found containing information's about foreign extremist elements and terrorist organizations that intended to act on Romanian soil through terrorist means, Romanian and foreign objectives being targeted. That is why appeared the need to organize protection against these actions for objectives and Romanian or visiting officials. The experience of other states already confronting with the problem was used.

Between 1972- 1973, Internal Affair Ministry using own structures managed to prevent a series of events, already announced by leaders of some extremist and terrorist

organizations of the period (Black September, National Popular Front for Palestine's Liberation, Bader Meinhof, Red Japanese Army). One of the plans of the Black September, for example, was to occupy Israeli's Embassy from Bucharest. The plan was disabled by Romanian specific security structures.

In September 1974, four terrorist leaders arrived in Romania; main purpose was to organize the extermination of the president of the Mondale Jewish Congress who was officially visiting Romania. The action was also prevented by combining intelligence and close protection measures. At 24 of august 1974, two members of Bader Meinhof organization entered Romania to meet with a Palestinian leader of Black September. Due to the anti terrorist cell actions an important explosive quantity (guns, grenades, plastic explosives) was discovered hidden in the car they entered into the country. Group was expelled from the country and declared non grata persons. In 1976, the actions of no less than 22 foreign citizens with terrorist intentions were prevented. Sixteen of them were expulsed and six declared non grata persons.

An unussual situation occured when a Palestinian officiall, leader of National Popular Front for Palestine's Liberation, come to Romania to recrute members within palestinian's students and to organise terrorist actions. Through intelligence gathered resulted that Egypt, Iran and Israelly's Embassy were targeted together with officials from these countries. The intell revealed that the National Popular Front for Palestine's Liberation planned to execute five terrorist actions in Europe, one of them very possible in Romania by using a member of this organization arrived from Italy. The official was expulsed from the country and declared non-grata person. These kinds of actions were mixed with attempts to organize turbulent actions against Syria, during Lebanon crisis period and official visit of Hafez El Asad, Egypt, U.S.A. and Israel.

In the beginning of 1976 some intentions of the Romanian citizens to leave country illegally were observed. They used terrorist techniques: air hijacking, kidnapping of officials, breaking border, armed attacks, etc. Illustrative is the case of the "Arcasul" organization, formed of four persons that intended to get illegal weapons (by convincing army personnel to steal from own unit or attacking local police locations). The same type of actions having the purpose of living the country continued also in 1977. Therefore in February 1977 six men from Cluj planned to hijack Tarom flight on Cluj-Bucureşti route threatening the flight crew. The action was unfinished due to meteorological conditions and argues within the hijacker's group.

In May 1977, Bucharest Jordanian Embassy security forces managed to prevent the attempt of murder and robbery organized by two Romanian citizens against ambassador. The takeover of the Bucharest Embassy of Republic of Egypt at 19 of November 1977 by some Arab students demonstrated the necessity of creating specialized forces capable to reinforce order in attacked objectives. As a result some measures were adopted:

- the assembly, in Bucharest, of the special anti terrorist division under command of U.M. 0625/R.P.;
- assembly of Special Unit for Anti Terrorist Defencewich grouped entire forces (police, security), destined to guard and defence of the objectives targeted by terrorist organisations under unitar command to facilitate common training and equipment purchase;
- assembly of medical team group with specialised personell from Internal Affair Ministry;

All over the country, according with measures instituted for preventing terrorist actions (Odin no. 00650/1975 of the Interior Minister), intervention teams were formed with security and police personnel. Security Forces Headquarter established for every district the assembly of a cell, platoon size, specially trained and equipped ready to intervene if

situation needed for strengthens security and defense of the important objectives or effectively to fight against terrorist forces.

Besides the facts related before, we can count a series of possible terrorist actions headed against Romania as stipulated in "Law No. 535 from 25 of November 2004 regarding the prevention and fight of terrorism":

- qualified murder, murder in first degree, privation of freedom;
- destruction crimes;
- illegal possession and use of weapons and ammunition crimes, disobeying the rules of handling and use of nuclear and radioactive materials or explosives;
- producing, possession, transport, supplying or transferring to other persons directly or not of chemical or biological weapons or researching in this field and development of such weapons;
- the spread in atmosphere, soil or water of the substances, materials, products microorganisms or toxins that are able to jeopardize human/animal health or the environment;
- acquirement, manufacturing, producing or supplying of destructive means, toxins, microorganisms, or any other means capable to destroy or jeopardize human or animal health as well as environment;
- recruiting or training of terrorist cell in handling and use of fire arms, explosives, ammunitions, chemical, bacteriological, nuclear and biological weapons;
- ease of enter/exit in/from country, hosting of facilitating of the access in objective areas of persons known as affiliated to terrorist cells;
- executing Intel actions or keeping data and information in the purpose of use in terrorist actions;
- spread of ideas, conceptions or attitudes for supporting cause of terrorist actions;
- illegal actions like: fraud banking, money laundering, corruption, blackmail, drug traffic or other illegal actions having the purpose the rise of money to support terrorist actions;
- any other actions committed to support, ease, hide or determine a terrorist act.

For prevent and fight terrorism, Romania established a national system of prevention and fight known as "*SNPCT"* that includes a wide variety of public authorities and institutions (Annex 7) and has clear ways of actions in the case of any special situation. (Annex 8 if Annex 9). For prevention and fight against terrorist actions there are levels of execution: first level lies in political and diplomatically medium to facilitate a priority approach at the highest level and an effective attempt of solving the terrorist threat on diplomatically means, second level consists in preparing response reactions by an sustained effective and permanently upgraded Intel activity and the third level is action level.

In the case that a terrorist act is already developing Romanian Intelligence Office, independently or in cooperation with other structures from "*SNPCT"* will execute, after the approval of Advise the Chief of Defense, a counterterrorist action for stopping terrorist act.

Success key in preventing terrorism lies in international[1] cooperation between states and nongovernmental organizations (cultural, religious, etc.).

2. Cyber-terrorism

Along with the development and spread of the use of informatics system all over the world

[1] Silion Costică, „Determinări ale terorismului internațional asupra securității naționale", Gândirea militară românească nr. 2 / 2007.

in all domains, major attacks with critical effects appeared. New naming appeared: cybernetic espionage, cyber-weapons, cyber-war, cyber-criminality or cyber-terrorism. The lack of defense measures or cybernetic security when every domain has informatics support can lead to a major breech in every security dimensions.

Cybernetic attack represents an important informational threat in "virtual space" or cyber-space that affects the computed system. Virtual space consists of communication networks and computer networks that rely for functioning on the use of informatics product (software, protocols, data bases, electronic mail, etc) and on data transfer. Its main characteristic consists in an unseen development of interconnectivity through assures data transfer and processing on the long distance of information in computer networks offering also good conditions for an unauthorized access and information harming. As often as a connection is used as important and useful becomes for efficient function of any informatics system and as interesting becomes also for enemy the perspective of network neutralization. Specialists established three types of activity in cyber-space: activism, hacktivism and cyber terrorism. Activism represents the normal use, undisruptive, of the internet but in the support of possible aggressors in order to get information, creation of web sites and also the use of electronic mail to coordinate scheduled actions. Hacktivism is referring to instauration of the feeling of superiority, satisfaction and self achievement (hacking) along with activism that results in specific actions against targeted sites on the internet in order to cut their normal functioning, but without causing major destruction. The most decisive action in cyber space is achieved through cyber terrorism. Barry Colin was the first to define cybertrrorism in 1980 as the convergence point between cyberspace and terrorism. Lately, Mark Pollit (special agent for FBI) defined cyber terrorism as a premeditated attack, politically motivated, against information, computed systems, programs and data, being an attack against non combat targets executed by agents or groups.

As a result, cybernetic attack is mainly an attack against computer networks. Its weapons exploits vulnerability of the base programs and applications, especially those with long distance access, using also software components designed to produce damage. Also, the attack is directed against data transmitting, data bases and data access. Objectively, the internet can be considered as the main battlefield in cyberspace and that is why is targeted by all combatants.

Romania needs to pay more attention in the future to the importance of cyber space and probably to inspire from American model that established a national strategy of securing of cyber space following an system of priorities : a system of response in the case of perturbing of the informational traffic, a national program of reducing vulnerabilities and threats in this space, a national training program in protection of the cyber space, governmental communication security, international cooperation in cyber space domain.

3. The spread of mass destruction weapons

Mass destruction weapons are type of weapons that, if used can produce simultaneously, in a short period of time massive damage to army personnel, means of fighting, population, economical, political and military objectives. Nowadays this category includes nuclear, radiological, chemical and biological weapons.

The existence and spread of mass destruction weapons sadly become a cruel reality creating concern and insecurity, due to permanent threat that these weapons can be used.

Maintaining weapons of mass destruction (nuclear, radiological, chemical and biological) as means of promoting of political and strategically interests and factors of multiplication of the military power becomes sources of concern and suspicion, requiring decisive measures, opened and efficient of

preventing their use and, in the same time, of reducing their numbers and removal of the effect.

The N.B.C. component of the unconventional weapons, chemical terrorism, illegal and disguised commerce with nuclear materials and substances under law of "Convention for Forbidding Chemical Weapons", accidents by mistake of on purpose produced at economical objectives with N.B.C. risks, sites of ammunitions or nuclear waste are serious and continuous threats during peace time and also during crises and war.

Throughout Romanian's history first atack with mass distruction weapons took place at 17 of April 1917. It was a chemical atack executed by German Army against 1 st Mountain Rangers Regiment. Another atack was launched on 5 th of July against 24 th Artilery Regiment on a 3 km wide batleline in Costieni-Gârleşti-Moldoveni-Năмoloasa[2] area. Those attacks together with other attacks launched by German Army in July 1917 determined instauration of The Gas Department in Romanian Army.

Lately, due to major social movements around the world, and also to the spread of the organized crime networks the access to this type of weapons of groups that promote finances or support various forms of terrorism is much easier than we think.

Nuclear, chemical or biological war threat rose gradually due to the spread of this weapons, technological advance and "efficiency" in their use in military actions. In support of this idea general belief is that this kind of weapons will continue to be a threat for both troops and population regardless of region or the conflict level. Although greatest attention is focused on nuclear weapons, chemical and bacteriological weapons are, from lethality point of view, comparable with troops and civilians but much heavier to control and easier to obtain and handle even for non professionals. This is the cause a big risk to be used by terrorists still exists

4. Psychological threat

„Entire art of war is based on cheating"[3] - probably, this belief burned as a result of the lessons learned along five centuries and developed forms and methods of psychological influence used during peace time and also in war.

The objectives of psychological threat over Romania can result in:

- Create chaos and social disintegration;
- Discredit state authority, political figures and leaders;
- Neutralize the liasion capacity of members and social groups;
- Diminish reaction capacity over negative influence;

There are various methods of psichological influence: coruption, blackmail, compromise and intimidation. Ussually, these threats are the apanage of the esspionage groups acting in various desquises: inside agencies, institutions, diplomatic missions, asociations, "cultural" organisations, etc. All these covers appearently have onest activities without any conections to those pointed against state.

Main characteristics that turn psychological influence and special threat are[4]:

- It has only one way- negative. Through these actions enemy achieve an intense psychological pressure aiming victim's psychological failure, decrease of the resistance capacity, loose of the will of fight and finally capitulation and acceptance of the domination.

[2] Colonel (r) Gheorghe Florea Creangă STOILEŞTI, „Istoria Apărării Civile", Editura Porto Franco, 1993, pag.86.

[3] Sun-Tzu, „Arta războiului", Ed. Militară, Bucureşti, 1976, p.33.

[4] Lt. col. Constantin Hariuc, Protecția împotriva agresiunii psihologice, Ed. Militară, Bucureşti, 1994, p.28-29.

- The enemy is aiming the achievement of a radical change that can lead to surprise and a constant pressure over the target, eliminating its capacity of fighting back.

- Influence passes national border, comes from unknown sources and is beyond direct contact.

- most of influence sources do not decline their identity, and when they do uses informational manipulation, peoples deceiving, well organized;

- Intel over the victim is total.

A special domain is represented by psychological manipulation actions because of their unusual characteristic and the mystery they are embedded in, being able to induce some disorganization and fear of response. Taking into consideration the lack of knowledge in this field for most of the population and natural attraction for fabulous and unknown we can imagine unlimited possibilities if used.

As means of achievement of psychological influence mainly used is persuasion, roomer, misleading and manifest.

Protection against psychological threat is an issue for everybody, or with another words of each and every one of us. Protection against lie is , before all, a problem of personal will. It is needed that institutions and organisations with responsabilities in psychological assurance and national security, in general, to act of souch manner being able to protect national and military values of any challenges.

CONCLUSIONS

Military specialists, and not only, considers that the humanity entered in an age of strategic insecurity. This conclusion derives from the fact that previsions, even on a short term are almost impossible to be issued. Due to the globalization process that continues states feel threatened and tries to protect themselves or (and this is the case with countries of Alliance) to work together for protecting commune values of democracy, security and freedom. For Romania, near future is not easy to approach. Challenges of the new millennium can be overcome with efforts of political will, by assurance of a linear economical development and significant improvement of the military field. In the light of possible aggression there is a need of cooperation and solidarity from everybody involved in National Security System.

Nowadays, national security policy is changing because some phenomenon like terrorism, organized crime, border traffic of narcotics, persons or military equipment are rising. Other risks are relatively new in the area: interstate conflicts, degradation of the environment, refugees. But there is corruption that degrades democratic fundaments of the society and worse, affects states credibility abroad.

For oure country security and self defence are the same with Europe's security and esspecially with the south-east part where in almost ten years efforts of some organizations, initiatives and international mechanisms were concentrated with the same purpose: stability and assurance of democratic and prosper evolution. NATO is the most important alliance of the contemporary world and the process of European integration must take into account this fact. Efficiency and modernization of the European and transatlantic process must be Romania's priority.

Placed between two areas with high conflict potential (West Balkan area and ex soviet region), Romania should establish a strategy that has the main objective to reduce the mistrust between euro Atlantic space and ex-soviet region. In this context, Romania could share with NATO and UE, its previous experiences in this field. By establishing such a priority, Romania could participate efficiently at the dialog between NATO and UE structures and organizations between areas. Romanian participation could increase authority and credibility of the state in consolidating regional peace and stability with a powerful political accent.

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POSSIBLE AGGRESSIVE MILITARY ACTIONS AGAINST ROMANIA

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*New political and economical context has one common feature for the entire humanity: **insecurity**, on a **global scale**! Aggressive political and diplomatically actions against nations are commonly used. Romania, as a NATO border, is exposed to these actions due to its **geostrategic** importance (West Balkans and ex Russian border). This layout emphasizes on most common used methods of aggressive actions against a country. These actions takes place within local environment but also affect country's image and credibility outside border.*

*Ways of action and methods to fight against these threats are detailed in this paper. The author tries to draw attention on this very actual and **delicate** subject, due to the changing global situation and emphasize that in order to fight against this threat determination, professionalism and dedication is required.*

AGGRESSIVE MILITARY ACTIONS

Lately, Romania directed its military resources for reforming and achieving the goal of maintaining an operational level adequate for E.U. missions, according with the European security policy, and for N.A.T.O. and O.N.U. tasks. The reform of the military system depends on: development of the economy, resources, structural and conceptual adjustment, personnel cuts (which are not compensated by acquisition of new techniques or upgrades of the existing weapons systems). The main objective of the military field is the achievement of the full interoperability with partner countries within the Alliance. The efforts are refering to training, structures, logistic, also includes social status of the military personell and a good, balanced relationsheep between civilian and military organisations deriving from the NATO member statut. The main concern is that inability to achieve the assumed commitments within Alliance would lead to Romania's external discredit. The main issue is that this situation is highly possible due to limited funding, the halt of the acquisition programs and cuts in personnel incomes. Due to the current Euro Atlantic environment military aggression between states are less probable, at list in near future. This situation creates multiple reactions in nearby areas, especially in ex-Russia zone. Russia intends to straighten its position within its nearby zone and there is no easy thing due the dysfunctional democracy from these states. . Romania's stand is determinate by its position at the border of the euro-Atlantic space. Possible threats that may appear are determinate by political and diplomatically hustle, different interpretations of some international treaties, various ways of cutting access to the resources, etc. These threats would be most probable disguised as issues in bi-lateral diplomatic relations between states and would not be seen as attacks against NATO or EU. To avoid the use of the 5th Article from Washington Treaty the potential aggressor might disguise its actions as: flights on routes that intersect air space limits (that will require the alert of the QRA service), military applications nearby Romanian soil, re-activation of some military bases close to the border, RECCE missions or electronic counter actions. Most probably mass media will debate these actions and create an image of this possible aggressor with serious long term repercussions.

There is a list of the most possible threats:

- internally: consequences of the reform in military field, poor logistics, social issues and weakening of the readiness combat; the rise of some radical or nationalist groups, elements of paramilitary forces belonging to the minorities, secret societies; stealing of weapons, munitions and explosives (Ciorogarla case) as traffic with these items; the lack of coordination between institutions with roles in assuring security, safety and national defense due to the civilian control; misunderstanding of the defense system where our country is situated.
- externally: the achievement of some military alliances hostile to our country; possibility of regional conflicts due to some old unsolved issues; due to the objective situations Romania was forced to reduce or even drop the acquisition of new military technique which leads to accentuation of difference in military potential and quality.

From specialists point of view there are three situations when Romania can be the target of an military aggression:

1. Development of a crisis situation that can lead to military conflict. This situation may occur if several conditions are accomplished: : existence of an general tension, the aggressor's technological superiority, the achievement of all intermediary stages of emergency situation, structural adjustment of the Army and National Security System. Strategically surprise is highly improbable.

Here are some possible counter measures: early informational warning based on a good intelligence, good efficiency of the crisis management system, assurance of a good internal stability, excellent proficiency and specialization of security structures, good logistic, operational forces available, keeping the initiative.

2. Romanian state becomes the main target of the aggressor. The existence of an certain conditions like : existence of general tension, technological an strategically decal age, initiative on enemy side, plan adjustment on situation evolvement, " blitzkrieg" enemy actions, structural adjustment of the Army and National Security System, etc, turns into aggravated situation. Additional counter measures that must be immediately applied: permanent situational monitor and opportune adequate reactions in order to avoid "surprise", rational displacement of military structures, realistic counter action plans and planning , adequate response, establishment of defense alignments on most probable attack directions, permanent special ops, creation of powerful reserves, preventing the creation of hostile alliances.

3. Romanian state can become collateral target as a result of the involvment of colective participation in defending other state. In this case there are specific conditions: strategical surprise is highly immprobabile; conflict area includes also national borders; there is an multi national defence action for defending Romania's national space; the opportunity of angaging enemy from any direction of Alliance space; national potential is partially engaged in other operation theatre; infrastructure is prepared for conflict. Additional counter measures that must be immediately applied: establishment of a safety defense pack; assurance of protection for strategically objectives; creation of reserves troops; determined actions after the conflict is finished for achieving the political purpose of the conflict.

Military aggression was perceived as the main threat to the state security. It represents the brake of diplomatic relations and leads to heavy looses. In some states or alliances there are differences in military proportions. Military field has its own development dynamic and it is able to solve problems by the use of force. Because military capacity is a reality derived from the need of sustaining and promoting state interests abroad a signals generated by some states can be misunderstand. Fear of losing leads to competitions between states: upgrades of the military equipments, high training standards or acquisitions of new systems and equipments. Some conclusions regarding arming race can be drowen by monitoring PIB percents allocated by targeted states to military field. A significant allocation of resources can broke

strategic balance within area and threatening regional or even international security.

Romania's statute as a member of NATO implies that the threats against Alliance are in fact threats against Romania.

CONCLUSIONS

Military specialists, and not only, considers that the humanity entered in an age of strategic insecurity. This conclusion derives from the fact that previsions, even on a short term are almost impossible to be issued. Due to the globalization process that continues states feel threatened and tries to protect themselves or (and this is the case with countries of Alliance) to work together for protecting commune values of democracy, security and freedom. For Romania, near future is not easy to approach. Challenges of the new millennium can be overcome with efforts of political will, by assurance of a linear economical development and significant improvement of the military field. In the light of possible aggression there is a need of cooperation and solidarity from everybody involved in National Security System.

Nowadays, national security policy is changing because some phenomenon like terrorism, organized crime, border traffic of narcotics, persons or military equipment are rising. Other risks are relatively new in the area: interstate conflicts, degradation of the environment, refugees. But there is corruption that degrades democratic fundaments of the society and worse, affects states credibility abroad.

For oure country security and self defence are the same with Europe's security and esspecially with the south-east part where in almost ten years efforts of some organizations, initiatives and international mechanisms were concentrated with the same purpose: stability and assurance of democratic and prosper evolution. NATO is the most important alliance of the contemporary world and the process of European integration must take into account this fact. Efficiency and modernization of the European and transatlantic process must be Romania's priority.

Placed between two areas with high conflict potential (West Balkan area and ex soviet region), Romania should establish a strategy that has the main objective to reduce the mistrust between euro Atlantic space and ex-soviet region. In this context, Romania could share with NATO and UE, its previous experiences in this field. By establishing such a priority, Romania could participate efficiently at the dialog between NATO and UE structures and organizations between areas. Romanian participation could increase authority and credibility of the state in consolidating regional peace and stability with a powerful political accent.

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INTERRELATIONSHIPS IN BETWEEN AIR POWER, AIR SECURITY AND AIR SOVEREIGNTY

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***Abstract**: Air power is not yet understood at its true value. Even if it got to play an increasingly important role both in peacetime and in war, the concepts that define and govern the air power are poorly known to many people, even among the military experts. This situation is due mainly to fundamental differences of views regarding the fact that the emergence of the airplane as a fighting asset has changed not only the tactics of carrying out the warfare but also strategies". As a result of the creative imagination of visionary thinkers, the plane became an object of the hope for many enthusiasts who thought they finally found the key towards quick victories in war.[1]"*

Nowadays the concept of security goes far beyond the purely military dimension. The new targets are the people, the political symbols and the economic infrastructure. Threats to security and the challenges are much more complex, they are no longer interstate conflicts, the terrorism has emerged as a problem, so did the organized crime, illegal migration, economic instability but also threats to the environment. State actors have emerged in addition to those non-states or over the state ones.

The security studies Safety studies have expanded their research considering the emerging multitude of concepts clearer or less clearer emerging lately, but all having common analysis segments, in terms that define the capabilities and intentions of a state or of the non-state actors, vulnerabilities, risks, challenges and threats, in order to demonstrate that the Air Power is a tool and a guarantee in achieving the Air Security and Air Sovereignty.

***Key words**: Air Power, Air Security, Global Security, Air Supremacy, State actors.*

Air power has changed the way wars are fought, beginning with the rise in the air of the first manned balloon. If initially has shortened the decision cycle and improved the command of the land forces through aerial observation, the massive use of air forces in conducting the last conflicts has shown that „*Air Power can radically change the War and the Peace, to the extent that these two phenomena are interrelated and interdependent, thus influencing in general terms the evolution of Human Society*[2]".

Air Power has caused many changes in the way the battle is fought, has changed the strategies, by compressing and sometimes deleting the line of demarcation between the strategic and the tactical level. „*It has boosted the effectiveness of the operations through the synergy in between the Air, Land and Naval Forces and through the air support provided using their traditional firepower – that will be conceptualized later as Close Air Support*[3]". That made the surface forces to develop active means, tactics and defence procedures against air threats (air defence, missiles, air force dedicated specifically to counter those of the enemy, etc.) and passive ones (deception, camouflage, and the simulation of the existence of some objectives or fighting disposals). It was thus demonstrated that Air Power has reached a development level that is not only of a vital importance for the surface forces, but it can support a war, by eventually winning it independently. „*Being a component of the Military Power, the Air Power is clearly favoured by politicians as a solution to rapidly, decisively and at least relatively impose a more desirable human End State*[4]".

In the current geopolitical context, the risks, the challenges and the threats towards the global security are increasing in complexity and they are losing to a large extent their predictability nature on a medium and long term, the appropriate and the effective use of Air Power will determine the adaptation of the means and of the action strategies to the new realities.

It is obvious that noticing „*the foreseen changes that would occur in this area in the use of Air Power, is offering conclusions for a possible future development of the Air Forces, to act efficiently, within a dynamic and complex security environment, full of risks, challenges, and multiple serious dangers and threats*[5]".

Based on these new concepts „*in order to translate them into practical action, to fulfil their basic missions, within the Air Force are to be carried out a series of coordinated activities related to the organization, planning, preparation starting in peacetime ... of the specific actions*[6]".

Initially, the concept of air power was defined elusive, being considered, as William „Bill" Mitchell did, „*a capability for an air action*[7]" or how Michael Armitage and Tony Mason recently wrote - two British Air Marshals, „*the ability to project a military force in the third dimension, using a platform to leave the Earth's Surface*[8]". Though separated for almost six decades, both definitions are saying the same thing.

Although there is an almost generally accepted point of view related to the meaning of the concept of Air Power, it rests some uncertainties and ambiguities that generate the disputes in the surrounding areas of the definition domain. „*It is sometimes confused with the Air Force or it is unclear whether or not to includes the forces and space assets*[9]".

A fairly recent definition, closer to nowadays, providing an extension to space domain, was made by Philip Towle in the „Dynamics of Air Power" defining it as „*the use or the prohibition of use of the military or the outer limits airspace in military purposes by vehicles capable of controlled and sustained flight beyond the immediate conflict zone*[10]".

Conflicts of the last decade have shown that, „*the Air Power is the only viable offensive weapon politically available to end and to keep under control an uncertain war*[11]". One can say that „*in peacetime, the Air Power has not shown certain manifestation only if the way it is a deterrent factor for every possible aggressor*[12]". We can consider that the Air Power is the ability to act, in, through and from the air by its own choice and to control or to deny somebody else activity within the aerial environment.

Today, the Air Power is accepted as being the State's capability to use in military purposes the air platforms that are operating and transiting the airspace. In other words, that is materializing in a complex of forces, means and actions that are allowing the State to defend the sovereignty of its own airspace, to impose sanctions and to have every single time a response against every potential aggressor. Conceptually speaking, the Air Power is representing „*the State's potential, in principal from the military point of view, that is to be used directly or through an alliance, in order to impose its will from the air sovereignty point of view, during peacetime, in crisis or at war*[13]". From the same perspective, the Air Power is comprising a series of components, in between there are certain interrelationships and interdependencies: conceptual, operational, economic/ scientific/ technical and psycho-moral/ professional.

The Air Power, from this point of view, is the State's capability that ensures the use of the air space according to its will and that is denying or limits the unauthorized use of this, by creating safety and aerial security.

In recent decades, „*the military experts began using a new concept, defined as the Air Power, as the capability of a state (alliance) to project the force, using the air means*[14]".

Acording to Stephen T. Possony, the Air Power is not represented by their air forces, that is comprising of „*a complex of at least 15 different elements, every single one being indispensable. Those 15 items are: materials and POL; industrial potential; the supply of the tools and a high rate of technological progress; the auxiliary services and force protection, communications and electronics,*

logistics and supplies, auxiliary services; the airborne forces; the guided missiles and the nuclear weapons; *the aircrafts*; *the human resource; the training; the morale; the intelligence; the reconnaissance and the ingenuity; tactics, strategies and planning*[15]".

A new applicable theory within the Air Power domain, developed by the American Air Force colonel, John Boyd, is the decision making cycle OODA (Observe-Orientate-Decide-Act)[16]. The essence of the theory is that successfully manoeuvring inside the enemy's cycle, you can be obtained a temporary significant advantage and you can be produce the paralysis of his decision making.

By resuming those presented before, we can say that the Air Power „*represents the state and the capability that allow a State to manifest its sovereignty inside its national aerial space for the aerial traffic*[17]", in other words, all the factors that are providing the execution in good conditions of all the activities within the air environment, that is creating safety and impose air security".

In order to accomplish its objectives, there is no need to apply the Air Power. Its simple existence and the expression of the political will to apply it have been proved sufficient in many cases in order to de deny every possible hostile intention. For example, the implementation of the „NO FLY ZONE" over the FRY, in February 1994, after NATO aircrafts shoot down 4 Super Galeb planes, was sufficient to deter the Serbian Air Force to fly within the „NO FLY ZONE".

After 11th of September, the Air Power was used also to fight against the terrorists. Together with the Special Forces, they targeted and destroyed the enemy's vital centres of gravity, „*the action was global, continuous and specific (based on different types of missions-attack, defence, reconnaissance, aerial surveillance, electronic warfare, transport, command and control, search and rescue, etc*.)[18]".

In conclusion, the State has to give the necessary importance to the Air Power, that it can be used only if it has the necessary air means and on the other hand to be aware that it needs it. The Air Power, based on its role, the mission and the place it has, it has to be endowed accordingly from the quality and quantitative point of view. Only in this way, it can guarantee the air sovereignty and security.

Looking back into the Modern History, based on the reality that the actions carried out by the modern armies have started with the air operations, that the engagement of the land forces could not be done without the air support, we can conclude that the vertical dimension of war cannot be subordinated to the achievement of the objectives of some operations carried out by land or naval forces, those because of the necessity of the obtaining and the maintaining the air superiority within the joint operations area and because of the limited number of the air assets that can be engaged simultaneously in the air.

The End of the Cold War has shown on the first sight another type of Air Power, that has been used in coalitions and alliances against some very different adversaries, from the dictators to radical religious regimes, from the traditional targets to those „invisible ones" belonging to the International Terrorism.

The modern Air Power can rapidly compensate the misused/ inadequate use of the land or naval forces, in the way in which the up side down relationship is not always possible, without diminishing their role in the achievement of success within the joint operations. Using in an efficient manner its characteristics, the Air Power can provide the „fundamental freedoms" for the success of the joint operations: the freedom of initiative, to operate and to manoeuvre.

The theories related to the efficiency in using the Air Power are demonstrating that the successful appliance of it, especially in war it continues to be more an art than a science. The political leaders have to learn how to achieve the balance in between the air capabilities and the diversity of the political objectives, the last ones being seriously influenced when they are formulated in order to exploit at maximum the inherent advantages of the Air Power. In other word, the education of the political leaders related to the proper use of the air capabilities during the war or crisis its a „MUST". During peacetime it is looking simple to authorize the attack of the fighting

aircrafts from the Air Police against a plane that is having passengers on board, than the declaration of War, but both decisions needs serious judgement and deliberation when they are done. This is also the reason why the use of the „destructive quality of the Air Power" it has to be the result of a profound analysis of the political gain against the risks and the moral costs of the action.

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TASKS OF AIR DEFENCE IN MISSIONS

prof. Ing. **Milan SOPÓCI**, PhD.

Abstract:*The contribution speaks about results of research in the area of asymmetric threats. Research was performed within soldiers of Slovak Armed Forces, participants in missions abroad with accent on missions in Afghanistan and Irak. Outside a lot of important information from different fields, the research show, that one from the biggest threats, is threat from ground-to-ground missiles. The article refers according these observations about new requirements on Air Defense means, especially on command and control system, warning systems, detection means, radars and missiles systems with accent on VSHORAD. In conclusion show on new computer possibilities to increasing of safety participant of missions.*

Keywords*: air defence, project, evaluation, research, fire unit, mission, operation, urban environment, protection.*

In the last year teachers from Armed Forces Academy succeed to carry in competition of parties concerned to achieve project of European Defence Agency. The competition was acclaim for subject of asymmetric threats, with accent on activity of missions in urban environment. In competition from 16 participants, defeats consortium consisted of 8 participants from extensive knowledge of military technologies, excellence in R&T, strong experience in force protection and with experience in missions.
The consortium is composed of:

- 3 state academic institutions (ACA): TNO-Nederland, AON-Poland, AOS-Slovakia;
- 1 non governmental laboratory (NGL): TRT-France;
- 2 small medium enterprises (SME): PYA-France, ITTI-Poland;
- 2 any other type (OTH): TRS-France, TNL-Nederland.

The SIMS – "Smart Information for Mission Success", project is built for a duration of 24 Months covering 7 Work Packages:

- WP1: Management
- WP2: User needs and asymmetric threats
- WP3: Mission /Planning core tools
- WP4: Smart Information Dissemination
- WP5: Mission/Planning Tools.
- WP6: Mission Planning & Training Tools demonstration
- WP7: Training centrum for preparation of missions

The main objective of the study is to provide concept, methods and tools for a mission planning centred on human aspects (method and tool usability as well as collaborative working). Special focus of SIMS will be on closing the information loop between the operational and tactical planning levels (static) and from the mission execution level (dynamic)-(fig.1).

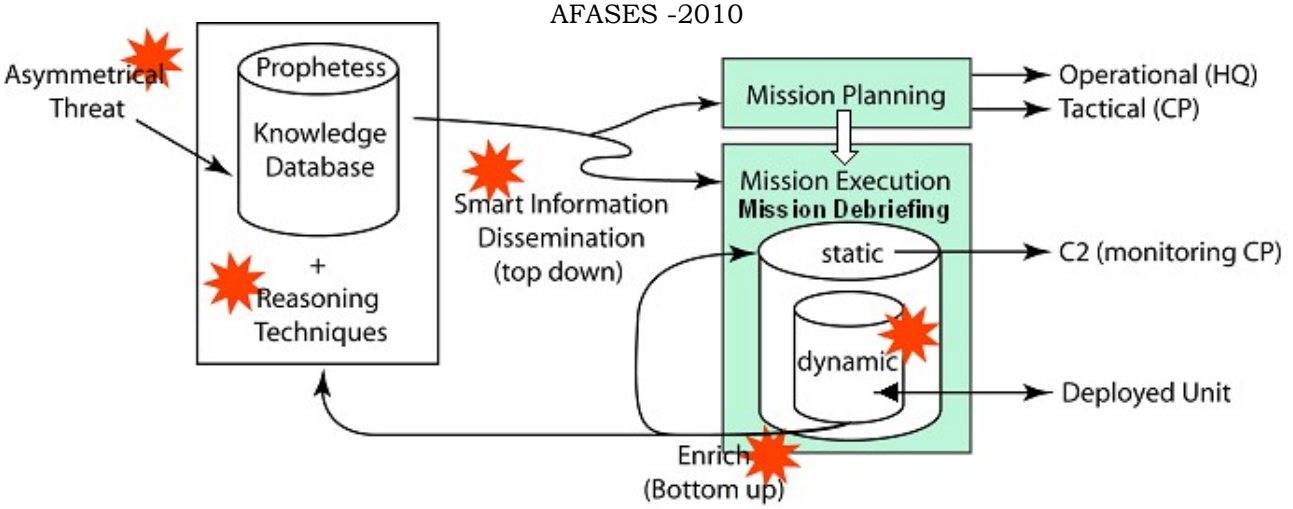

Fig.1 The SIMS Concept, focussing on five areas of innovation

The objectives of SIMS are:

- To collect threat data in a knowledge database;
- To use reasoning techniques to extract raw data and transform this into "smart, useful and relevant data";
- To disseminate this smart information both at operational and tactical levels including deployment plan and tactics for mission preparation, and smart data for mission execution;
- To improve mission debriefings, especially to overcome the current time delay drawbacks.

For a successful implementation of the SIMS concept, the following elements thus need to be determined:

- What kind of information is important for situation understanding?
- How does information need to be processed and shared to allow working effectively and collectively?
- How should information be displayed on a Human System Interface to be an efficient help?
- How should military operators be trained and prepared for asymmetric warfare?

The Knowledge Database should be populated with realistic data and asymmetric threat models. Secondly, SIMS deliveries need to be validated with military experts in a realistic mission environment. This will require the participation of military personnel in the definition of a realistic study case, definition of their needs and working context and the related operational criteria and SIMS solutions assessments in relation with the human factors previously identified.

The information for the user will thus be a conjunction of the three pillars depicted in the below figure 2.

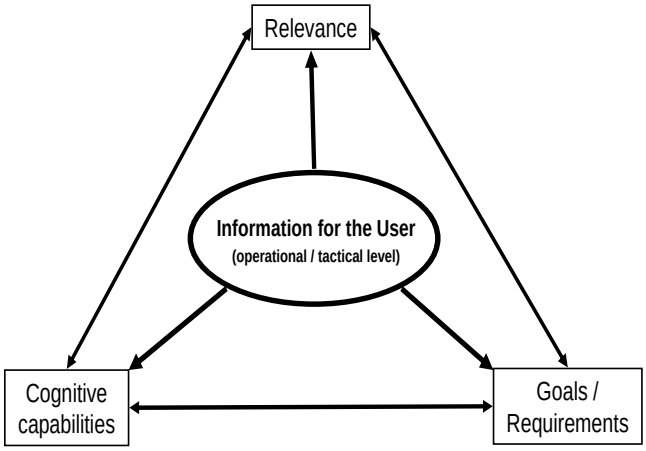

Fig.2 Three pillars for information superiority

Limited mission planning and rehearsal/training tool at tactical level, will be based on accurate recent information on asymmetric threat; easily updatable, portable, interactive and user friendly, including rapid update from sensors on the mission environment.
One of the most important parts of project is definition of users requirements and creation of threat database and knowledge database.

The requirements will be prepared on basis of the experience from the operations in regions such as: The Balkans, Afghanistan, Iraq.

The focus of second part of project will be put on easy and quick update of information:

- To the personnel in the terrain by providing instant information directly from the system, on request or related to the mission progression (check point);
- From the personnel in the terrain, directly to the Mission System in an acceptable format. It is expected that this way of dealing with information will reduce the time cycle of mission report and debriefing, and facilitate the work of the deployed personnel in the terrain.

In an effort to obtain relevant basis of asymmetry threat valuation it was organized and performed research at army, at mission participants in Afganistan – ISAF 2009.
Behind lifetime of the Slovak republic, from start of attendance members of Armed Forces at missions abroad it was not similar research organized. Short messages from command of missions evaluated only execution of tasks alternatively appreciated standing problems emergent during missions (worthiness of material and armament and likewise) but unvaluated it main – hazard of activity in specific environment, or safety level during missions and filling other specific activities[1]. From listed reasons was processed list of questions, whose contents was consults with some participants of missions the first of all with some commanders. The contents this questonary is based on four pillars , the first is data about participants which comprise age, function and rank structure of participants. The second pillar dealt of environment evaluation , where is valuated different terrain but also urban environment. The third pillar express stage of hazardousness during mission filling in specific environment and the four pillar express threat specific probability of participants by antiaction of enemy.
Just safety margin of participants regarding antiactivity of enemy was expressed by four grades :

VP – threat with high probability
NP - threat with lower probability
OZ – rarely threat
BO – without threat

Look like threat means were appreciated:

Piloted means
Unmaned means
SHEL - rockets G – A
- rockets G – G
- artilery grenats
- mortar firing
- grenats
- firing by light weapons
- sniper rifle
- supported load
- ridden load

From all threats, participants mark as most highly threat usage surface to surface missile (more than 30%) even though, they have met with its only two times, from view eventual after – effects , they have feeling of the highest danger (fig. 3).

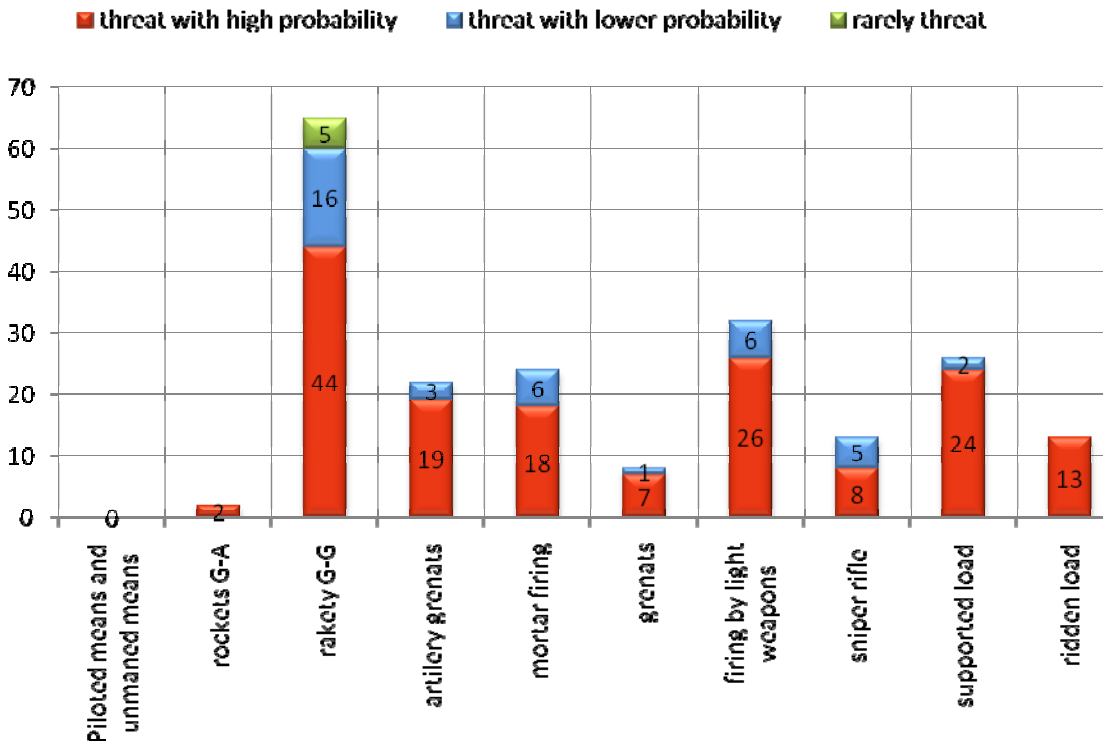

Fig.3 Evaluation of threats participation by enemy means

With big distance succed threat of application light (15%) and explosive using in conection with activity self – murder attackers (13%). Its possible to predict that expresion of threat mode it cannot take with 100 % safety. Here is possibility also exchange threat or no correct valuation of using attack means (exchange G – G rockets, beyond mines or artilery grenats). In some cases is able to reach to overvalue using attack means e.g. extension information (by crowd psychosis).

Evaluation which showed on high rate of threat participants by G – G rockets, automaticely evokes question, where is in this case place of Air Defence, is possible at all to protect expeditionary troops convoys military camps and areas against strikes from air?

When we see more closely on possibilities of warning system and on capabilities to react on threats by actual Air Defence means we can observe that these ability Air Defence has but its using in conditions of missions is disesteem. Why is it , it results from historical views under review possibilities of Air Defence. Advanced armies NATO were always oriented for using aviation (fighters or multifunctional aircrafts) and the same is it in present time in missions in crisis aeras. Armies from NATO countries, former Eastern pact in nowadays do not dispose of the highest technology and financial resources for purchase of modern Air defence means. For all that exist means and sensors which make possible these means of air attack to uncover and armies and objects early to alert and protect.

There are from warning system the first of all radars means – active and pasive too. Because G – G rockets have extreme small effective reflection surface, we can use from active radars only radars with milimetre and metre extension. While the first type is more acurately and has smaller range, the second has bigger range but smaller precision for locking and tracking of targets.

Besides them is possible to use pasive radars too, the third generation of radars (type VERA) has in equipment some NATO countries and has ability to detect air targets using technology STEALTH.

We have, besides listed active and pasive radars, in disposition a lot of different types of sensors infra, sound, movement and others. Their usage can be useful complement for main detection means. Considering also ability of obtaining

information about air targets from space reconnaissance, with accent in areas with high probability of threat by G – G rockets, we have wide spectrum information in disposition for fire units.

From active fire means will be edvantage to use Air Defence systems with short reactive time.

Because G – G rockets used by enemy ,there are not classic means of tactic assessment (e.g. with range to 100km) and often there are not neither rockets with typical balistic air trajectory, but there are launched from range a few kilometers, max. some tenth kilometers, in consideration will not come middle and long range Air Defence missiles systems. The application vice – versa will be here short and very short range Air Defence systems especially combined missile – artilery systems with reactive time some seconds. These systems are characterized high killing probability of targets, useful killing zone, ability paralel firing of targets missails and artilery firing and possibility repeat firing on targets in short time period.

Big edvantage of modern reconnaissance and fire means is fact that do not need special command and control systems. Actual technologies and computers makes possible to transmission information and commands practicaly in real time. It means that fire units can open fire on targets depending up reactive time directly after target detection.

Listed reconnaissance, fire and command system presents common integrated system of retaliatory activity, that can avoid casualties and serious material loss(fig. 4).

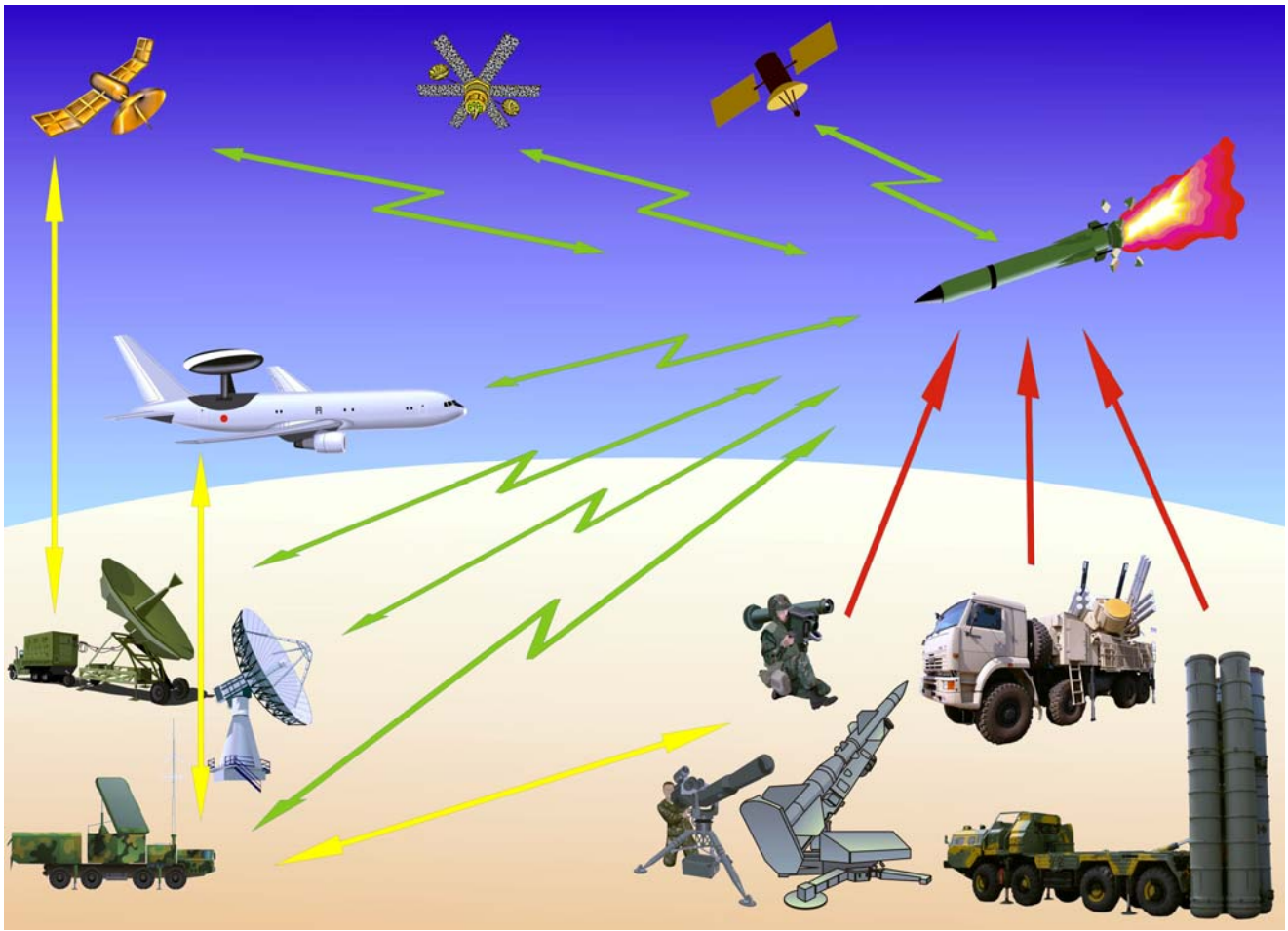

Fig. 4 Integrated system of retaliatory activity

In conclusion we can emphasize fact, that just concerning of mission structure, absence forces and Air Defence means it markedly wreaked on expedicion corps threat from air by G – G rockets. The slight of possibilities and tasks Air Defence systems caused that in

evaluation participants of missions this threat was marked in the first place and in ultimate result casualties caused by these means were many times higher then often highlighting self – morder attackers threat. We have to get back to history and think up that forces and Air Defence means belong as inseparability component every operation on random level.

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AIR FORCE CAPABILITIES IN THE CONTEXT OF JOINT AND COMBINED OPERATIONS

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The changes that have occurred in the international socio-economical and political area as well as various contemporary military phenomena have generated essential transformations in the military field. These circumstances have entailed an ample process of reevaluation and rethinking of dimensions as well as planning in the structure of the new command/control, operational and support units and in the manner of planning based on the capability of these units in operations.

An Overview of the Challenges Facing the Romanian Air Force

The strategic context of our days is very complex and it is often submitted to unexpected changes. Terrorism, the imbalance of collapsing states, crises and regional conflicts are only a few determining factors of such changes, especially of those related to the role, missions and concepts on deployment in operations of the armed forces.

Under such circumstances, the Romanian Air Force features as a basic component of Romania's national defense system with the fundamental role of generating, applying and supporting air power in operations, at peace, crisis or war, irrespective of their location – inside or outside the country – together with allies or coalition partners.

The formation of genuine, self-sufficient and flexible capabilities that allow interoperability and deployment in the theater, ready to participate to the whole range of NATO and EU missions as well as to those demanded by coalitions - in accordance with NATO standards and requirements – imposes the acceleration of the transformation process within the service structures of the Romanian Military.

In this context, it is of utmost importance for the Romanian Air Force to continue the process of structural modernization and transformation, despite the drawbacks created by the economic crisis, according to the requirements of the full operational integration process into NATO and EU structures. Such measures represent the only viable alternative for the achievement of national and Alliance air space defense and for the fulfillment of undertakings assumed by Romania within the North Atlantic Alliance.

The complexity of risks, threats and vulnerabilities toward national and collective security, which may have a rising tendency in the near future and on medium range, imposes a permanent necessity to maintain and optimize the capability for reaction.

Romania's present status as a NATO member makes it highly improbable to have to be facing a surprise attack. Nevertheless, existing risks and threats require that immediate effort be focalized on the increase of the Romanian Air Force capacity for action in view of discouraging a potential aggressor and of ensuring adequate forces to be sent on NATO missions.

Consequently, it is necessary that the process of adapting existing capabilities and creating new ones be continued on service level. The Romanian Air Force must be able to accomplish the missions appointed by the General Staff as well as fulfill present and future commitments toward NATO and the EU or toward regional initiatives and international

coalitions.

The Importance of Air Power and Its Future Evolution

In the present geopolitical and geostrategical context it is a constant concern of analysts and specialists in the field to forecast the direction in which military matters will evolve, and, based on such predictions and other factors, to formulate a viable and efficient frame for the national defense and security.

Future conflicts will most probably be characterized by selection of objectives and spaces of confrontation, decrease in the size of combat actions, a higher intensity and a shorter period of the conflict, increase of force mobility and a more diverse use of operational forces. There will be a massive use of new generation 'intelligent weapons', electronic surveillance, reconnaissance and attack systems, of C4I systems as well as of the whole range of actions specific of network war.

Furthermore, the historical evolution of conflicts demands a reassessment of armed force missions in the context of a substantial change in the use of the military as an instrument of creating effect. The goal of occupying a territory has been replaced by the undertakings to influence events. The necessity of presence has been substituted by that of control and influence, and, if necessary, intervention wherever necessary in order to avoid physical confrontation between belligerent parties. Emphasis from causing substantial damage to the enemy has been transferred to avoiding great losses for both parties, especially in cases when civilian populations are involved.

Such a situation will allow the Air Force to play an important role in solving a conflict at any level by obtaining control over an air space of strategic importance or by producing important losses in the military potential and combat readiness of the enemy. The Air Force is also a key element in creating conditions for the other services of the military to accomplish their own missions since Land Force and Naval Force missions are usually preceded by those of the Air Force.

The diverse possibilities of using this branch allow the military leaders of national and combined forces to discourage and prevent aggression and to adapt the dimension and intensity of Air Force operations carried out in order to solve crisis or conflict situations, according to the political command. **Air superiority, precise commitment, informational superiority, effect-based operations and mobility** are the essential elements of a strategic perspective for the use of the Air Force in any type of armed conflict, be that traditional or asymmetric.

Air superiority, precision engagement, information superiority, operations based on effects, mobility represent the essential elements of the strategic perspective of the Air Force use in any armed conflict, symmetrical or asymmetrical. In addition, the Air Force provides specialized expertise and appropriate support for special operations structures.

Air superiority (temporary) must prove the ineffectiveness of enemy air defense and limit the risks of its air strikes. For this purpose, it is necessary to ensure annihilation capabilities of the opponent's air defense in order to give freedom of our own forces action, and the air operations efficiency and persistence beyond the capabilities of enemy air defense space in bad weather unfavorable for air forces.

Through direct and indirect effects of air operations, it is created the possibility of ***using joint armed forces***. Direct effects of air operations allow the enhancement of combat capabilities of surface forces, and indirect ones translated into isolation and preparation of space in which warfare operations and combat actions of surface forces will take place. Through offensive use, the correct choice (selection) of the target (target acquisition) and the effectiveness of weapons, the Air Force may exert a decisive influence on the intentions of a possible aggressor. By this, the Air Force becomes a key element in domination of a conflict and deterrence of the adversary.

Precision engagement provides an increase in an output target hit / plane and obtains specific effects, eliminating the risk of fratricide and collateral damage and, ultimately, achieving significant effects on both military and psychological plans.

Information superiority is based on: integration of research systems with and without a pilot, and also the spatial/cosmic ones; space combat picture, which also includes the recognized air picture in real time; early alarming; effective use of information by ensuring the information flow and execution of informational operations; prohibiting the use of C4ISR systems by the opponents.

Rapid mobility (vertical maneuver) has grown in importance to a point where it is needed in every military action. This allows the achievement within air operations /joint operations of an air bridge and of a military capability for effective and timely movement within or in the area of interest adjacent to the operation theater, anywhere and in any conditions.

Agile combat support allows the execution of sensitive operations, persistent and effective in all conditions.

Technical and tactical characteristics and usage possibilities of air assets make nearly impossible the escape of any targets from their attack. The risk potential that arises from this can be countered only with the same kind of means. Therefore, air power can be offset *only* by air power. Alliances or solitary states can be intimidated if they do not have a credible air power.

In conclusion, the importance of air power, both in prevention and in conflicts and crises denouement, is given by the ability to perform a wide range of missions, to hit targets accurately located throughout the operation theater, to react in short time, and to deter any threat. Through its ability to react quickly and to discourage, I appreciate that the importance of air power will increase / will remain at a significant level in the period ahead.

Influence of the contemporary security environment in determining future and present air capabilities

To better understand the role of Air Force, the missions they can perform and the necessary capabilities, it is appropriate to look at the characteristics of the environment in which Air Force can act today. In essence, pretty much what is seen today in Iraq and Afghanistan will be see in the future. It is still room for surprises and definitely there will be moments that will surprise no matter how well prepared the forces will be.

Nature of future conflicts will not differ from that of today's conflicts. History teaches us that each conflict *characteristics* are different each time and they will surely change, but the permanent nature of war as human enterprise will remain largely unchanged.

As in the current period, future opponents will determine the forces to adapt just as they themselves adapt. They will attack targets in their weaknesses, in locations and through the strangest and most handy methods. The thing that is influencing the type of actions intended to be undertaken and the ability to put them into practice is the environment.

Today's conflicts may arise as a response to the measures taken to globalization and also as a reaction to the manifestation of overwhelming military and political superiority. Future adversaries will exploit the interstate boundaries and other political, economical and tribal layers in order to identify a shelter to protect conventional military capabilities, a thing that complicates pretty much the operational planning. Actions performed in such environments will support or will attack state and non state actors. Once defined the general environment, the context of the area or interests in the area must be understood in order to obtain a complete picture of the strategic issue. On many occasions, the operational environments are clearly influenced by foreign countries that might have an interest in the conflict zone. In many cases, the opponents will follow no rule in the fight simply because they can not succeed and even survive in any other way. In conclusion, in sizing the forces it is absolutely necessary for their structure to be balanced in

order to be able to cope with both conventional and unconventional or hybrid threats of the future. Why? Because now the unconventional, asymmetric, "irregular", hybrid warfare is being studied and talked about, but who expects a conflict as the one in Georgia in 2008 ?!...

The difference is given by the fact that in conventional operations the opponent is forced by the nature of losses to surrender in the traditional sense, while in unconventional conflicts it is likely that the defeat is no longer an alleged event but only visible when the opponent is "defeated" in the public eye and becomes ineffective or irrelevant, and then the role of informational, psychological and special operations is undeniable.

Sizing the required accurate capabilities is a challenge in an unconventional war. Threats are not created by massive conventional, nuclear forces.

At present, the threats are generated by opponents who have learned that they can threaten and destroy nations by unconventional means. They can destabilize neighboring countries and generate flows of refugees, may be involved in narco-terrorism, in small-scale attacks in or outside the territory of a State, and intend to proliferate weapons of mass destruction. Moreover, they have learned to attract, to hire suicidal attackers, to abduct citizens, and many other. In short, all these are called the threats of the asymmetric or "irregular" warfare.

Deterrence and defeat of these threats require forces with new capabilities. Forces able to operate in the spectrum of conflict are required. The application of force or the threat of force application must be fast, selective and decisive. Force must be applied so as to deter aggressors and to ensure allies and partners. This requires a force structure that shows speed, strength, endurance, interoperability and surgical precision. To be both appropriate and decisive in the 21st century, the force should be adapted to be able to face these new threats.

To this end, it should be determined first what is expected from the the Air Force in a possible conflict. First, knowledge related to the events happening in that conflict zone is needed - knowing the situation; then it is highly important to run missions for air defense and, in the best of cases, for air sovereignty (temporary missions). Then, rapid deployment and planning of air superiority in the military action zones are needed while running and supporting air operations. Thus, the following question arises: what are the necessary elements of the Air Force to be able to perform the tasks listed? These include: **air surveillance, research, protection, mobility, distance and accuracy**. What can be identified, however, as the most uncomfortable question, as the biggest challenge? What is missing is the ability to discover, identify and neutralize targets that are *camouflaged* , not only in the traditional way (forests, bunkers, etc.) but in populated areas as well; *scattered*, not only in certain areas of operations but also in locations with unevacuated civilians ("human shields"); *mobile* and *short-term* (*convenience*).

To overcome these challenges and limitations of the Air Force should have sensors for long-term action in order to discover *camouflaged* and *scattered* targets and to be able to respond and react to the *mobile* and *short term* ones (*convenience*). Special emphasis should be placed on these two areas. This means intelligence superiority, distance, accuracy and timeliness.

Finally, looking again at what is expected of the Air Force in a possible conflict, it appears that the equation contains *the ability to predict what will happen in the combat zone*, which becomes the most important capability in modern conflicts. In the future, the gap in capabilities of the Air Force, will be revealed by the means of obtaining, in a short time, the information necessary to a weapon system to intervene in time upon a target of *convenience* (Time Sensitive Target). Again, this means superior intelligence, distance, accuracy and timeliness.

Place, role and capabilities of the Air Force in combined joint operations.

The Air Force takes action in and out of the airspace and integrates the actions performed by other types of military forces.

The role of Air Force resides in the missions of the Romanian Military and is closely related to the missions the other military services.

Air Force plays an important part in the conduct of military actions by obtaining the temporary air superiority, maintaining control of airspace and the conduct of strikes in enemy-controlled areas to produce significant losses of potential key elements of their military (command centers, required crossing points, reserve and offensive elements of the enemy) and the creation of favorable conditions for carrying out missions by the Air Force and other services as well.

The platforms and the weapon systems enable the Air Force's degree of control over the airspace necessary to ensure the adequate freedom of action taking in any type of military operations. Maintaining control of the airspace and freedom of action undoubtedly ensures the conditions favorable to successful air,land, and naval operations. By the attacks upon the elements that define the center of gravity of the enemy force, the Air Force achieves strategic effects which reduce the enemy's capacity and resources and deter further aggression.

Depending on the aims and dimensions of the planned joint operation, a grouping of forces can constituted, which will include military structures of two or more services. These forces can take the form of functional components, corresponding to the specific environment, namely the land component, the maritime component and air component, to which other components, such the special forces, may be added depending on the needs and possibilities.

The air component comprises most or all of the Air Force Operational structures, capable of executing air operations,as well as the military structures specialized in air defense operations belonging to the Land Force and the Navy respectively, which will operate under the operational command of the air component commander.

The Air Force can participate in combined joint air operations, together with large units and composing units, on the basis of and within the mandate of the constitutional authorities and in virtue of explicit legal provisions.

The Air Force structures participating in multinational operations can operate independently or in multinational structures, under the operational control exercised by multinational headquarters.

The Air Force participation in multinational operations, depending on the situation and mission, involves the following steps:

a). preparation of participating forces;

b). deployment in the theatre;

c). delegation of authority over the participating forces;

d). implementation of logistics;

e). conduct of operations / air combat actions;

f). redeployment;

g). adjustment of capabilities.

The multinational air operations can be carried out independently or within the multinational joint operations in order to ensure colective defense, crisis management, or peace support.

The Air Force structures participating in multinational operations, in conjunction with similar structures from other participant states, represent the air component of the multinational joint forces.

The Air Forces generate, apply, and support the air power during operations with the purpose of protecting both the national air space, and the air space common to all NATO member states, supporting the actions of other categories of forces, and bringing to fruition the international commitments.

In order to achieve the assignements, the Romanian Air Forces have created an ***air defense system*** which relies on two major components:

The active component – is destined to controling the air space use, and, if necessary, to fighting against air threats with a wide range of capabilities, air-based platforms, ground-based vectors (antiaircraft artillery systems and ground-to-air missiles) and electromagnetic jamming systems. It is equipped with automated capabilities for weapon control and a high state of readiness

when faced with suspect or hostile air platforms. The active component of the air defense system is composed of:

a). The combat service – the Air Police (SL-PA) under NATO command, permanently carried out with air-to-air MiG-21 Lancer aircraft ready to take off in real time, with capabilities to fight against air targets by using self-controlled infrared missiles;

b). Ground Based Air Defence System (GBAD) – ground-to-air missile systems and antiaircraft artillery baterries deployed into territory, into zones of interest in order to ensure protection against potential air attacks;

c). Electronic attack sytems in the electromagnetic environment (electronic warfare) which permanently carries out the Electronic Surveillance combat service (SL-SE).

The passive component – is destined to coordinating and taking of air pictures - RAP (Recognized Air Picture), managing of operational air traffic, monitoring of air targets, and reinforcement of perspective at the level of the military and political decisions on national air space security. It is composed of the national air command-control system (SCCAN), as part of the Romanian Armed Forces' C2 system. This provides the command and control capabilities specific to air space actions, being the basic component of the air defense incorporation and compatible with the existing one at the level of the Alliance. SCCAN comprises the Air Operations Center (AOC), the Control and Reporting Center (CRC), the Reserve Control and Reporting Center (CRC Rz), the operations centers of the air bases (COBA) and of ground-to-air missile units (CORSA), the electronic warfare (CORE), the sensor system for air surveillance (tridimensional digital radars FPS-117, Gap Filler and digital analogue radars, with automatic data extraction) and the sensors for *electronic surveillance* (electronic warfare systems);

The Air Forces' Capabilities represent the available resources, their technical-tactical potential, the training level of the personnel using them, and the other resources necessary to ensure appropriate and continuous line of actions.

The air defense capabilities include the ground-to-air defense capabilities and air-to-air fight capabilities. *The present ground-to-air defense capabilities* rely on the SA-2 (S-75 VOLHOV) ground-to-air missile systems and the 57 mm-calibered (S-60) AA guns. These are mainly destined to protecting the capital and the air bases. *The air-to-air fight capabilities* are based on MIG-21 Lancer B jetfighter's platform. The aircraft are equipped with video recording capabilities, as well as an alert system for friend or foe identification (IFF). These are the main methods of carrying out the combat service – Air Police under NATO command. They can also carry out Air Defence Infrared (ADI) missions. The *Air Police in the Baltic countries* mission carried out under NATO command, as part of the collective air defense, with the purpose of maintaing the integrity of the designated air space, represents for the Air Forces an extremely valuable experience, as well as a challenge to test their mission preparation, deployment, and fulfillment capabilites on a military base belonging to another NATO member state.

The experience gained by the ***BALTICA-07*** detachement ***(***4 MiG-21 Lancer aircraft and 67 persons***)***, revealed specific aspects which contributted to the improvement of the training level of the deployed troops. Mainly, it emphasized the importance of continuing the training process based on the use of the NATO command and control procedures, by means of significantly increasing the training level of the flight crew in interception missions with real weapons onboard, adjusting the aircraft to carry out missions against low speed and low altitude targets. Additionally, solutions aimed at improving the military equipment and resources required in such a mission, as well as the activity of the detachment given the limitted support of the host country have been identified.

The air-to-ground fight capabilities rely on the MiG-21 Lancer A aircraft platform, the ground attack version. The MIG-21 Lancer aircraft can carry out Fighter Bomber Atack

(FBA) missions, and they can be partially deployed to carry out missions under NATO command. The aircraft are equipped with radar warning receivers, jamming resistant radio communication systems, as well as CHAFF and FLARE launching systems. The aircraft are capable of carrying out day air-to-ground attacks in good weather conditions, Close Air Support (CAS) missions for their own forces and Air Interdiction (AI) missions against both planned and unplanned targets, deep into enemy territory.

The ground attack capabilities with the use of armoured helicopters rely on the IAR - 330 SOCAT helicopter platform, which has been upgraded so as to boost its efficiency in such missions.

The Combat Search and Rescue (CSAR) capabilities rely on the IAR-330 SOCAT helicopter platform. The combat search and rescue missions are carried out especially for the recovering of the personnel that have previously undergone training in survival techniques for hostile environment and is already familiar with search and rescue techniques.

Strategic air transport capabilities also within the theater are based on C-130 aircraft. Air Forces have a deployable detachment with a C-130 aircraft, affirmed NATO. In the efforts to ensure interoperability, this detachment participated over the years, at numerous transport missions. C-130 aircraft has proven its value in the theaters of operations and Air Force crews showed that possess the necessary training to operate jointly with the Alliance members. Modernizing the existing C-130 aircraft and purchase of new variants are decisions that have been supported as a result of lessons taught.

Capabilities of medium and short courier transportation are based on AN-26 planes and the IAR-330 helicopters, modernized and standard, are provided the transport capabilities at short distances, on summary arranged runways and on hardly accessible terrain. In April 2010, the Air Forces operated the first two aircraft C-27J Spartan, which will lead to a doubling of military transport opportunities, equipment and materials, as compared to current capabilities. This plane, together with C-130 and C-17 (jointly operated under the SAC program - Strategic Airlift Capability), will ensure to Romania a modern air transport capacity, sufficient for operational needs of the armed forces.

Medical evacuation capabilities (MEDEVAC) with helicopters are based on the IAR-330 helicopter platform, specially prepared for this kind of mission execution. Also the IAR-330 LRo helicopters with MEDEVAC complete or minimal equipment can perform similar missions but they require upgrading to meet the specific standards.

Air Research capabilities are provided with the AN-30 air aircraft, meant to aerophotogrametric research and the MiG-21 Lancer, on which the research container can be caught.

Air surveillance capabilities, based on FPS-117 digital radar platforms and digitized analog radars (referred to extracting data), which, in order to ensure the minimum requirements in the field of air surveillance, ensure the radar coverage on the border and the radar coverage within the borders to support training flight information. When necessary, air monitoring can also be achieved with a variable number of non-modernized analog cameras;

Electronic warfare capabilities of the Air Force are specialized (electronic warfare unit) and non-specialized (ground-air missile brigade and air space surveillance units). They can perform research and neutralization by jamming the radio network of a leading potential adversary and navigation systems that operate in areas of responsibility;

Special operations capabilities. Part of the Air Force may participate directly or indirectly in the execution of missions meant for special operations. According to the upper echelons' decisions and within the limits of the aviation resources, the Air Force provides air means for insertion / extraction of special forces to carry out missions on Romanian territory or in other theaters of operation, together with special forces of the Alliance. Air support for the FOS can be achieved with IAR-330 SOCAT helicopters, to provide

tactical transportation and training, as well as with aircraft formations MiG-21 and LanceR and/ or IAR-99 FALCON, for mobile protection (direct or remote).

Force protection capabilities - GBAD, EOD, CBRN. The main force protection capabilities refer to ground-based air defense, the neutralization and destruction of the conventional and unconventional explosive devices, as well as to the research, permanent monitoring of the airspace and of the units perimeter, warning and opportune alarm of the subunits, individual and collective protection measures and forces decontamination.

Command-control capabilities are achieved through the SCCAN program. For a medium and long-term, the C2 capability will be fully integrated into the NATO C2. The main command-control structures of the Air Force: Air Operations Center / AOC, Reporting and Control Centre / CRC Base and CRC Reserve bases, Air Operations Centers / COBA, Center of Ground-Air Missile Operations/CORSA and Center of Operations for electronic warfare / CORE) provide air operations leadership, on national territory or outside, air operations planning, production and transmission of orders, receiving reports, implementation, distribution and exploitation of the single overhead recognized image of the air situation; management / airspace control, air traffic operational management, command and control of aviation use, radio-electronic jamming and limited means of artillery and ground-to-air missiles; resource management command and control, threat assessment, protection of information.

Communication system is achieved from interconnected communications centers through digital streams and fiber feeds.

Air Operations Coordination Centers, planning / liaison teams and tactical air control groups are elements of interconnection of the Air Force with other categories of the armed forces. In this direction there are still many steps to do, in order to achieve the required standards. The lessons identified during the joint exercises conducted by CopI (current C.C.Op) confirm that training must be enhanced to achieve the joint nature of operations and meet the need for a continuous and precise coordination.

The joint exercises should be part of Air Force training, mainly for the certification and affirmation of the deployable forces put at the disposal of NATO. During these exercises, the limits of the existing capabilities can be identified, particularly in terms of equipment in service. Consequently, new programs for purchasing modern equipment must be developed, in order to eliminate these limitations.

The training of the deployable forces continues to remain a challenge for the Air Forces. Connecting to the informational flow within the theater of operations, logistics and force protection on air bases where the HNS is minimal remain open questions. To find appropriate solving solutions, it is necessary to continue to participate in joint exercises and training, to carefully analyze their results and to exchange permanently information with the allies.

DISCIPLINARY LIABILITY OF THE MILITARY PERSONNEL

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Liability "occurs on the grounds of an already done evil", that is after committing an offense. Specific violations committed by public officials, including those with special status, is the fact that they can intervene while performimg their fonction, either in connection with this performence or simply by the deviation from certain rules which have no direct connection, with the function, but which may question the prestige of the public employee.

Liability as a fundamental institution of law has, for the military, some special connotations resulted from their special responsibility, but not at such extent that this profession avoid the general principles of liability. As for civil employees, generally speaking, also for the military, liability occurs when executing their function or in connection with its execution, they deviate from the legal norms of their profession.Thus, the soldiers are passive subjects of the following forms of liability: disciplinary, contravention, material and criminal.

The disciplinaty liability is a form of the administrative liability, together with with the contraventional and asset liabilities. All three forms of liability occur as a result of committing administrative violations, the difference being that in the first two cases it is a sanctionatory legal liability and in case of asset liability, we speak about a reparatory liability.

The term "discipline" comes from Latin, where the meaning was, on the one hand, system, rule, moral principles, good standing, and on the other hand, training, school, education, science, skill, meanings that we find today, respectively the assembly of the rules of conduct, of order, imposed on members of a group members for a proper functioning of its social organization and, of a particular domain of knowledge or branch of a science, field of instruction or area of learning curricula[1].

The discipline supposes the leadership right to formulate obligations and prohibitions, the authority to make them be observed and the power to apply sanctions if necessary. Mandatory in all areas of social life, discipline is essential to the military organization, *being one of the determinant factors of the fighting capacity of the army, based both on the conscious acceptance of the established rules of conduct and the granted rewards and sanctions enforcement*[2].

The legal nature of military discipline is the law regarding the statute[3] which establishes among other duties of the military, to respect the military oath and the provisions of normative acts in force, the exact execution of the commanders' and chiefs' orders, the military being responsible for the way they fulfil the tasks entrusted to them.

The commander is the one responsible for the application of the military discipline norms within the structure he commands and the delegation of competence does not exclude entirely his liability. As a result, the legal nature of the military discipline is not related to the working right, it does not stems from a contract of employment but from a status

[1] Dicţionarul enciclopedic, vol.2, Editura Enciclopedică, Bucureşti, 1996, p.107.
[2] Art.3, paragraph. 3 of Rules of Military Discipline, RG-3/2009 published in Gazette of Romania,no 187 of 25.03.2009.
[3] Law nr. 80/1995 concerning the military statute and Law no. 384/2006 concerning the soldiers and volunteer NCO's statute

stipulated by law, that is why all the characteristic of an institution of administrative law meet. The importance of military discipline is that in many armies, the disciplinary norms should be grouped into a real "disciplinary law" as distinct institution, specifically recognized as military law and regulations exist to this effect[4].

The disciplinary deviation is a form of illicit behaviour that manifests itself in a breach of the obligations by the military, obligations that result from laws, orders and regulations which, altogether, constitute the functional tasks of the military but also the military discipline content. Thus, the only legal basis for the disciplinary sanction is disciplinary deviation and where the military's act was noticed as well as a crime, the disciplinary proceedings shall be suspended until the non-initiation of the criminal prosecution or by the date on which the court dispose the trial discharging or cessation.

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Disciplinary violation involves two minimum conditions of military, that is the quality of military duties and breach of a statutory duty. This means that the subject of the disciplinary offense stipulated by the military discipline rules can be only military and the disciplinary violations scope is limited to acts of conduct by which the military honor and dignity are compromised, the duties of service are vilolated by by failing or faulty performance of functional tasks and mission accomplishment.

Disciplinary responsibility of the military has the following features: it is based on the breach by a military of a report of administrative law; the active subject is always a military commander or a public authority, subordinated in th e violated judicial report; it is based on the passive subject's guilt who has the capacity of administrative law within the violated juridical report; the sanctions have a systemical configuration.

The disciplinary sanctions are coercive means, stipulated by law, whose purpose is to defend the disciplinary order, to develop the spirit of responsibility and accountability for the accomplishing the work duties, the rules of conduct as well as the prevention of acts of indiscipline. They are expressly and limiting stipulated by law[5], having both an educational character but also preventive.

Establishing disciplinary responsibility for soldiers who have committed disciplinary violations is done by sending them, as appropriate, in front of the Honor Board, trial council or prior research commission where they always have the right to the audience, defence and petition[6]. Nevertheless, those who consider themselves mistreated by the applied sentence cn address by written report to the direct superior of the person who issued the sanction decision and who is obliged to name a research commission. The decision proposed by the new research committee may maintain or cancel the disciplinary sanction or may apply another sanction[7]. In its turn, it may be appealed in a court of law by administrative contentious in charge, in accordance with the administrative contentious Law in force.

The legality control of the act of punishment exercised by the administrative contentious is both a formal inspection and background control.

The formal control consists in verifying the legal procedure for application of the legal procedure sanction, that is the military hearing before the Honor Board or the court, as appropriate, the prior research, the document issued by the competent organ, etc.

Upon completion of the formal control, it will be determined whether the penalty is legal under procedural circumstances and if

[4] See RG-3 / 2009, Rules of Military Discipline, RG – 7/2006, Rules of Honour Board; RG-8/2005, Rules of Trial Councils.

[5] According to RG-3/2009, the Rules of military discipline approved by the Order of the Ministry of National Defense no. M.26/06.03.2009, the sanctions that may be applied to the military personnel are: for active military personnel: warning, written reprimand, demotion of position, postponing the next rank advancement for 1-2 years, retire; for ranked and NCO: warning, written reprimand, service pay reduction by 5-20% for one month up to 3 months, postponing the next rank advancement for 1-2 years, disciplinary dissolution of labor contract.

[6] No disciplinary sanction out of those stipulated for the military personnel cannot be taken, excepting the warning, before the facts research and trial by the Honour Boards or Trial Councils, as appropriate. Otherwise, the disciplinary sanction imposed shall be struck by the absolute nullity.

[7] The new applied disciplinary sanction may not be harsher than the contested disciplinary sanction, as the principle "non reformatio in pejus" is applied, according to which no one can receive a worse situation in his appeal against the notice of penalty.

not, the sanction document will be sanctioned, so that the background control is unnecessary.

The background control aims at the checking the existence of military's fault, which can be done based on documents that have been the basis for issuing the notice of penalty, of his guilt, the consequences of the crime committed and the causal link between the act committed and the consequences produced.

As a result of the background check, it will be determined whether the conditions of applying the disciplinary sanction and whether the individualization of the penalty was correct.

If these conditions are not met, a notice of cancellation penalties will be provided, and if the penalty was not correctly individualised, the act of punishing shall be amended in order to apply a lighter penalty.

From our point of view, setting another disciplinary sanction, a lighter one, is possible only if such a penalty has been requested by the plaintiff military, because in this way the court gives what was not required and it will violate a general principle of procedural law, namely the principle of availability.

Also, in our opinion, changing the actual act of punishment, for the purposes of applying another disciplinary sanction, an easier one, must be also done by the defendant, military authority, according to the limits laid down in the final and irrevocable judicial decision of administrative court, whereas military authority is by law the sole disciplinary power over his subordinates[8].

For a long period of time, it was considered that a firm compliance with the military discipline must be taken to the soldiers who have committed violations of the rules of military discipline without criminal penalty of arrest.

This was the reason why, at the ratification in 1994 of the European Convention on Human Rights, Romania made a reservation to Article 5 thereof, in the sense that it will not prevent the application by Romania to the provisions of Decree no. 976/1968 which regulate the military disciplinary system, provided that the duration of the deprivation of the individual freedom based on the commanders' decision, must not exceed 15 days. Romanian Constitution revised in 2003, taking more faithfully the European Convention on Human Rights, produced significant changes in this area, stating, inter alia, that liberty and security of person are inviolable, that the arrest of a person is allowed only in cases and the procedure provided by law, and it can only be ordered by a judge and that the penalty of imprisonment can only be of a criminal nature. The new constitutional provisions imposed, in fact, the reserve withdrawing and the military discipline rules and regulations approved in 2009, is stipulated that the disciplinary penalty targeting taking into custody of any military is not an issue anymore[9].

CONCLUSION

In conclusion, the administration put, as fundament of its entire activity, the application and observance of law, the principle of legality being one of the basic works of administration activity, including the military. Liability in any of its forms is determined by the committing of illegal acts, by the violation of the value system established by the city and recognized by law norms. In legal literature we find the thesis according to which in any branch of law we place ourselves, the liability has two purposes: to restore the violated legal order, causing a return to legality status; to express a negative reaction to the author of the illicit act, with the aim of determining him realize the significance of his deed, to regret and, in the future, not to repeat it again.

[8] According to art. 74 of Law no. 188/1999 concerning on the status of civil servants, public officials displeased with the penalty, may appeal administrative court, requesting cancellation or amendment, or, as appropriate, the order or sanction, the provision which is, in our view, unconstitutional because the law adds, to the solutions adopted by the court, as well as, the change order or penalty provision, in violation of the principle of separation of powers. Changing the administrative act by the administrative court equals with its interference within the jurisdiction of government.

[9] The former Rules of military discipline RG. 3/2000 stipulated the disciplinary sanction with imprisonment for 15 days for soldiers and military students and pupils.

To talk about responsibility, it necessarily requires its relationship approach with responsibility. Responsibility precedes responsibility and can remove it. It involves observance by the individual of the value system established by the city, at a global or micro social level. If this value system is respected, man lives in harmony with himself and with others, with his society, as a whole. When the value system is denied, the man ceases to be responsible; he becomes liable for its unlawful behavior[1]. The career military personnel must take responsibility as a priority in their behaviour. For them, there is no other value, more important than accomplishing his tasks; a belief emerged from rational understanding of phenomena. They must carry out their tasks, not because they are required to, but because they are convinced that it is their professional role.

THE OPTIMIZING OF THE TRANSMISSION SYSTEM BY USING PRECESSIONAL TRANSMISSION

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***Abstract**: The passing capacity, the basic factor that influences the stability of military vehicles, depends on some dynamical and geometrical characteristics and it is influenced by the projection solutions that were adopted for global organization and by the constructive solutions of some parts of vehicle. A way of developing transmissions is the drawing up of new types of mechanical drive lines. The harmonic transmission has appeared this way. Cinematically and constructively speaking, the harmonic transmission has many tangent points with the planetary transmission. The disadvantages are: low reliability of the flexible element (and low reliability of transmission in general), reduced capacity to work on high speed and some technological difficulties. These disadvantages do not occur in case of the precessional planetary transmission.*

***Keywords**: precessional transmission, passing capacity, drive lines, adherence.*

1. THE PASSING CAPACITY OF WHEEL VEHICLES

The passing capacity is the possibility of vehicles to circulate off-road and on bad or bumpy roads and to pass different kinds of obstacles. The highest requirements are for off-road vehicles (cars and trucks). The passing capacity is characteristic of military heavy vehicles, which, apart from the possibility of moving on the unpaving or bumpy roads, have to be capable to circulate into natural ground, in any meteorological conditions and to be capable to pass some obstacles like unevenness, grooves, fords, snow-drifts etc.

The passing capacity, the basic factor that influences the stability of military vehicles, depends on some dynamical and geometrical characteristics and it is influenced by the projection solutions that were adopted for global organization and by the constructive solutions of some parts of vehicle. Briefly, the increasing of the stability of off-road vehicles is the main idea of the paper and the stability is seen not only as fighting stability, but also as global stability.

2. THE PRECESSIONAL TRANSMISSION

A way of developing transmissions is the drawing up of new types of mechanical drive lines. The harmonic transmission has appeared this way. Cinematically and constructively speaking, the harmonic transmission has many tangent points with the planetary transmission. It is one of its modifications. The flexibility of one of the pinions is the main difference. The harmonic transmission is compact, has high lifting capacity and assures high cinematic precision and the possibility of sending power into watertight medium – the basic advantage of harmonic transmission. The disadvantages are: low reliability of the flexible element (and low reliability of transmission in general), reduced capacity to work on high speed and some technological difficulties [3].

These disadvantages do not occur in case of the precessional planetary transmission. This was known before the harmonic transmission but it was not used too much because of the inadequate using of internal evolventic gear. This gear does not take into consideration the influence of the

particularities of the spherically-spatial movement of satellites to the transmission function. The increased multiplicity of precessional transmission (till 100% teeth pairs in gear simultaneously) provides a high lifting capacity and a cinematic accuracy and moreover low overall size and mass. Other advantages could be: large cinematic possibilities, high efficiency, low acoustic emission, the possibility of sending the movement into watertight medium and the possibility of solving all technological problems. In conclusion that is why the precessional transmission has large possibilities to be used in mechanical engineering.

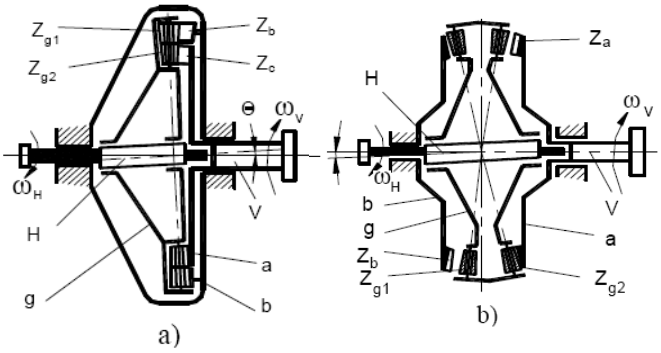

Fig. 1 Precessional transmission K-H-V and 2K-H

Depending on the structural scheme, the precessional transmissions are two basic types: **K-H-V** and **2K-H**. Starting from these two basic types, a large range of constructive solutions with large cinematic and functional possibilities can be drawn up. They could have the possibility to work as reduction or multiplicity gear, differential, auto break system etc.

The gear-train diagram of precessional transmission **K-H-V** (look to the figure 1 a) consist of four elements: planet carrier *H,* satellite wheel *g*, central wheel *b* and body. The satellite wheel *g* and the central wheel *b* are into internal gear and their teeth generating lines cross each other in one point; this point is named center of precession. The satellite wheel *g* is placed on the planet carrier *H* which is built like an inclined crank. Its central axle together with the axle of central wheel forms an angle θ. The inclined crank *H,* because of its rotation, send to satellite wheel *a,* a spherically-spatial movement as against the ball joint from the center of precession.

The precessional transmission **2K-H** (figure 1 b) has higher performances mainly in cinematic plan. It consists of the satellite wheel *g*, with two crown gears Z_{g1} and Z_{g2}, which are in gearing with two central wheels: one is mobile *a* and the other one is immobile *b*.

Both types of precessional transmissions have not been used in automotive industry yet, but, considering their performances, they can be successfully applied for differentials, gear boxes, reduction boxes, drive wheels, particularly for "off-road" vehicles.

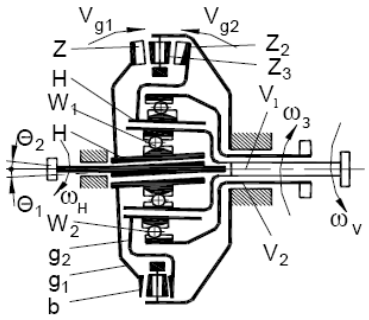

Fig. 2 Combined precessional transmission

In Fig. 2 represented a scheme of combined precessional transmission, which includes two transmission **K-H-V** roller gears. The crown roller is stationary. With her engage, on both sides, teeth wheels satellite gears g_1 and g_2, crank installed tilted differently (as a crank inclined to wheel-g_2 satellite serves the outer surface of the satellite hub g_1). Rotational movement of the wheels satellite g_1 and g_2 is transmitted through the trees led V_1 and V_2 the mechanisms connecting W_1 and W_2.

Into KHV precessional transmission with fixed central wheel, an important element is the mechanism W connecting the satellite wheel shaft driven V. In this case $z_g = z_b \pm 1$. The average transmission ratio of the transmission is determined from the relationship:

$$i_{HV}^{b} = -\frac{z_g}{z_b - z_g} \quad (1)$$

Higher performance, including kinematic plan, has precesionale 2K-H transmissions in different variants. Precessional transmissions 2K-H (Fig. 3) include satellit-wheel *g* with two crown gears z_{g1} and z_{g2}, which is in gear with central mobile wheel *a* and central fixed wheel *b*. In this situation:

$$i = -\frac{z_{g1} z_a}{z_b z_{g2} - z_{g1} z_a} \quad (2)$$

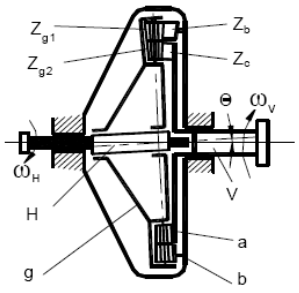

Fig. 3 2K-H precessional transsmision

Analysis shows that relations precesionale 2K-H transmissions ensure the achievement of a range general reports of transmission i = (12...3599) [2].

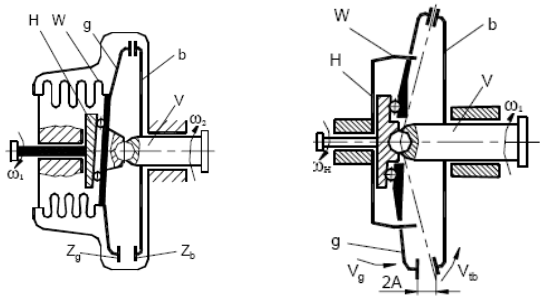

Fig. 4 Tight precessional transmission

In Figure 4 are presented two exemplas of structural schemes of transmission precesionale tight. They could be used for Amphibious Personnel Carrier.

3. IMPLICATIONS OF CHANGING THE CLASSICAL DRIVE LINES (PLANETARY OR/AND RIGID AXIS MECHANISMS) WITH PRECESSIONAL TRANSMISSIONS

Straight implications:

- The global mass of transmission (vehicle) decreases → **m ↓;**
- If it is necessary the conversion ratio of power unit could increase → **i ↑;**
- Compact transmission that bring about increasing of protection level;
- The transmission efficiency increases → η_{tr} ↑;
- The possibility to use precessional transmission as drive wheels, differentials and high watertight gear and reduction boxes.

Indirect implications:

- The wheel torque increases because: $M_r = M_e \cdot i_t \bullet \eta_t$;
- The wheel tangential force increases because: $F_r = M_r/r$;
- The traction force increases because: $F_t = \frac{M_e \cdot i_t \cdot \eta_t}{r}$;
- The general dynamic of vehicle increases because of mass decreasing;
- It is easier for the vehicle to be used on the stable area of traction (adherence) characteristic mainly for the most difficult moments, starting and low speeding moments, because driveline connection is done without jerking (it is a feature of the precessional transmission), so, without high sliding; this thing is very difficult or impossible to be done by classical transmission.

4. THE JUSTIFICATORY CONCLUSIONS REGARDING SUGGESTED SOLUTION FOR THE INCREASE OF ADHERENCE

A detailed analysis of traction (adherence) characteristic is going to be done in order to justify the main adopted solution for the increase of adherence between tyre and rolling surface. The rolling (traction, adherence) characteristic is the specific tangential force φ_t – sliding *a* relation. This one has approximately the same variation for braking and acceleration. The specific tangential force

is the ratio between the tangential force on the driving wheels F_t and the total weight G_a of the vehicle; this ratio is similar to the adherence friction coefficient only when all the wheels of the vehicle are drive wheels.

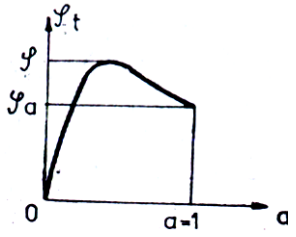

Fig. 5 Traction (adherence) characteristic

The graphic drawing of the dependence of this ratio to the sliding between tyre and ground surface from figure 5 shows a fast increase of the adherence capacity, approximately proportional with the sliding, until it touches a maximum value, named adherence coefficient ($\varphi_{max}^{t} = \varphi$), for the sliding between a = 0.18 and a = 0.30, and, after that, it decreases with the sliding increase, until a value φ_a, named sliding friction coefficient, when the sliding is maximum.

The relation between the adherence capacity (the utilization coefficient of adherent pressure from the contact spot) and the size of tyre sliding is:

$$\varphi_t = \frac{X}{F_r} = E\frac{A}{Z_r}\cdot a\,, \qquad (3)$$

where:
X – tangential force from contact spot;
E – tyre longitudinal modulus of elasticity;
A – the tyre area of frontal section, including the adherence profiles sections;
Z_r – normal resultant.

This relation is true for the pseudo slips of contact spot.

For the same wheel, the ratio EA/Z_r is a constant, so, into the limits of wheel pseudo slips on the road, it is a right proportion between the adherence capacity and the size of sliding. This was experimentally acquired, too.

So, a correspondence between both dependences is only for low values. For higher values of the tangential force, when the sliding between tyre and ground appears, the design of the curve (compact line) follows a variation till full sliding (a = 1). On the contact spot, in this case, it could appear a partial sliding of some areas.

In conclusion, the point of maximum value of the adherence coefficient splits the characteristic in two parts: the stable area on the left and the instable one on the right. The last area has to be avoided for the acceleration and for the braking. The vehicle has to work in the high area of the stable zone as much as possible because it could be said that on the maximum area of the adherence coefficient is the point (it is in fact a zone) of "adherence bursting" [1]. The physico-chemical features of the tyre and the human factor (the last one decisive for the safety of the traffic), as straight factors which influence the rolling style are very important. The features of the rolling surface are an indirect factor. But, the capacity of the driver to realize the moment of "adherence bursting" and to drive in maximum safety conditions (the precessional transmission could support him) are more important using only the stable area from the rolling (adherence) characteristic**.**

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CONSIDERATION REGARDING THE SENSOR SUBSYSTEM INFLUENCE IN THE AIR PICTURE GENERATION PROCESS AT COMMAND POSTS LEVEL

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Abstract: *The main characteristics of the sensor subsystem have a powerful influence in the Air Picture Generation process at the Battalion Command Post level. In order to obtain an accurate aerial image and to assure the Air Surveillance operation, a sensor is capable of detecting and forwarding cueing data for all (most of) target types, whose trends indicate a continued evolution towards smaller, more sophisticated, armed Unmanned Air Vehicles (UAVs) and low cost Cruise Missiles as the primary airborne threats.*

The paper presents some relevant aspects regarding the Air Picture Generation process, viewed through the prism of target detection achieved by the sensor subsystem.

Keywords: *air defence, air picture, Battalion Command Post (BCP), cueing system, sensor, weapon terminal*

1. INTRODUCTION

Modern warfare depends heavily upon situational awareness. The soldiers/operators which deserve weapon systems (WS) on the ground, need to understand the environment around them and identify threats as early as possible. State-of-the-art military advanced sensors have unprecedented requirements regarding the vast amount of environmental data to be measured and processed. Therefore, a basic functional element which must be assured at the level of a *Ground Based Air Defence* (GBAD) system is the ***surveillance***, which consists of two main aspects:

- air picture production;
- asset management.

The operational heart of a ground based air defence system is represented by the Battalion Command Post (BCP), and, in order to assure the ***surveillance*** function, a BCP must integrate and control:

- a sensor subsystem;
- a few Battery Command Posts (BtCPs) with their own integrated sensors.

In the same measure, the BCP interfaces to the Higher Echelon Unit (HEU) through Tactical Data Link (TDL).

A BCP can control multiple sensors and will fuse the organic information with information received from the TDL, presenting a Single Integrated Air Picture (SIAP)

The main tasks which are performed by a Battalion Command Post (BCP) are:

- data link management;
- sensor control;
- air picture production;
- track identification and classification;
- friendly protection;
- threat ordering;
- weapon system allocation.

2. A BATTALION COMMAND POSTS TYPICAL CONFIGURATION

The BCP site consists of a sensor subsystem, a command and control shelter and a vehicle. The BCP controls a number of Battery Command Posts (BtCP's) which are connected in a Battalion radio net. A Battery Command Post, whose site consists of a command and control shelter and a vehicle, controls a number of weapon terminals (WTs) which are connected in Radio net.

Therefore, the Battalion Command Posts represent the command and control (C2) structure of that battalion. This structure integrates weapons (with/without dedicated sensors) and the sensor subsystem.

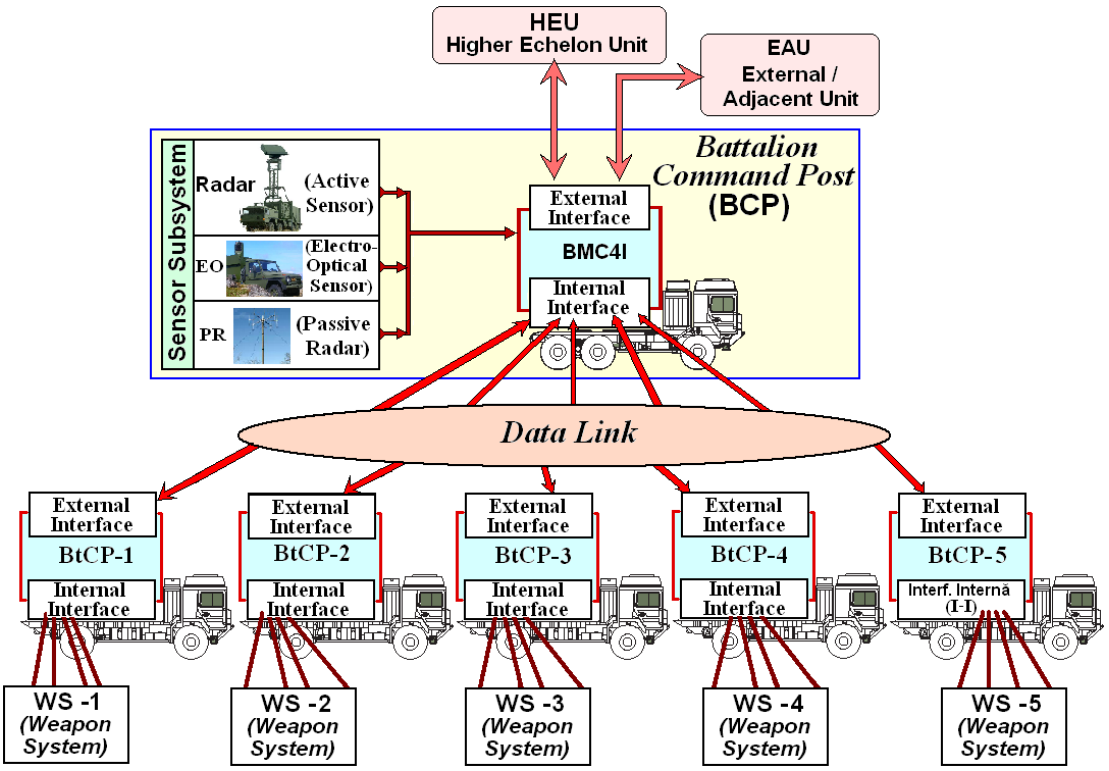

Fig.1 - A typical configuration for an air defence battalion

2.1. Weapon Terminals. Real time situational awareness picture

An innovative system, named Cueing Systems (CS), has the role to improve the capabilities and mission profiles of the weapon systems. This system (CS), which is supposed to close the capability gap of connecting weapon teams to a real time situational awareness picture, comprises a Cueing Device, the Communication/ Cueing Processor Unit (CCPU) and a Weapon Terminal (WT). The computer is configured to display and handle real time surveillance data as well as airspace control means. Within the Weapon Terminal all required orders and commands like fire control and target data can be transmitted. Pursuant to the reports and information about status and position of weapon teams, the Weapon Terminal (WT) provides cueing information to the gunner.

This information is displayed by the Cueing Device that visually guides the gunner to cue the weapon system to the assigned target. Therefore, the basic function of the WT is to assure the ***engagement management***, which consists of three phases:

- *target designation and search*: WT displays in real time the target designation data from BtCP.
- *target identification*: when used with an optronic sensor, WT displays the video for visual target identification
- *firing and kill assessment*: Weapon Terminal informs the operator when the target is inside the firing range.

These three phases are presented bellow in the next figure (Fig.2).

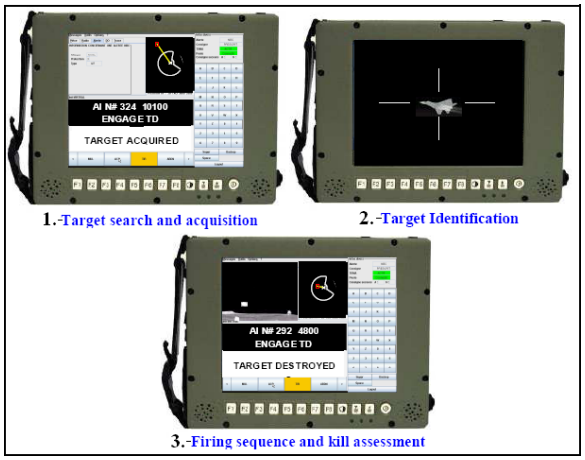

Fig. 2 –Phases of the engagement management process displayed on a Weapon Terminal

3. AIR PICTURE MANAGEMENT

Air Picture Management is a basic function in the Command Post and makes shared awareness throughout the GBAD force possible. The air picture management subsidiary functions are: Track Correlation, Identification handling, Friendly Protection and Airspace Control Orders visualization. The geographical area which is in full colour displays lots of information such as: target data, Airspace Control Order, position of Defended Assets, position of Air Defence systems.

3.1 Track Correlation (TC)

One fundamental factor in executing efficient operator and system related GBAD operations is to have access to a timely, accurate and unambiguous recognized air picture.

The TC function is performed on various levels both in the BCP and the BtCP and the function merges track data received from various integrated track sources including HEU and non-organic sensors. The end product of the Sensor

Integration and TC function is a real-time Single Integrated Air Picture (SIAP).

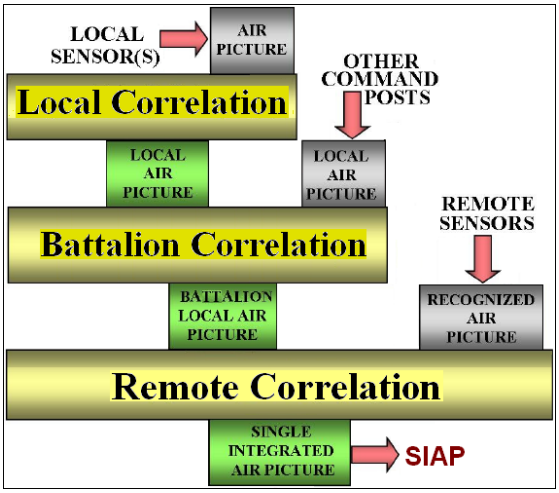

Fig.3. –Track Correlation Levels

The best available track data are at all times provided to the ID handling, Threat Evaluation (TE) and Weapon Allocation (WA) function, as well as to the Tactical Data Receivers on subordinate weapon level.

3.2 Identification (ID) handling

The purpose of the ID handling process is to assist in identifying tracks in the system, to reduce delays in operation and prevent fratricide. The ID process may be fully automated or semiautomatic as it may provide ID recommendations. An auto or semi-auto initiated ID can at all times be manually overridden by the operator. For positive ID, a method of employing electronic (e.g. IFF) and visual means to positively identify tracks within a given airspace, is dependant on operator interaction. However, some fixed override rules can be defined, e.g. jammers will automatically be recognized as a hostile track by the system. The operator will select the type of track symbology to be displayed on the tactical displays dependent of the tactical situation.

A mature ID functionality will recommend track ID based on operator inserted parameters, Airspace Control orders and IFF. Recognized ID information is distributed automatically to all BtCPs in the network and the HEU, thus reducing risk of fratricide.

3.3. Friendly Protection

A friendly protection function alerts the operator if a friendly target is attempted engaged. The track's position is checked to see whether it is a member of a defined volume.

All friendly information available in the system will automatically be distributed to all units in the network in a real time manner, radically reducing the fratricide risk.

4. SENSORS INFLUENCE IN THE AIR PICTURE GENERATION PROCESS

The BCP will provide air space data exchange with Higher Echelon Unit (HEU), subordinate and/or adjacent Air Defence units. This requires use of standard interfaces in order to communicate within the internal environment, as well as with the external environment. It will have the capability to combine the RAP (Recognized Air Picture) and LAP (Local Air Picture) in a Single Integrated Air Picture (SIAP).

The BtCP collects a Local Air Picture based on input from sensors on the weapons. The Weapon Terminal (WT) receives commands and target information from the Battery radio net and integrates the weapons and sensors on the weapon platforms.

The quantity and quality of the information which represents the aerial

situation is strongly influenced by the main characteristics of the sensors. Thus, image quality which reveals the airborne threats depends on the following sensor characteristics:

- range and elevation coverage;
- accuracy (in azimuth, in range and elevation);
- data renewal rate;
- resolution (separation of 2 targets);
- detection capability against future threats (UAVs, stealty targets, cruise missiles);
- radar track capacity;
- the signal processing, dedicated to reject the noise and, to eliminate the effect of electronic countermeasures.

In order to achieve an image quality measurement, which represents in fact the degree of degradation of the image in its production process, may be used some adequate indicators (measures), such as:

- ***MSE*** (*Mean Squared Error*), defined by the calculation relation:

$$MSE = \frac{\sum_{i=1}^{I_T}\sum_{j=1}^{J_T}[p_{ij} - p_{ij}^*]^2}{N}$$

where p_{ij}, p_{ij}^* represent the pixels' intensity for the original and, respectively for the degraded image, I_T, J_T, represent the total number of rows and columns in the image and N is the total number of image's pixels;

- ***mean2*** (the arithmetic mean of the pixels' values);
- ***Sd*** **–**the ***standard deviation*** value, measured in a image region that is supposed to have a constant reflectance (***r*** ≈ ct.), defined by the relationship:

$$Sd = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^2}$$

where N represents the total number of pixels in the region, $\{x_1, x_2, \ldots, x_N\}$ represent the pixels' values (their intensities), and $\bar{x}$ is the arithmetic mean of the pixels' values.

- ***Hsd*** (histogram's standard deviation).

5. TRENDS REGARDING THE EVOLUTION OF THE SENSORS SUBSYSTEM

Forward are presented some relevant trends which characterize the evolution of the sensors subsystem inside a BCP:

- The capability to operate in any environmental conditions. Thus, the most of sensors are designed to cope with the severe climatic and electro-magnetic environments.
- The possibility to choice of emission band, in order to avoid any interference with new civilian Radio Local Area Network developments.
- Identification of friendly aircraft through IFF.
- Most of sensors may operate autonomously and communicate with the BCP via wideband fiber-optic link. They can also distribute their data over a radio network.
- Low Probability of being Intercepted (LPI) for the most recently radars (discrete radars), due to using of Electronic Countermeasures (ECM). Consequently, these radars are Anti-Radiation Missile (ARM) resistant.
- The radar antenna uses phase-frequency electronic scanning technology, forming sharp 3D pencil beams covering large surveillance and track volume.
- In order to provide high altitude coverage, the radar energy is spread in multiple elevation beams. The elevation coverage may be very high (over 50°), allowing just minuscule blind gap above

the radar. This is illustrated below by a mode example showing 50 km instrumented range and full elevation coverage.

- The capacity -for some radars to perform automatic terrain following/ mapping which enables the radar to detect and track targets in low altitude and high clutter environments.

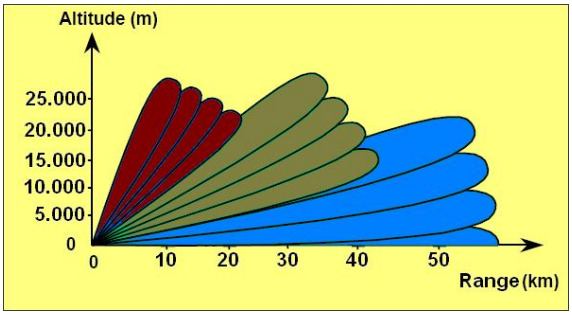

Fig.4. –Multiple Elevation Radar Beam Patterns

- Narrow azimuth and elevation beam radar widths. This feature has the benefits:
  - minimizes volumetric and distributed ground clutter cancellation residues on signal-to-interference ratio maintaining accurate target updates;
  - maintains track accuracy for very low-altitude threats;
  - minimization of exposure to main beam jamming.

- The improvement of the basic characteristics, such as: the detection range, the elevation coverage, the data rate, the accuracy and the resolution.

- The use of the passive sensors. Thus, due to the development of air-launched high-speed anti-radiation missiles, the use of air defence radars becomes more dangerous. This kind of missiles can continue their attack on the basis of the last computed target position if the radar is closed down.

The advent of the anti-radiation drone is encouraging the use of passive sensors, such the Electro Optical (EO) sensor and passive radar.

- The development of a new generation of radars, completely passive, which can't be detected by the anti-radiation weapon systems. This type of radar analyses the reflection of local FM signals (radio stations) that naturally illuminate any incoming air target to paint a picture of a certain arena's airspace operations. Stealthy and low-flying aircraft are no longer hidden from view as the system can monitors airspace in 360° radius out to (over) 70 km. Because this radar has not radiation emission, it creates nor ECM issues or ecological deployment restriction and, can be deployed where normal radars cannot.

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ROTARY WING MICRO AIR VEHICLES SOLUTIONS

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***Abstract**:First we present the benefits of rotating wing micro aerial vehicles (RW-MAVs) and a classification of the mission scenarios. According to the new missions we define the basic requirements that RW-MAV that should be satisfied in order to successfully complete urban and indoor missions. We define the new 4RW-MAV architecture and we propose a compartive analysis with the characteristics and performaces of different classic solutions including the shrouded RW-MAV configuration. With a better maneuverability, portability and agility there are some differences regarding the performances and the payload capacity. In urban or indoor missions the maneuverability is crucial and thus the new architecture should provide better movement capabilities. The 4RW-MAV configuration is effective in indoor narrow space with a capability to maneuver in a very fast and effective way, impossible for other configurations. The net effect relevant for control during autorotation landing is analyzed by adding a vertical offset relative to the vertical position predicted in the absence of ground effect. This vertical offset is estimated from flight data and taken into account accordingly.*

***Keywords**: micro aerial vehicle(MAV), rotary wing MAV (RW-MAV), flight dynamics,*

1. Introduction

Autonomous RW-MAV flight represents a challenging control problem with high dimensional, asymmetric, nonlinear dynamics. RW- MAVs are widely regarded to be significantly harder to control than fixed-wing micro air vehicles. At the same time, RW-MAVs provide unique capabilities, such as in place hover and low-speed flight, important for many applications.

Recently, there has been considerable progress in autonomous RW-MAV flight. Examples range from basic upright hovering and forward flight to inverted hovering, and even to extreme aerobatic maneuvers. All of this prior work pertains to helicopters operating with normal engine power.

The starting point for this kind of research is based on a new definition, a new classification of scenarios and missions proposed for the smallest category of UAVs. Based on the new technologies and the downsizing of the payload and sensors, the effective envelope of civil applications for UAV systems (UAS) is extended and the research is focus on the ways to find new architectures, new solutions for reducing the costs of missions. According to their special capability to hover, there are different types of missions for RW- UAVs: urban law enforcement, special operations and information gathering; coastal patrol, on-shore border patrol and maritime surveillance; civil security (search & rescue and avalanche survivor search); fire brigade; civil security and police (contamination measurement and natural disaster monitoring); environmental (crop monitoring and local science mission); flight services (training, terrain mapping, photography and monument inspection). The aim of the analysis of scenarios and the capability to respond to different possible profiles of the mission is to obtain new solutions, more robust and more effective. The main obstacles in the development of small size rotary wing vehicles are related to the following aspects: it is very difficult to develop control laws in an environment in which the flow induced by rotors in the vicinity of walls generates strong nonlinear aerodynamic ground effects; the problem of obstacle avoidance is difficult for small size objects; the autonomous navigation in a GPS-denied environment is not very accurate for small systems; the design of an airframe that can protect the vehicle against

collision is possible only for dedicated configurations (ISAE concept). There are made of course new steps in video compression and real time monitoring, in navigation and control of micro vehicles. It is also necessary to reduce the weight, size and power consumption of payload (analyzing sensors technology, optics, housing and cabling and connectors), to adopt innovative sense and avoid systems, to test some new platform configurations that allow an extended envelope of operation for such miniaturized systems.

The basic performance parameters are presented in the following list:

- **Maximum Take Off Weight**: it represents the overall value of the vehicle mass. It is calculated considering the whole RW-MAV with every kind of device or instrument installed on it at the moment of the start of the mission (take off).
- **Payload:** for this parameter different definitions can be found. In our case, considering the modular conception of the platforms that will be designed, the payload can be seen as the maximum weight of the module applied to the vehicle. The difference between maximum take off weight and payload represents just the weight of the vehicle with the only devices strictly needed to make it fly.
- **Maximum speed**: this is the highest value of speed that the RW-MAV can reach during the fly.
- **Endurance**: it represents the time that the air vehicle can spend flying before a new landing is required (for changing batteries, refueling, recharging, downloading collected data, …).
- **Range**: it represents the maximum distance from the starting point that the vehicle can reach considering that it must come back and land. This parameter could change depending on the mission. In fact if it is not required the RW-UAV to come back, the maximum range could be theoretically double.
- **Ceiling**: due to the changing of the air characteristics with the altitude with respect to the sea level, the RW-UAV can reach a maximum height depending on its characteristics (power, efficiency, etc.).

2. Innovative RW- MAV platforms, different from the conventional ones

The basic requirements to satisfy in order to successfully complete an urban mission are:

- **Safety**: is for sure the most relevant topic when any kind of vehicle, especially if it is a flying vehicle, has to operate near to human beings. In case of accident, due to an external factor (system failure, too strong wind, etc) or a mistake during the mission (wrong manual maneuver, bad mission definition to the autopilot, etc), the contact between any rotating part of the vehicle and people in the surrounding has to be prevented and avoided.
- **Agility**: in urban environments it is common to find buildings very close one to each other, with different height, trees, electric cables, poles and a huge number of other fix or moving obstacles. For this reason, once took for granted that any "urban-UAV" must have its own collision avoidance system, the vehicle needs a great agility in terms of rapidity in changing speed, direction or altitude. The controllability must be improved as the speed of the platform increases as at high speed there is less time for decision and command of escape maneuvers. This characteristic would be probably more relevant than other, like the maximum speed value, because in narrow spaces it can become strictly necessary. Form this point of view the best platform would be the smallest and lightest one (for instance a small 4 rotors) or in general the one with the higher power/mass ratio.
- **Autonomy**: in order to satisfy this particular requirement, the general platform layout or shape is not so relevant. More relevance has to be given to all the vision sensors (cameras, IR, thermal or sonar sensors, etc) and the flight control software (autopilot, collision avoidance, etc.). So during the design phase of an UAV for urban applications, all these devices must be taken into account and must be developed very carefully.

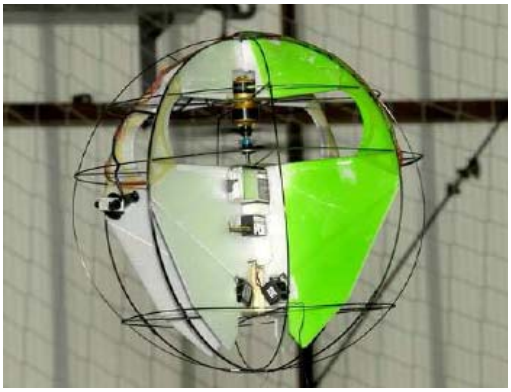

Fig. 1 Concept from ISAE

a)Vision concept from ISAE (Figure 1) is a new tilt body bi-rotor concept based on two propellers facing each other and surrounded by a series of circular carbon rods. Each propeller is driven by a simple out runner brushless motor which has the advantage to avoid the complexity of a hollow shaft system. Speed control of both motors is carried out through a pair of speed controllers electrically connected through the carbon rods.The ultimate goal of the Vision is to be used as a hand-launch projectile which could be thrown through a window, roll on the floor and take-off to complete its indoor spying mission.

b) AirRobot (Figure 2) is a micro UAV with autonomous flight and navigation capabilities and modular payloads for use in reconnaissance, surveillance, search and rescue, documentation, inspection and also other scenario.

Fig. 2 AirRobot

AirRobot AR family is a concept based on quadro-rotor solution and has a compact size of only 700 mm in diameter and utilizes a new (patented) propulsion system..

Fig.3 Fancopter

Fancopter (Figure 3) is a close range aerial reconnaissance micro- system. The compact dimensions and collision avoidance system enable this RW- MAV to be used even inside buildings.

The Small Quad-rotor **4RW-MAV** (Figure 4a) is suited for very small payloads and can eventually fly inside buildings. Due to the small size of the platform part of the structure or internal components can be shared with model aircraft industry, this allows the widespread utilization of COTS for the design and development of such systems. Quad-rotors can be up scaled to higher maximum take off weight mass and payload mass to fulfill payload requirements for other missions, such as those coupled with the small shrouded rotor platform (Figure 4b). **SIERRA Cargo Plus** allows the utilization of bigger sensors for missions inside buildings. It results a capability to perform some missions that involve surveillance thanks to the availability of professional camera and video camera in the new payload range

a) b)

Fig.4 a-SIERRA Concept , b-Classic and 4RW Cargo Plus

3. An analysis of the dynamics of a conventional 4RW-MAV

4RW-MAVs are well-known to have complex dynamics. For instance, to completely capture the state of the "4RW-MAV system" one would have to include the state of the air around the 4RW-

MAV into the dynamics model. However, various prior work done on a conventional RW-MAV has shown it is possible to build a sufficiently accurate model for control by treating the 4RW-MAV as a rigid-body, possibly including the blade-flapping dynamics and the main rotor speed.

Let $\{e_N, e_E, e_D\}$ the inertial axes and $\{x_B, y_B, z_B\}$ the body axes. Euler angles of the body axes are $\{\varphi, \theta, \psi\}$ with respect to the e_N , e_E and e_D axes (roll, pitch, yaw). Let *r* the position vector from the inertial origin to the vehicle center of gravity and ω_B the angular velocity. The current velocity direction is referred to as e_v in inertial coordinates.

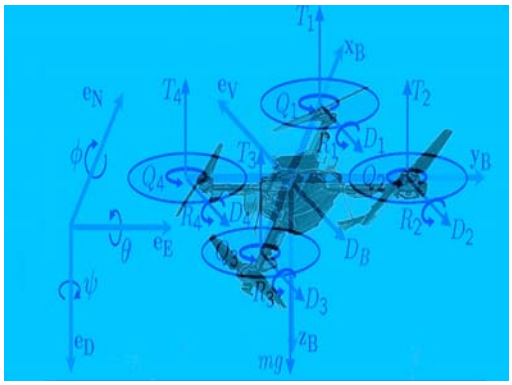

Fig.5. Diagram of a quad-rotor aircraft

The rotors, numbered 1−4, are mounted outboard on the x_B , y_B , $-x_B$ and $-y_B$ axes, respectively, with position vectors r_i with respect to the CG. Each rotor produces an aerodynamic torque, Q_i, and thrust, T_i, both parallel to the rotor's axis of rotation, and both used for vehicle control.

$$\text{Here, } T_i \approx u_i \frac{k_t}{1+0.1s} \text{ ,} \qquad (1)$$

where u_i is the voltage applied to the motors, as determined from a load cell test. In flight, T_i can vary greatly from this approximation. The torques, Q_i, are proportional to the rotor thrust, and are given by $Q_i = k_r T_i$. Rotors 1 and 3 rotate in the opposite direction as rotors 2 and 4, so that counteracting aerodynamic torques can be used independently for yaw control. Horizontal velocity results in a moment on the rotors, R_i, about $-e_v$, and a drag force, D_i, in the direction, $-e_v$. The body drag force is defined as D_B, vehicle mass is m, acceleration due to gravity is g, and the inertia matrix is $I \in R^{3x3}$. A free body diagram is depicted in Figure 2. The total force, F, and moment, M, can be summed as,

$$F = -D_B e_v + mge_D + \sum_{i=1}^{4}\left(-T_i z_B - D_i e_v\right)$$
$$M = \sum_{i=1}^{4}\left(Q_i z_B - R_i e_v - D_i\left(r_i \times e_v\right) + T_i\left(r_i \times z_B\right)\right) \qquad (2)$$

The full nonlinear dynamics can be described as,

$$m \cdot \ddot{r} = F$$
$$I\dot{\omega}_B + \omega_B \times I\omega_B = M \qquad (3)$$

where the total angular momentum of the rotors is assumed to be near zero, because they are counter-rotating. Near hover conditions, the contributions by rolling moment and drag can be neglected in Equations (1) and (2). Define the total thrust as $T = \sum_{i=1}^{4} T_i$. The translational motion is defined by,

$$m\ddot{r} = F = -R_\psi \cdot R_\theta \cdot R_\varphi T z_B + mge_D \quad (4)$$

where R_φ, R_θ, and R_ψ are the rotation matrices for roll, pitch, and yaw, respectively. Applying the small angle approximation to the rotation matrices,

$$m\begin{bmatrix}\ddot{r}_x\\ \ddot{r}_y\\ \ddot{r}_z\end{bmatrix} = \begin{bmatrix}1 & \psi & \theta\\ \psi & 1 & \varphi\\ \theta & -\varphi & 1\end{bmatrix}\begin{bmatrix}0\\0\\-T\end{bmatrix} + \begin{bmatrix}0\\0\\mg\end{bmatrix} \qquad (5)$$

Finally, assuming total thrust approximately counteracts gravity, $T \cong \overline{T} = mg$, except in the e_D axis,

$$m\begin{bmatrix}\ddot{r}_x\\ \ddot{r}_y\\ \ddot{r}_z\end{bmatrix} = \begin{bmatrix}0\\0\\mg\end{bmatrix}\begin{bmatrix}0 & -\overline{T} & 0\\ \overline{T} & 0 & 0\\ 0 & 0 & 1\end{bmatrix} + \begin{bmatrix}\varphi\\ \theta\\ T\end{bmatrix} \qquad (6)$$

For small angular velocities, the Euler angle accelerations are determined from Equation (3) by dropping the second order term, $\omega \times I\omega$, and expanding the thrust into its four constituents. The angular equations become,

$$\begin{bmatrix}I_x\ddot{\varphi}\\ I_y\ddot{\theta}\\ I_z\ddot{\psi}\end{bmatrix} = \begin{bmatrix}0 & l & 0 & -l\\ l & 0 & -l & 0\\ K_r & -K_r & K_r & -K_r\end{bmatrix}\begin{bmatrix}T_1\\T_2\\T_3\\T_4\end{bmatrix} \qquad (7)$$

The 4RW-MAV control is based on a 4-dimensional action space: the cyclic pitch controls i_{lon}, i_{lat}, which cause the 4RW-MAV to pitch forward/backward or sideways; the tail rotor (rudder) control i_{rud}, which affects tail rotor thrust, and can be used to yaw (turn) the 4RW-

MAV; the main rotors collective pitch control i_{col}, which changes the main rotors thrust by changing the pitch of the rotor blades.The interest is to use a dynamics model with a relatively small number of parameters to be estimated from flight data. In this case we first subtracted the effects of inertia and gravity, and then learn a model from data to predict accelerations in a coordinate frame attached to the 4RW-MAV. We integrate the accelerations over time to obtain position, velocity, orientation, angular rate and main rotor speed. The simplified dynamics uses the following parameterization:

$$\dot{u} = v \cdot r - w \cdot q - g_u + C'_u \cdot [u] \quad (8)$$

$$\dot{v} = w \cdot p - u \cdot r - g_v + C'_v \cdot [v] \quad (9)$$

$$\dot{w} = u \cdot q - v \cdot p - g_w + C'_w \cdot \left[1; w; i_{col} \cdot \Omega; \sqrt{u^2 + v^2}\right] \quad (10)$$

$$\dot{\Omega} = C'_\Omega \cdot \left[1; \Omega; i_{col}; w; \sqrt{u^2 + v^2}; \left(i_{lat}^2 + i_{lon}^2\right)\right] \quad (11)$$

The velocities (u, v, w) and angular rates (p, q, r) are expressed in the 4RW-MAV's reference frame. Here g_u, g_v, g_w refer to the components of gravity in the 4RW-MAV's reference frame; is the main-rotor speed.

4. Conclusions and future work

The 4RW-MAV architecture has similar characteristics to the traditional shrouded configuration. The main differences are in the payload entity, the maneuverability and the portability. The payload, instead of being from 3 to 20 kilograms, is less than one kilogram. In this way it is the best choice for scenarios whose payload is an optical camera or a simple IR camera. This is the case of the different indoor missions. In this case the maneuverability is crucial and thus the configuration must provide a very high level of movement.

The 4RW-MAV architecture is able to maneuver in a very fast and effective way, moving in a way not possible for the other configurations. The portability can fulfill the needs of a typical mission, in which the rotorcraft should be carried on by a single person and should become operational in a very short time. The weaknesses of the 4RW-MAV configuration are the low speed, low endurance and short range.

We found that the net effect relevant for control during an quad rotor autorotation landing was sufficiently well captured by adding a vertical offset relative to the vertical position predicted in the absence of ground effect. This vertical offset was easily estimated from flight data and taken into account accordingly.

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MEF ANALISYS OF HEAT TRANSFER IN IAR-99 BRAKING SYSTEM

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Abstract. *The paper presents aspects of the thermal field on the block braking of IAR 99 aircraft during landing and thereafter. The thermal field was conducted with the finite elements method*
Keywords*: break system, temperature, fem*

1. FEM relations

Equation finite element method for nonstationary heat transfer is:

$$[C]\{\dot{T}_i\}+[K]\{T_i\}=\{R\} \quad (1)$$

The matrices of the relationship 1 are:

$$[C]=\int_V \rho c\{N\}^T\{N\}\,dV \quad (2)$$

$$[K]=\int_V [B]^T[\lambda][B]dV+\int_{A_2}\alpha\{N\}^T\{N\}\,dA \quad (3)$$

$$\{R\}=\int_V \{N\}^T\{Q\}\,dV+\int_{A_2}\alpha\{N\}^T\{T_2\}\,dA-\int_{A_3}\{N\}^T\{q\}\,dA \quad (4)$$

where

ρ : material density;

c : specific heat;

λ_x, λ_y, λ_z : thermal conductivities in x,y,z direction;

$[\lambda]$ thermal matrix;

$\{N\}$ interpolation function vector;

[C] caloric capacity matrix;

[K] thermal rigidity matrix;

{R} free terms vector.

2. Finite element modeling

Modeling the components of the braking system was simplified geometry to achieve a convergence of the grid. Thus the base part and pressure plate have been removed the screw holes.

Intermediate rotor disc in the form shown in figure 1 (6 parts), is remade in the new form shown in figure 2 (single part).

Figure 3 is presented finite element tetrahedron model of the braking system with four nodes per element. The resulting was 119.340 elements and 27.253 nodes.

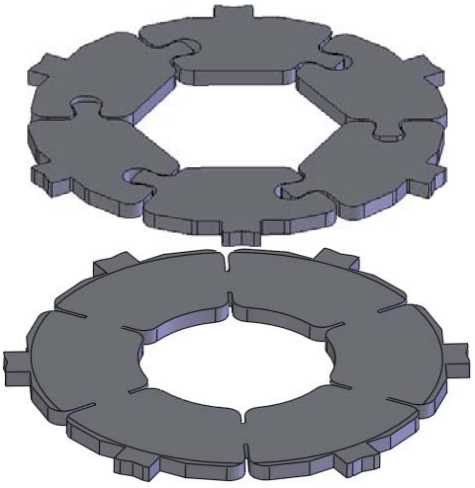

Fig. 1 Intermediate rotor disc
Fig. 2 The new form

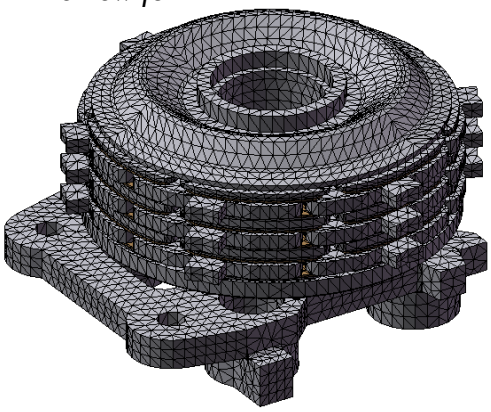

Fig. 3 The FEM model

The data collected at airplane IAR-99 landing, is found:

- Speed at the start of braking $v_i = 180$ km/h ;

- Speed at the end of braking $v_f = 30$ km/h - speed remains approximately constant until the parking of aircraft;

- Average braking distance D = 650 m;

- Airplane weight: M = 4500 kg;

- Diameter of the tire wheel brake: Dr = 650 mm;

- Number of wheels that brake: n = 2.

Changes in the kinetic energy of the plane can be written as:

$$\Delta Ec = \frac{1}{2} M\left(v_f^2 - v_i^2\right) = -5.469 \times 10^6 \text{ J} \quad (5)$$

The work produced by the forces of friction braking system is equal to the change of kinetic energy, neglecting air friction.

Calculating for a wheel:

$$\Delta L_{fr} = \frac{\Delta Ec}{2} \quad (6)$$

To determine the heat generated during braking is assuming that 95% of work is transformed into heat, the rest being properly brake wear plates and other phenomena. Thus the heat produced by braking system on a single wheel is:

$$Q = \frac{95}{100} \cdot \Delta L_{fr} = 2,598 \times 10^6 \text{ J} . \quad (7)$$

Braking time, corresponding to a constant deceleration is:

$$tf = \frac{2D}{v_f + v_i} = 22,286 \text{ s} \quad (8)$$

Contact area for the metal plate is $Apc = 2643,78 \text{ mm}^2$.

Heat flow is:

$$q = \frac{Q}{2 \cdot nr.contacte \cdot nr.suprafete \cdot Apc \cdot tf} = 0,48 \times 10^6 \frac{W}{m^2} . \quad (9)$$

The contact surfaces between stator and rotor disks were loaded with heat flow determined, considered to be constant in time and area. Law of variation of heat flow is shown in figure 4.

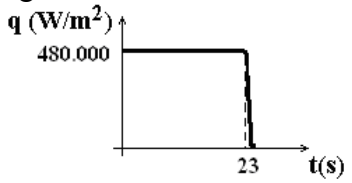

Fig. 4 Law of variation of heat flow

It is considered that the lateral surfaces of the discs lose heat by convection with the external environment with $\alpha = 5 \text{ W/m}^2\text{K}$, by being exposed the gap between discs and rim, and for the base areas being exposed to a greater air flow rate of thermal convection $\alpha = 30 \text{ W/m}^2\text{K}$.

The figures 5 and 6, presented in section, the temperature field in the block brakes. In figure 7 is presented the temperature variation for 1815 node.

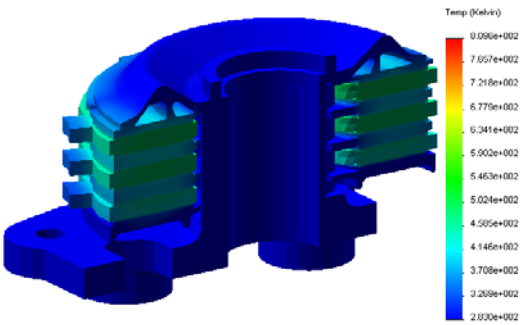

Fig. 5 Thermal field at 10 s from the beginning of breaking

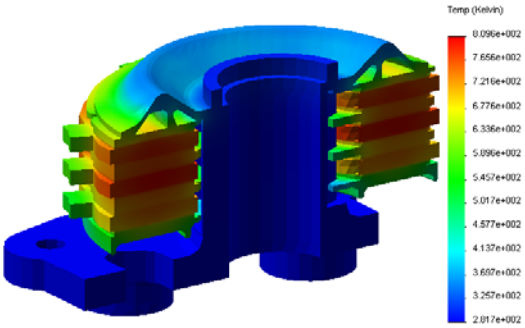

Fig. 6 Thermal field at 23s from the beginning of breaking

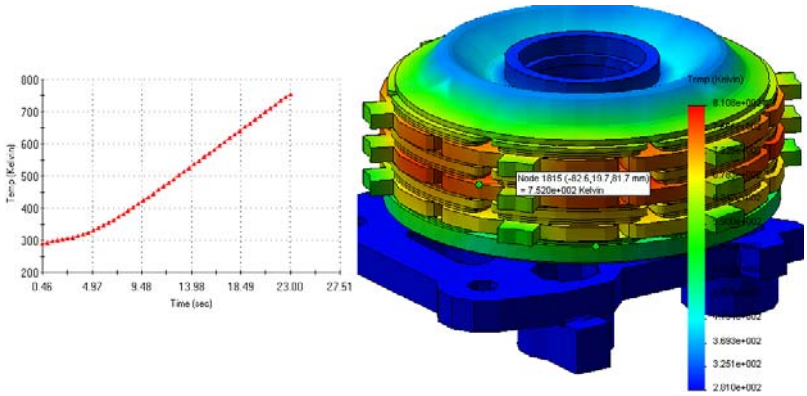

Fig. 7

3. Conclusions

There is a maximum temperature 809°K reached the end brake discs inside the packages, to the outside this of 780° K. In most of the heat gained by friction temperature being distributed about conduction in the volume of metal surrounding, only a very small proportion being evacuated by convection.

The convection becomes important for larger time intervals.

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TEMPERATURES IN THE BREAK SYSTEM OF IAR-99 LANDING GEAR AFTER LANDING

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Abstract. *The paper presents aspects of the thermal field on the block braking of IAR 99 aircraft during after landing. Experimental aspects are presented.*

Keywords: break system, temperature

1. Description of the braking system

The braking system consists of brake discs. Figure 1 shows a state intermediate disc and metal plate in figure 2 intermediate disk rotor (rotating with rim) made of steel plates.

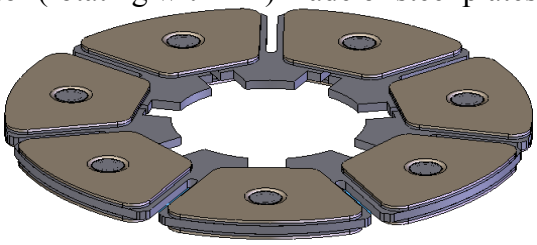

Fig. 1 Intermediate stator disc

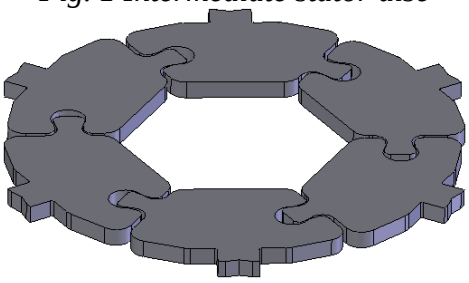

Fig. 2 Intermediate rotor disc

Figures 3 and 4 are presented discs marginal sea. Thus in figure 3 is the disc acting hydraulic pistons and in figure 4, the disc comes into contact with pressure plate.

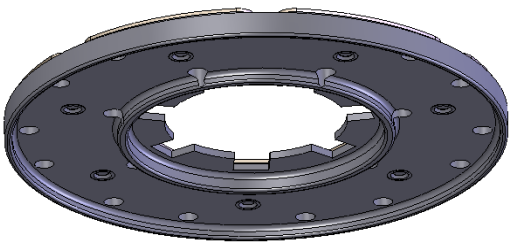

Fig. 3 Stator disc where is acting the hydraulic pistons with pressure plate

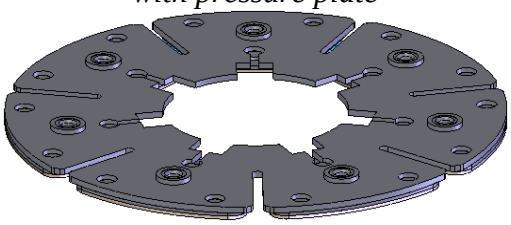

Fig. 4 Stator disc in contact

Rim is presented in figure 5 and in 6 is shown the braking system in section.

Fig. 5 The rim

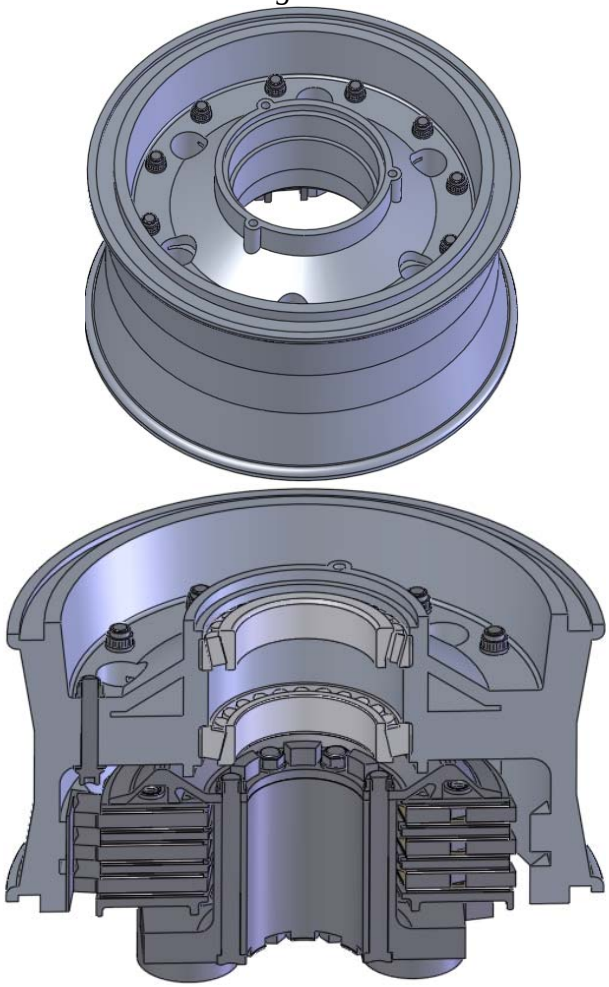

Fig. 6 Breaking system in section

2. Determination of making the airport

Experimental determinations were carried out at the airport of the punk, the airplanes IAR 99. Temperatures were measured on the pressure plate, the piston block, on the rocks near the tire and the tire. Temperature was measured with an infrared thermometer. Determinations were made immediately after the parking of aircraft, after a route with an average speed 30 km/h to at parking. The landing has two stages: first is to break the aircraft speed of about 190 km/h to 30 km/h (braking distance is achieved on average 600 m) and run to the end of the runway with a speed of 30 km/h.

Instantaneous temperatures were taken at the points specified for each aircraft as soon as sidings, the brake block elements, and were determined temperature trends for the same flight time.

Weather conditions the operation of measurement was:

- Air temperature 4 - 10 ° C.
- Wind speed 2 - 4 m/s.

Figures 7 and 8 are presented measurements of the aircraft immediately after the parking.

Fig. 7 Temperature on pressure plate

Fig. 8 Temperature on rib

In Table 1 are the measurement results for samples taken immediately after the parking. The temperature values have variations of several tens of degrees on certain components (such as pressure disk).

Table 1 – Temperatures after parking

Probe	Temperature on the last stator disc [°C]	Temperature on rim in tire vicinity [°C]	Temperature on pressure disc [°C]	Temperature on tire [°C]
1	209	72	270	43
2	169	64	294	41
3	250	78	270	42
4	210	60	278	41
5	180	55	200	39

Temperature determinations over time. Temperature evolution was determined for a single plane, on a time about 36 minute from the beginning of parking.

Temperatures were measured in the following order: the pressure plate, the rim near the tire and tire near rib. The time required measurement of the three values is small, and the change in temperature is very small over this period. He made assumptions that the time for determining the three temperatures are considered to be during the first measurement.

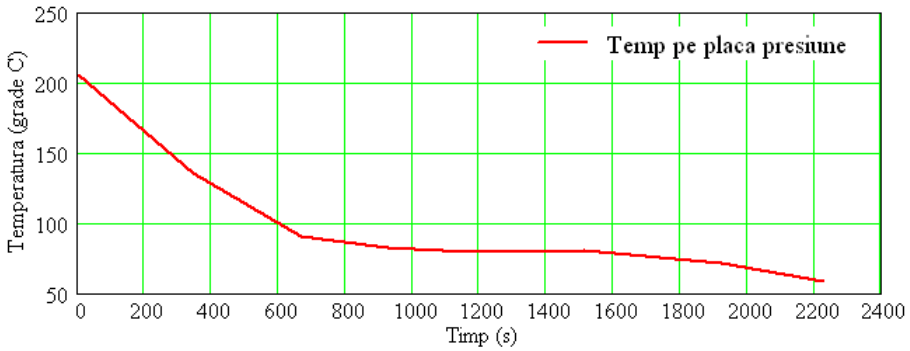

Fig. 9 Pressure plate temperature

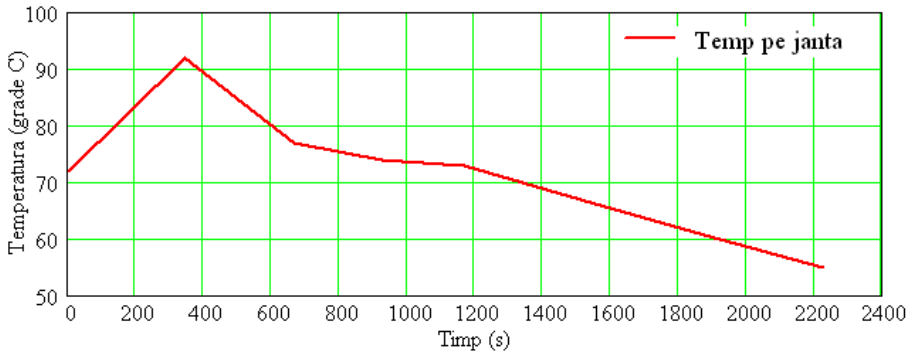

Fig. 10 Rib temperature

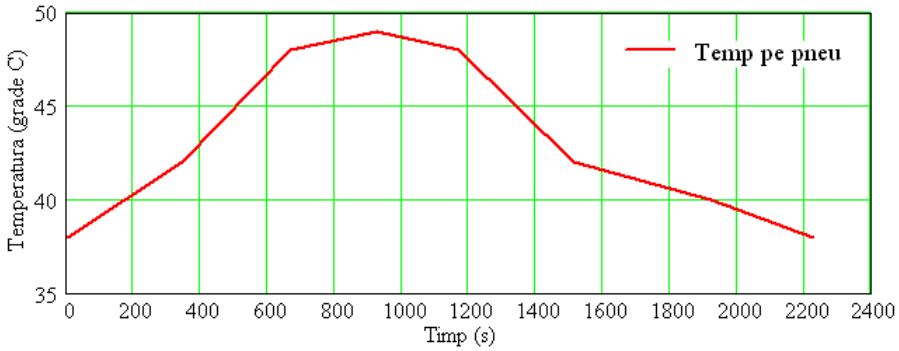

Fig. 11 Tire temperature

3. Statistical processing of experimental data

For data interpolation I use polynomial regression whit a 3-th degree polynom and spline interpolation.

Figure 12 is presented the temperature interpolation function measured by pressure plate.

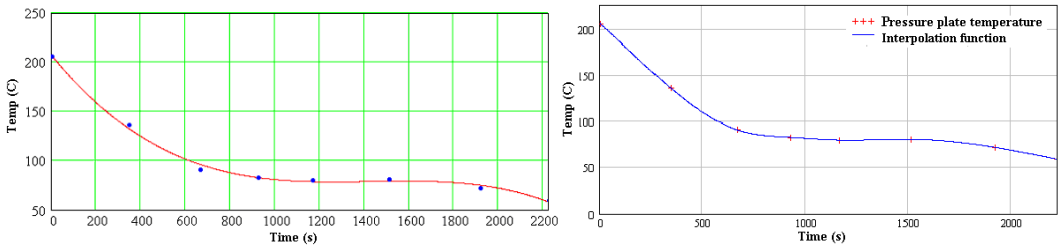

Fig. 12

$$Tpp(t) = 206,739 - 0,277 \cdot t - 4.625 \cdot 10^{-8} \cdot t^3$$

In figure 13 is presented the rim temperature for interpolation function measured on.

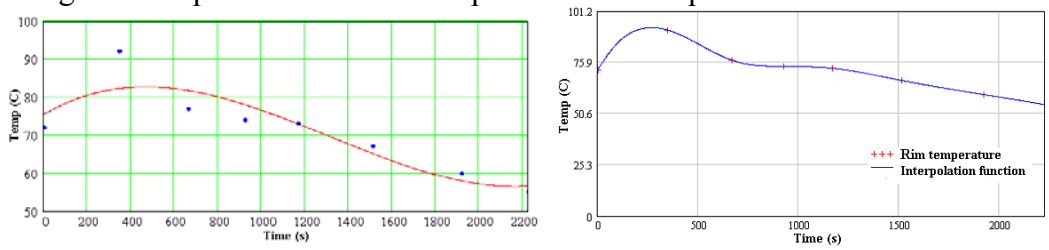

Fig. 13

In figure 14 is presented the tire temperature for interpolation function measured on.

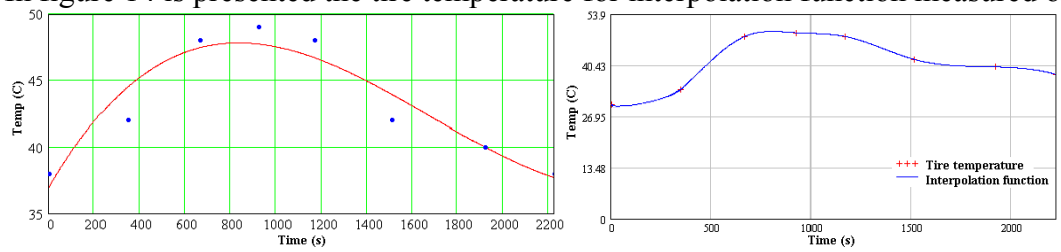

Fig. 14

$$Tp(t) = 37,001 + 0,029 \cdot t + 4,627 \cdot 10^{-9} \cdot t^3$$

4. Conclusion

The temperature variations immediately after sidings for different planes can be explained by different regimes of aircraft brakes, which are mainly conditioned by the speed at landing.

The heat of brake system is change by conducted in mass parts and by convection in the atmosphere. Conducted heat is observed in the interpretation of figures 12-14, where, noted that while the pressure plate temperature decreases in time interval $[0,500]$ sec, the tire and the rim temperature and increase.

Forced air flow (due to wind) favors the exchange of heat with air.

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APPLICATION OF INTERNATIONAL AVIATION REQUIREMENTS IN THE BACHELOR-DEGREE PROGRAMMES AT THE FACULTY OF AERONAUTICS OF THE TECHNICAL UNIVERSITY KOŠICE

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Abstract: *This paper is providing solution to the application of international aviation requirements in Bachelor-degree programmes at the Faculty of Aeronautics of the Technical University Košice.*

Keywords*: Joint Aviation Authorities (JAA), European Air Safety Agency (EASA), Joint Aviation Requirements (JAR), Part, Bachelor-degree programmes, PEGASUS, Road 66*

1 INTRODUCTION

The formation of the independent Slovak republic as of 1 January1993 represented a substantial change in the accepted links of control, economic and logiticsand the relations within civil aviation. New control structures have been created, formerly typical only of ther federal level . By decision of the Minister of Transportation, Post and Telecommunication of the Slovak republic of 26 June 1998 No. 74/98 on the issuance of the Statute of the ammendments to the Charter of Foundation of state budgetary organization, namely the State Aviation Inspectorate, was instrumental in the formation of the Slovak Aviation Authoritiestaking office since 1 July 1998[1]. The aviation requirements , guidelines, methodology and procedures so far valid inCzechoslovakia have been adopted in full extent. The Slovak Civil Aviation Authorities immediately following its formation has started an intensive cooperation with international organizations. In the wake of the declaration of the independence, the SLovak republic has become member of ICAO[2] and ECAC[3] as well as other international organiyations of civil aviation. The Slovak Civil Aviation Authorities have also taken on the the demanding job implementation of Joint Aviation requirements known as „JAR“. On joining the European Union, the Slovak republic has accepted all the commitments related to air transportation which hjhad been in force in the former member-states and which have been accepted by the direction of the European Parliament and the OCuncil of European Communities (EC) and the directions of the committees (EC).

[1] **Civil Aviation Authorities of the Slovak Republic** – supreme body of civil aviation fo the Slovak republic, cooperating with international organizations repsonsible for standardization and active in implementation of those norms and recommendations of ICAO or JAA in everyday life ovf civil aviation.

[2] **ICAO** – International Civil Aviation Organization – Organization of worldwide coverage residing in Montreal, Canada, established to ensure systematioc development of international civil aviation, motivate activities related to designing and flying transport aircaraft, support buidliding new lines, airpports and navigational aids and be concerned with air safety.of civilian aircraft. It defines unified norms and issues recommendations as regards aviation staff, air traffic, meteo service, aviation maps, technical operation of aircraft and communication services.

[3] **ECAC** – European Civil Aviation Conference – International organization residing in Paris, ensuring coordination of european air transportation with the aim to bring the highest possible efficiency and its further development. It is compiling situational overviews on air transportation status, to solve concrete problems and submit suggestion for international agreements. In larger scale, i tis dealing with unification of air regulations in Europe and providing technical assistance. Established on the initiative of the Council of Europe and closely cooperating with ICAO, assisting in its functioning as laid down in the statutes.

Acceptance of these requirements is exactly defined in terms of time and are binding for the Slovak republic.

2 SLOVAK REPUBLIC AND THE AVIATION LEGISLATIVE OF EUROPE

The directives of the European Parliament and of the Council No. 216/2008 of 20 February 2008 „On common rules in the field of civil aviation and establishing a European Aviation Safety Agency“ defines the sphere of activity of European Aviation Safety Agency within the bounds of European Union.

The directives of the Committee (EC) No. 1702/2003 of 24 September 2003 is defining the executive rules of certification of aircraft and related product, parts and equipment as well as certification of development and manufacturing organiyations, forming appendix to this document marked as Part-21.

The directives of the committee (EC) No. 2042/2003 of 20 November 2003 is defining the executive rules of continued airworthiness of aircraft and aviation products, parts and equipments and approval of organizations and personnel involved in these activities. In the appendices of this directives are the requirements : Appendix I – Part M – Continued airworthiness of aircraft and issuance of the certificate of verification of airworthiness, Appenmdix II – Part 145 – Organizations of aircraft maintenance, Appendix III – Part 66 – Certifying personnel of maintenance and Appendix IV – Part 147 – Approved training of maintenance/ tests. The regulations mentioned as „Parts“ are in full extent takin over the marking, contents and also the form of Joint Aviation Requirements known as „JAR“ and are aktualizované onto the current conditions of the European Union. The transition of EU member stsates onto these regulations is controlled and coordinated by the civil aviation authorities of meber states and are subject to a mandatory schedule. The regulations Part-147 and Part-66, which, appart from small exceptions, are entering force in September 2005, bear extreme importance for the Faculty of Aviation of the Technical University Košice. In line with these standards, the school is to adopt a system of preparation of future aviation experts so that they, on completion of their studies, could be prospectively accepted on the European job market of civil air transportation.

3 APPLICATION OF EUROPEAN LEGISLATION ON AVIATION IN THE CURRICULA OF BACHELLOR DEGREE PROGRAMMES AT THE FACULTY OF AERONAUTICS OF THE TECHNICAL UNIVERSITY KOŠICE

The merger of the Air Force Academy of G. M. R. Š. Košice and the Technical University Košice in 2004 resulted in the formation of the Institute of Aeronautics, on the basis of which the Faculty of Aerionautics of the Technical University Košice (LF TUKE) in 2005. Based on the drafts submitted, the Ministry of Education of the SR has approved the programmes of Bachellor and Master degree studies. Simultaneously, on the basis of the criteria met, accredited were also some of the Doctoral degree programmes. The programmes presented have been developed already in compliance with the valid EU standards and regulationsso that the Faculty of Aeronautics of the Technical University could be approved as the authorized organization for running aviation personnel in line with the requirements of European aviation regulations Part-147 and Part-66 by the Slovak Civil Aviation Authorities. The curricula of the Bachellor degree programm subjects at the FA TUKE has been designed in line witht he contents of appropriate study modules laid down by Part-66 so that graduates could meet theoretical requirements for holding th posts in service of civil aviation Categories B1 and B2. The Master degree curricula are designed to meet theoretical requirements of Part-66 for Category C.

Almost immediately after the development and accreditation of curricula, the FA TUKE applied in 2005 for approval of the school as an authoriyed organization for training of aivation personnel in compliance

with Part-147 and Part-66. Following a detailed assessment of the „Interpretation of the organiyation of the FA TUKE“ as well as the further documents required by the Slovak Civial Aviation Authorities, the FA TUKE has become an authorized organization in compliance with regulations Part-147 and Part-66. To enablese of training and practice of students, the FA TUKE has established facilities, workshops and special-purpose laboratories, taken over from the former AFA G.M.R.Š. Practical training on a concrete aviation equipment, in line with contracts concluded with Air Transport Europe spol. s. r. o. (Ltd.) Poprad, will be run directly within the premises of the airliner.

Among the new subjects lectured at the FA TUKE, in line with the curricula, is „Air Law I.“, formerly, at the AFA G.M. R. Š. was reduced only to military regulations. The subject is planned for the first semester and is a mandatorily optional for all aviation specialiyations, meeting the requurements of module 10 of Part-66. Prerequisites to success in that subject is earning the credit and taking the examination. The successful student is consequently awarded 5 credits, in line with the Regulations on Studies of the FA TUKE. The aim of the subject „Air Law I“ is that the studens on having particiated in 56 lecture hours, exercises and seminars acquire a general view of the majro national and international rules of the air and thereby be able to graps the character of the individual rules. Successfully passing from the subject is enabling the student of Bachellor degree programme to make his or her own choice of regulations when solving concrete problem areas when performing and controlling servicing, maintenance and repair of aviation equipment with companies of civilian aviationnot only in Slovakia or elsewhere within the EU. The curriculum laids great emphasis particularly on managing international terms, definitions and abbreviations (JAR-1), requirements to be met by the certifying maintenance personnel (Part-66), requirements to be met by organisations approved for maintenance (Part-145), requirements to be met by approved training of maintenance and tests (Part-147) as well as requirements to be met when organizing commercial air transportation (JAR-OPS 1). Appart from international regulations and standards, students have to be familiar with Law No. 143/98 Coll. on Civili Aviation (Air Law) and its ammendments No.37/2002 Coll. and 544/2004 Coll. and the relevant national requirements, guidelines and provisions in force. Practical exercises and seminars, making up a quarter of the sum of the hours assigned for the subject, are intended for acquisition of practical skills when working awith the concrete regualtions and developing the capability of acquiring the necessary information in via the internet and handling them properly. The success of coping with the tasks set by the subject is much dependent also the students´previous language skills, namely coommunication in the target language, i.e. in English. The same approach, in line with the requirements set by the individual modules, was adopted when developing further accredited sspecialiyations in mechanical and electrical engineering.

Bearing the approval of the Civil Aviation Athorities to the of FA TUKE curricula for the subjects, for the modules as defined by Part-66, the civil aviation personnel is given chances to continuously update theoretical knowledge and sit for examinations for the individual levels A, B1, B2 and C directly at the FA TUKE. To this end, the FA TUKE is currently developing a form of distance study enabling study of the concrete module by Part-66 in line with his or her requirements at a substantially lower financial costs and losing time at work. The suggested scheme of distance study is requiring a previously completed introductory consultancy during which the undergraduate is being oriented in the subject, as to its content, requirements necessary for successful completion of the moduleas well as in the mandatory and recommended references. Towards the end of the introductory consultancy the participant to the course is furnished with information as to the use of electronic study sources. In the course of the study, the student has access to electronic communication with the lecturer

and thereby solving problems arising during the course. Prior to the final examination perform ed in the form of a standardized test, a final consultancy is planned in the extent of 8 lecturing hours. The standardized test are developed in compliance with the requirements of the Slovak Civil Aviation Authorities. The results of tests from theory of th e modulefor the given category of the personnel are prerequisites of approval of the Slovak Civil Aviation Authorities and on successful completion, are bases for the recognition of the given module for the given category of the personnel (A, B1, B2 and C). This form of distance study enables flexible reaction to the immediate needs for supplying qualified personnel for the widening job market in the civil aviation of the SlLovak republic.

4 INTERNATIONAL LEGISLATION – AIR LAW AND THE SLOVAK AIR FORCE

Within the framwork of the restructuring of the Slovak Armed Forces, the model document called „MODEL 2020“ has defined a task of „...preparation of trainees in the Air Force Professional Training School Košicein compiance with international regulations, „JAR-66“ and „JAR-147“. SImultaneously, in 2004, Ammendments to the Law No. 143/1998 Coll. (Air Law) by Law No. 544/2004 Coll.,where §48a defining task for the Slovak Armed Forces (SAF). In line with the law mentioned, as of 1 January 2006 the Office of Military Aviation came into being to coordinate military and civil aviation in accordance with international rules of the air in close cooperation with the Slovak Civil Aviation Authorities. The need to prepare military professionals for the air force in compliance with the regulations mentioned.

The end of the year 2008 was determined as the date for finishing the schooling of all technicians of aviation in accordance with rules of PART in Slovak Air Forces. In this time it was schooled and re-examined all technicians of aviation from law on aviation in co-operation with the Office of Military Aviation. After the successful re-examination and fullfiling of given conditions for authorization to work for aviation the Office of Military Aviation issued the certificate to all technicians of aviation. All following re-educations in Slovak Air Force are in accordance with rules and they are accomplished under the guarantee of the Office of Military Aviation which supervises on strict fullfiling of given conditions. has necessitated correction to be made in the curricula of former students of the AFA Košice for the 9th semester, i.e adding an extra subject namely the „Civil rules of the Air“.

The requirement of continuous schooling of the air force staff in international law on aviaton has been emphasized by the fact that the Slovak Air Force is to participate in NATO missions anywhere in Europe with its Mi-17 helicopters. The servicing staff of these helicpters is required to hold the appropriate internationally accepted certificates meeting the criteria set out by international regulations known as „Part“ („JAR“).

International rules of the air within the Slovak Armed Forces are in their early stages of implementation. In the near future, the process will require much more efforts on the part of the military, in terms of widening cooperation with civil organizations who have gone much more farther in this area.

5. CONCLUSION

Implementation of international standards nad regulations and international air legislation into the curricula for Bachellor-, Master- and Doctoral-degree programmes run by the Faculty of Aeronautics TU Košice coupled with close co-operation with international organizations and universities within the implementation of projects of the Council of Europe has allowed coordination and improvement of the system of education aviation professionals for civil aviation, achieving higher level of safety in civil air traffic and flexibility in meeting the needs and requirements of the rapidly developing civil air transportation in the Slovak republic as well as thos of the manufacturers and

operators of aviation technology throughout Europe. Since 2005 until now our university has already re-educated the third goup of graduates of our Faculty of Aeronautics of the Technical University in Košice according to rules of PART.

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Hocko M. – Air legislation I., collection of lectures for Bachellor –degree programmes

PRACTICAL USAGE OF THE A-319CJ AIRCRAFT AT THE CZECH AIR FORCE

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Abstract: *The article analyses remarkable changes in activities of the transport airbase in terms of substitution of obsolete aircraft by modern transport airplanes. Further, differences between transport airbase's aircraft and Czech Airlines' airplanes are introduced, as well as fundamental tactical and operating specifications, time and space factors regarding personnel transport, supplies transport and possibilities of Airbus A319CJ's freight hold adjustment in dependence on the nature of transport.*

Key words: *Airbus A-319 CJ aircraft, transport aircraft, airbase, Czech Air Force.*

1. INTRODUCTION

The task of air transport by airliners within Czech Republic and abroad is fulfilled by the 24th Transport Airbase at Prague – Kbely. During duty alert status of the state and during emergency measures, it fulfills tasks assigned by the Minister of defence. It has been participating on the transport of constitutional representatives since 1993, unofficialy since 1990. Beside that, it provides transport of transplant organs and it participates on the integrated rescue system.

The transport component of our air force has been still conducting airlift and transport missions by the Russian-made Tu-154M aircraft since the 1970's. It is true, that these aircraft belong among the most recent of its type (the last delivery was realized just a few years ago), thus both technical and period lifetime enables their operation for many years on. As far as the often mentio-ned failure rate is considered, it is actually not as bad as it is commonly presented. The biggest problem of Tu-154M aircraft is its three engines, which produce enough power, so these aircraft are among the fastest airliners whatsoever, nonetheless they begin not to satisfy some important requirements for modern aircraft.

The Tu-154M aircraft have not been continuously modernized by the manufac-turer since they were put into service and therefore they were taken out of service by the majority of commercial airlines (Czech Airlines incl.) because of economical rea-sons in the 1990's. At the present time, these aircraft are operated just by countries of the former Soviet Union and also for transportation of Slovak and Polish govern-ment representatives.

The following data are the basic tactical and technical specifications of the Tu-154M: maximum gross weight 100 000 kg, cruise speed 900 kph, cruise Mach 0.84, maximum FL 410, maximum ferry range 5 000 km with commercial load 7 000 kg (passengers and freight) or 4 000 km with 117 passen-gers.

The necessity of Tu-154M replacement emerged because of these reasons:

- technical and moral obsolence
- economical demand factor (high fuel consumption, navigation, airport and landing fees)
- failure to satisfy noise and emmision limits (flights on exeception - noise fees, flight ban on civilian airports from 22:00 till 06:00)
- inconvenient navigation, communi-cation and technical equipment

- insufficient flight performance (ferry capacity, maximum ferry range with respect to maximum service payload) lowered servicing and technical support availability.

2. MAIN DIFFERENCES BETWEEN AIRBUS A319CJ AND A319S OF CZECH AIRLINES' FLEET

Development of Airbus A 319 aircraft began on June 10, 1993 and the first's machine's roll-out took place at the production plant in Hamburg on August 24, 1995. It took off for its 3.5 hour long virgin flight the next day. Its next flight tests followed in Toulouse, France.

Fig. 1 The cockpit of Airbus A319CJ

The A319 aircraft acquired the ICAO and JAA certification for commercial operation on April 10, 1996 and it conducted its first passenger flight shortly after. Since the year 2000, an A319CJ version is manufactured, which is intended for private transport and mainly for government and VIP transport. For renewal of their fleet, the Czech Airlines are acquiring aircraft of the Airbus A320 type family, which includes the A318, A319, A320 and A321 models. One of purchased models will be the A319. After a thoughtful examination of airlift demands and the character of fulfilled tasks, the Czech Air Force chose the same type of aircraft.

In the case of the Czech Airlines, it is the standard A319 airliner with ferry capacity of 124 to 142 passengers, dedicated for short and medium range flights and purchased in the expected number of 12 aircraft. The annual production of airliners of this type is about 120 to 170 aircraft. In the case of the Czech Air Force, it is the special version of A319CJ (Corporate Jet) aircraft with ferry capacity of 44 to 100 passengers, intended for medium and long range flights. The annual production of this version is 8 to 15 aircraft.

It is obvious just from this general characteristic, that it is the same type, though with entirely different technical solu-tion and with unlike technical parameters, equipment and quality of manufacturing. The main differences between A319CJ air-craft of the Czech Air Force compared with the Czech Airlines' link aircraft are in the power unit, which incorporates the CFM 56-5B/7P engines with higher nominal thrust of 15.5 kN, 4 700 km longer maximum range with additional fuel tanks (in the VIP version).

Fig. 2 The Airbus A319CJ airplane in national colours

Another differences are represented by the installation of the communication centre, cryptographic communication system, insta-llation of intrusion protection system etc. From the operational point of view, the 92% system identity and 87% navigation and equipment identity of both versions of the aircraft is a major advantage.

3. FUNDAMENTAL TECHNICAL SPECIFICATIONS OF THE NEW PURCHASED AIRPLANE

The last version of Airbus A319 so far is the A319CJ (Corporate Jetliner}, sometimes designated as ACJ. The main change compared to the basic version is a high

variability of the inner configuration of the passenger cabin. This version is currently manufactured in eight basic saloon modifi-cations and the manufacturer offers nine more additional passenger cabin confi-gurations for 10 to 43 persons. The CORPORATE saloon variant can be converted into ferry version for 100 passengers in approximately 10 to 12 hours.

Fig. 3 Installation of additional fuel tanks in the freight hold

Another important change regarding the A319CJ is the possibilty of range enhancement up to 11 670 km. This is accomplished by instalation of up to six additional fuel tanks with maximum capacity of 37 520 litres.

The passanger cabin guarantees comfort especially during long intercontinental flights thanks to its equipment and size. The airplanes for Czech Air Force have a range of 8 300 km in the VIP version (with four additional fuel tanks) and approx. 3 200 to 4 000 km in the TROOP version (without additional tanks or with two tanks).

The aircraft is standardly equipped with digital avionics of the third generation, which include fully automated flight-navigation complex FANS B, anticollision warning system TCAS, GPWS warning system, satellite navigation system etc.

Fig. 4 Wing mechanization of the A319CJ airplane

It can land under meteorological conditions of ICAO category II and III b practically at all common airports all over the world. The aircraft has the ETOPS certification for 180 minutes of flight with one fuctionless engine. It also incorporates fly-by-wire aircraft controls.

The aircraft is powered by two turbofan General Electric/Snecma CFM 56-5B7 engi-nes with high bypass ratio and maximum thrust of 120 kN at take-off. It is also equip-ped with an auxiliary power unit (APU), which supplies the aircraft systems in the case of shutdown engines. Basic tactical and technical data of the A-319CJ are as following: maximum gross weight 75 500 kg, cruise speed 870 kph, cruise Mach 0.80, maximum FL 390.

Four deckchairs (among others) for patients will be purchased for the airplanes. These deckchairs are placed over the folding benches of the TROOP variant. Two PTU medical units are to be purchased for the second airplane.

These can be installed in place of seats and will make it possible to transport heavily wounded personnel. The medical units are fully equipped with all necessary medical devices and an oxygen system. The PTU and deckchairs expand the applicability of A319CJ for MEDEVAC.

4. CONCLUSION

By introduction of A319CJ into the transport component of Czech Air Force, an entirely new transport system is instituted. It is a new aircraft, which is by two generations more advanced than aircraft currently used.

Higher demands lay on the flight personnel and also from the technical part point of view new problems will have to be solved regarding different system of maintenance, documentation, operation pro-vision etc.

Major technical parameters of A319CJ airplane include maximum take-off weight of 75 500 kg, maximum landing weight of 62 500 kg, maximum weight without fuel of 58 500 kg, fuel capacity with four additional fuel tanks of 37 520 litres (which is 30 878 kg), cruising speed of 840 to 870 kph, range with 42 passengers of 8 300 km and ceiling of 12 500 m.

The essential advantages include the possibility of take-off and landing at all world airports, which come up to respective standards. Each airplane will have its independent communication centre, which provides fax, phone and internet satellite connection (SATCOM I).

The airplanes are fully certified according to civilian regulations (JAA, FAA), they are certified for III.b category ICAO (ILS) operation, alpine airport (up to 14 100 ft) operations and they are further emission and noise certified according to ICAO Annex 16. The airplanes will be equipped with its own system of protection against unauthorized access during parking.

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SELECTED ASPECTS OF LIFE CYCLE COST ISSUE FOR DEFENCE AND AVIATION SYSTEMS

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Abstract: *The objective of this paper is to present the information concerning the selected aspects of life cycle cost (LCC) issue for defence and aviation systems. The paper in the introductory part underlines the importance of LCC analysis during the all life cycle stages of the products and defence systems in the context of defence capability development and great pressure on the defence budgets. The authors briefly inform on the attention and works provide by NATO authorities in the LCC area. The paper shortly describe methods and models for LCC estimation, a two major attributes of estimation - risk and uncertainty and also the impact of obsolescence on LCC. The short overview of US initiatives concerning the value engineering and reduction of total ownership cost is presented. The information on selected European research projects relating to LCC analysis and modeling for aviation systems are a part of paper as well.*

Key words: *Life Cycle Cost (LCC), LCC Estimation, LCC methods and models, obsolescence, value engineering, defence system, aircraft*

INTRODUCTION

The defence departments bodies of majority countries, different civilian authorities and organizations in the design, development, testing , manufacturing, operation and support areas as well as users of defence and aviation systems has been placing an increasing emphasis on Life Cycle Cost (LCC) to ensure they are given proper weight in decisions during the all system life cycle stages.

This is especially so in the present era of a great pressure on the state and defence budget. Cost of new programmes has been increasing, available financial resources has been decreasing and customer requirements towards quality of defence and aviation systems and time schedule for fielding of the new capabilities are more and more demanding. Defence departments acquire and operate expensive and complex defence and aviation systems that have a service life of many decades. Taking into account these and other factors is needed more soundly based the programme costs and to find the better balance between the programme and budget. Reflection of approach based on the application and implementation of the methods for LCC analysis/estimation, planning and control of LCC is a key factor for fulfilment of users requirements taking into account principal aspects related to products and systems: quality, performance, acquisition time and effectiveness.

LCC was first applied to defence projects by the US Department of Defence in the early 1960´s [14]. It has become more popular and important in the acquisition of defence systems and in the design, operation and support of aviation systems. The reasons for this are numerous , one of the main reason is to offer the potential for major resources saving and efficiency gains, particularly in the area of the through-life cost of ownership.

The introduction of LCC issue to defence management is a difficult process, requiring changes to armaments and logistic approaches, changes in planning and

programming issue and introduction of new methods of monitoring performance.

1. LIFE CYCLE STAGES AND LIFE CYCLE COST PRIMARY CATEGORIES

According to **ISO/IEC 15288:2002** " System engineering-System life cycle processes ", which is basis also for the NATO Policy for System Life Cycle Management and for NATO standard **AAP-48** " Life Cycle Stages and Processes" (as implementation guideline for implementation this policy) the **Life Cycle** is divided into **six stages**: Concept, Development, Production, Utilization, Support, Retirement (Disposal).

There is a several means of possible LCC dividing, but we can divide the LCC into four primary cost categories [1,9,16], take into account the above mentioned life cycle stages:

- Research and development (R&D) cost:
  - ✓ Concept exploration/definition phase
  - ✓ Demonstration/validation phase
  - ✓ Engineering/manufacturing development phase
- Production and construction cost (especially in US literature named also as investment cost)
- Operation and support (O&S) cost (or operation & maintenance cost)

Remark: The term O&S cost has been used in US and other terminology, term in brackets has been used in a NATO standard ALCCP-1.

- Retirement and disposal cost

The list of all the cost elements in each cost category would be considered in a project and organised in a Life Cycle Cost Breakdown Structure, mainly referred as a **Cost Breakdown Structure** (**CBS**). The role of the CBS in the LCC process is twofold [1]:

- it must support the overall scope of the cost estimation process,
- it must facilitate the calculation and estimation of the relevant costs.

Depending on the system, costs or spending rates can peak at any phase in the program life cycle. Majority of total life cycle cost has been composed by operation and support (O&S) cost. From operation of the serial aviation systems it is known, that O&S cost composes approx. 50-70% of their total life cycle cost [16], in the case of F-16 combat aircraft even 78% of total life cycle cost (2% represent the R&D and 20% the investment cost for this type of aircraft) [9].

2. ACTIVITIES PROVIDED BY THE NATO AUTHORITIES IN THE LCC AREA

Common understanding and implementation of the LCC issue in the NATO and NATO Nations frameworks has a high importance. The principal role in this regard has been provided by the NATO Research and Technology Organization (RTO) and AC/327 Life Cycle Management Group (LCMG), which is part of the Conference of National Armaments Director (CNAD) structure.

RTO completed the following main research studies focused on LCC area [1,5]:

- **SAS - 028** The development of a NATO generic Life Cycle Cost Breakdown Structure
- **SAS -054** Methods and Models for Life Cycle Costing (including the parts regarding to role of LCC, the cost analysis, requirements for multinational programs, LCC methods and models, data collection, risk and financial analysis, a.o.)
- **SAS-069** Code of Practice booklet for Life Cycle Costing (provides guidance on LCC issue: definition of LCC, benefit from LCC, requirements for LCC, different stages of the life cycle, expectations from LCC, a.o.)

At the present time the **SAS-076** Independent cost estimating and the role of LCC in Capability Portfolio Analysis Report has been elaborated, which will be finished by the end 2010 [5]. The SAS-076 will be a beneficial document from the NATO defence planning and capabilities portfolio analysis issue, too.

Of course the LCC issue is a very important part of the armaments/ acquisition processes and defence capabilities development field. From this reason the NATO authorities and bodies in the armaments area pay a special attention to the applications and implementation of a method for LCC analysis/estimation, common understanding of a cost definition based on the Generic Cost Breakdown Structure (GCBS) and adopting a common exchange mechanism and methodologies for cost data collection, processing, validation and presentation. These factors and also the RTO above mentioned studies results have been taking into account during the elaboration of the first NATO standard in the LCC area- the **ALCCP-1 "NATO Guidance on Life cycle Costs**"[1] under the AC/327LCMG responsibility. In this regard we would like to appreciate the principal role of the Rumanian chairman of AC/327-SG/A – WG on LCC Col. Prof. CIOBOTARU and specialists, who worked on elaboration of this NATO fundamental standard.

3. METHODS AND MODELS FOR LIFE CYCLE COST ESTIMATION

Cost estimation is defined as the process of predicting the cost of system (product) before all the stages of the system development have been executed [6,13]. There are many methods and models available to conduct LCC estimation and it is important to understand the applicability of each method and model has own specifics. Availability and the quality of data is a major factor in the estimator´s selection of the appropriate method [1]. In order to develop a cost estimate is needed to cover the following main areas: description of activity (including the life cycle duration), history (data collection), tools (cost element structure, inflation factors), medium, documentation and of course to have appropriate technical experts.

The cost estimating process is compounded from next phases: definition and planning, data collection, estimate formation, review and presentation, final document elaboration. As with any scientific undertaking, this is a repeatable process at the core. Concerning the definition and planning part we would like to underline the following aspects:

- Knowing the purpose of the estimate,
- Exact definition of the system,
- Ground rules and assumptions,
- Selecting the estimating approach,
- Establishing the working team and creation of a team effort.

For consistency, both the methods and models have been categorized as Optimization, Simulation, Estimation and Decision Support. **Tab.1** shows the categorization of methods to be used in life cycle cost estimating [1,13].

A lot of defence departments have been used a special guidelines for the Cost Estimating Process. Very well-known guideline is for example the US DoD 5000.4-M " Cost Analysis Guidance and Procedures" [15]. The cost estimating guidance has been used also by Aviation Authorities. The Federal Aviation Administration (FAA) has been used document " FAA Standard Cost Estimation Methodology"[6]. The analogues and parametric estimation methods have been used as a most widespread classic methods.

A cost model is a set of mathematical and/or statistical relationship arranged in a systematic sequence to formulate a cost methodology in which outputs, especially cost estimates, are derived from inputs [1]. During the early life cycle stages most of the cost models are used to support operational analysis studies . In the later life cycle stages most models are used to support investment appraisal, logistic modeling and through life management planning. Optimization or simulation models are mainly used from the project definition stages and for optimization of logistic resources and simulation of the support system.

Tab.1 The categorization of method to be used in LCC estimating

Method Category	Methods
Optimization	Linear programming Heuristics
Simulation	System Dynamics Discrete Event Monte Carlo
Estimation/ Calculation	A. Classic estimation methods - Analogy (analogous methods) - Parametric - Engineering (bottom-up costing method) B. Advanced estimation methods - Feature-Based Costing - Neural Networks - Fuzzy Logic C. Other methods - Bayesian - Catalogue - Rule of Thumb - Expert opinion (Expert System)
Decision Support	Analytical Methods: -Tolerance-Based Cost Model -Activity-Based Cost Estimation -Operation -Based Approach -Break-Down Approach Multi-Criteria Decision Analysis

4. RISK AND UNCERTAINTY AS ATTRIBUTES OF LCC ESTIMATION

Life cycle cost estimates of defence and aviation systems are inherently risky and uncertain [1,10,13]. **Risk** is exposure to loss [1]. Risks are translated into costs of defence systems and added in the initial point estimate. Cost risk has three components [1,11]:

- Cost estimating risk (risk arising from cost estimating errors and the statistical uncertainty in the estimation)
- Schedule/Technical Risk (risk associated with infeasible tight schedule and the difficulty of conquering the problem posed in the system technical specification)
- Requirements Risk/Threat Risk (risk associated with changing of proposed requirements a with change of the threat for which the defence system was designed)

Uncertainty is the indefiniteness or variance of an event [1]. As it is widely known, the majority of life cycle cost is related to in- service (utilization) stage of defence systems. During the service of defence and aviation systems as well as a part of both bidding preparation and bidding evaluation phases would be pay attention particularly to the following main types of service uncertainty [10]:

- Equipment (support of COTS equipment and utilization of equipment),
- Technology (rate of technology change),
- Lines of maintenance,
- Supply chain (the largest source of costs)
- Customer requirements (their exactness and stability , no frequent modifications)
- Resources (especially their planning and sustentation)

- Environmental and organizational changes.

The most important and at the same time the most difficult part of the process of estimating risk and uncertainty, is data collection and analysis (cost uncertainty analysis) process. Understanding uncertainty in service costing is a major challenge.

5. IMPACT OF OBSOLESCENCE ON LCC

Obsolescence affects all equipment, software, tools, processes, support products, standards and specifications [12]. It impact upon all stages of the life of systems. It is inevitable, may be expensive and cannot be ignored, but its impact on cost can be minimized by forethought and careful planning. We would like to quote [10] some expressions of well- known defence and aviation companies: "Obsolescence is bigger issue than reliability" (British Airways Engineering), "…obsolescence is now one of the biggest threats to the future of many sectors of industry…" (BAE SYSTEMS). In connection with the Eurofighter Typhoon project was mentioned, that "… obsolescence is number 2 risk to the project." These quotations confirm, that predicting cost impact of obsolescence is also a major challenge in the LCC issue.

The **management of obsolescence** is essential to achieve optimum cost effectiveness throughout the whole system life cycle. In the obsolescence management framework is needed to pay attention towards three main areas and factors (see **tab.2**) [10].

Tab.2 Principal areas and factors in the obsolescence management framework

Obsolescence Risk Assessment	**Mitigation Strategies**	**Resolution Approaches**
Critical factors:	**** Reactive***	
- Demand rate - Obsolescence probability - Unit cost - Difficulty to be replaced	**** Proactive:*** - Monitoring - Technology roadmapping - Life/Last Time Buy - Partnering agreements with Suppliers - Consider obsolescence at the design stage: ✓ Designing with multiple sources and technology transparency, modularity a.o.	- Existing Stock - Reclamation - Alternate - Substitute (replacement) - Equivalent - Aftermarket - Emulation - Redesign

The **NATO STANAG 4597** emphasizes, that each Nation will be responsible for evaluating obsolescence management strategies carried out in accordance with the guidance laid in this STANAG [12].Also the commercial and Defence / Aerospace **OEMs** (Original Equipment Manufactures) daily face the risk of components obsolescence. Regardless of the life cycle length of the end product, all OEMs have some measures of obsolescence management in order to decrease product and development costs by reducing the number of active parts and also to mitigate the risks and costs of diminishing components. Take into account this fact and impact of obsolescence on system life cycle cost it is possible to underline the following aspects [10,12]:

- Importance of obsolescence management as integral part of defence system design, armaments/acquisition processes (including inclusion to the technical specifications – requirements on supply chain, a.o.) and life cycle cost

analysis /estimation, including the participation of the specialized obsolescence managers,

- Using of obsolescence monitoring tools,
- Necessity of proactive approach towards obsolescence issues,
- Selection of the key parts that would be managed proactively.

6. US VALUE ENGINEERING AND REDUCTION OF TOTAL OWNERSHIP COST ISSUES

Relevant US Federal and Defence Department authorities pay special attention to life cycle cost issue and reducing of total ownership cost. Information from these areas are useful and usable from many reasons, nevertheless that US specific environment, procedures and institutional base are different in comparison with European framework.

Office of Federal Procurement Policy Act 41 USC 432 imposes each executive agency to establish and maintain cost-effective **Value Engineering** (**VE**) procedures & processes. This public Law has been implemented by OMB Circular A-131, which is implemented by the USA DoD through VE Strategic Plan [3].

Value Engineering is an organized effort directed at analyzing the functions of systems, equipment, facilities, services and supplies for the purpose of achieving the essential functions as the lowest life cycle cost consistent with required performance, reliability, quality, and safety (OMB Circular A-131) [3].

Main objectives of DoD VE Strategic Plan have been following:

- ✓ improve the value proposition for defence systems,
- ✓ align industry and government value propositions in defence systems,
- ✓ increase value engineering expertise.

VE methodology is an effective tool for making systems engineering decisions and to achieve: reduction of cost, increasing of productivity, improving quality related features and processes/procedures. There are a set of measures and tools as part of each defence systems life cycle stages (phases).

Reduction of Total Ownership Cost (**R-TOC**) has been considering especially during the O&S phase. The R-TOC program was established in response to longstanding concerns about the adverse impact of defence budgetary and operational trends on force structure and readiness. The purpose of the R-TOC program is to achieve readiness improvements in defence systems by improving the reliability and maintainability of the systems, reducing of supply chain response time and logistic footprint and competitive product support [3,17]. DoD decided to use 30 programs as pilots to test the R-TOC concept in the following categories: development systems (Comanche), production systems (C-17, a.o.), mixture of developmental and fielded systems (aviation support equipment, H-60), fielded systems (inter alia AWACS, B-1, C-5, C/KC-135).

Results of modern design practices, both the users and aviation producers activities and the emphasis shifted more towards a life cycle cost approach have also influence on considerable reduction of maintenance man-hours per flight hour (MMF/FH) of US combat aircraft. For example, when the F-111 entered service in the late 1960´s, it required more than 45 MMH/FH. The F-18 entered service in the early 1980´s with a requirement approx. 25 MMH/FH, significantly cutting costs by reducing personnel and spares provisioning. Next development in this areas brought another qualitative progress: F-22 has quoted design only 12 MMF/FH [14].

7. SELECTED EUROPEAN RESEARCH PROJECTS ON LCC ANALYSIS AND MODELING OF AVIATION SYSTEMS

LCC issue is highly actual for the aviation system producers, research institutions and aeronautical universities. We present some

interesting projects related to LCC analysis and modeling of aviation systems:

❖ **VIVACE** (Value Improvement through a Virtual Aeronautical Collaborative Enterprise) project as an integrated project in the European 6th Framework Programme with aim to define the future European Aeronautical Collaborative Design Environment with associated processes, models and methods. In the VIVACE project [17] a " Multidisciplinary Design and Optimization (MDO)" use case is defined, in which the helicopter LCC analysis are performed in the following areas: development and integration of a LCC model in a pre-design sizing tool, identification of the cost driving parameters and performing the sensitivity analysis, development and implementation of a methodology to find a multidisciplinary design solution to optimize LCC [2].The European Engine Industries also took part in VIVACE project and focused on engine LCC modeling, including the activities concerning the common European standards on the LCC modeling process (of course they have been providing own activities focused on jet engine LCC modeling).

❖ The **EUROCOPTER** company is developing a helicopter LCC model which reflects the impact of both the major technical parameters and the major categories of customers and missions. The LCC is based on the following estimated cost items: rotorcraft acquisition procurement, cost of spare parts procurement, cost of documentation, direct maintenance cost, insurance cost, pilot overall cost and fuel cost.

❖ The **Dutch National Aerospace Laboratory** (NLR) has developed a methodology for the analysis of specifications for a rotorcraft that should be capable of fulfilling a set of flights and missions. The methodology has been implemented in the computer program called **SPEAR**- " SPEcification Analysis of Rotorcraft " [2]. The Eurocopter helicopter LCC model has been integrated in the SPER analysis program.

❖ The British **FLAVIIR** research project is looking technologies for future UAV. This 5 year research project is managed by Cranfield University and including 9 other university partners. The LCC modeling as an aircraft design decision support tool, a novel methodology to link aircraft performance with survivability analysis for estimating especially the maintenance costs are parts of this beneficial research project.

CONCLUSION

The NATO bodies and agencies, Nations, defence departments and industry , especially in their role as acquirer or supplier pay a special attention on LCC issue. Importance of LCC analysis and estimation processes as part of life cycle stages and particularly the project assessment processes (but also as part of agreement processes), part of the planning, programming and budgeting processes and other activities has been enormously increasing.

The purpose of this paper was to point out the selected aspects of this broad and actual issue, which certainly has been implemented and developed also by the Slovak and Rumanian institutions.

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Battle groups, main element of the European Rapid Reaction Force

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***Abstract**: "The European Union is a global actor, ready to undertake its share of responsibility for global security. With the introduction of the Battlegroup Concept, the Union formed another military instrument at its disposal for early and rapid responses when necessary."*

***Keywords**: EU military force, EU Battle Groups, Headline Goals, rapid response, approach, mission*

1. Introduction

The initial ideas for the Battle Groups (BG) began at the European Council summit on 10–11 December 1999 in Helsinki. The Council produced the Headline Goal 2003 and specified the need for a rapid response capability that members should provide in small forces at high readiness. The idea was reiterated at a Franco- British summit on 4 February 2003 in Le Touchet which highlighted as a priority the need to improve rapid response capabilities, "including the initial deployment of land, sea and air forces within 5-10 days." This was again described as essential in the "Headline Goal 2010".

But in December 1999 the Member States signed the Helsinki Headline Goals 2003 (HG2003) providing for the development of an European Union (EU) military force for crisis management, capable of fulfilling the all range of the Petersberg tasks (humanitarian tasks; peacekeeping tasks; tasks for combat forces in crisis management, including peacemaking). This force would comprise 50,000 – 60,000 soldiers, (up to corps level) deployable within 60 days, and capable of staying in the theatre of operation for up to one year. These forces should be militarily self sustaining with the necessary command, control and intelligence capabilities, logistics, other combat support services and, additionally, as appropriate, air and naval elements. This will require an additional pool for deployable units (and supporting elements) at lower readiness to provide replacements for the initial forces.

In other words, the full force of the Headline Goal was to be comprised of 15 brigades of around 4000 personnel each and it was the full force, i.e. the European Rapid Reaction Force that was the force development end-state.

The Member States declared that the targets were reached on a quantitative level, however the full ambition was never tested. The HG2003 had other initiatives such as the creation in 2004 of the European Defence Agency (EDA) and the EU Battlegroups.

On 10 February 2004, France, Germany and the United Kingdom released a paper outlining the *Battlegroup Concept*. This was submitted to the Political and Security Committee, which, in turn, asked for the Military Committee's opinion on the technical aspects of the concept (February 18, 2004). It subsequently gained further support at the Brussels informal defense ministers and Chiefs of Defense Staff. The document proposed a number of groups based on Artemis Operation (in Democratic Republic of Congo - the first autonomous EU-led military operation launched in June 2003 at the request of the UN Security Council) that would be autonomous, consisting of 1500 personnel and deployable within 15 days. These would be principally in response to UN requests at short notice and can be rapidly tailored to specific

missions. They would concentrate on bridging operations, preparing the group before a larger force relieved them, for example UN or regional peacekeepers under UN mandate. The plan was approved by all groups in 2004 and in November that year the first thirteen battlegroups were pledged with associated niche capabilities.

2. Structure of the Battlegroup

The Battlegroup is a specific form of the EU's rapid response elements and is one possible answer to the timely provision of the necessary capabilities for an EU rapid response operation. It is the minimum militarily effective, credible, rapidly deployable, coherent force package capable of stand-alone operations, or for the initial phase of larger operations; is based on a combined arms, battalion sized force and reinforced with Combat Support and Combat Service Support elements.

This kind of units will be based on the principle of multinationality and can be formed by a Framework Nation or a multinational coalition of Member States. In any case, interoperability and military effectiveness have to be the key criteria. In the same time BG, must be associated with a force headquarter - (F)HQ and pre-identified operational and strategic enablers, such as strategic lift and logistics.[1]

Characteristics:

- Designed for a range of possible missions;
- Generic composition of a BG = +/- 1500 troops;
- All deployment assets & capabilities will be associated with it;
- Sustainability: 30 days initially, extendable to 120, if re-supplied appropriately;
- Close relation between the core of the BG (Infantry Battalion) and the (F)HQ; prior training and interoperability required.

Requirements:

- Utility across all Treaty + European Security Strategy - ESS tasks; full potential best in tasks of combat forces in crisis management, bearing in mind their limited size;
- Could be on request of the UN or under UN mandate;
- Potential area: outside EU (possibly for long range operations);
- Concurrency: 2 single BG ops;
- Number on standby: minimum 2;
- Readiness: 5 - 10 days;
- Assured deployability;
- Training and certification is member states responsibility.

The Battlegroup Concept consists of highly trained, battalion-size formations including all combat and service support as well as deployability and sustainability assets. These should be available within 15 days notice and sustainable for at least 30 days (extendable to 120 days by rotation). They should be flexible enough to promptly undertake operations in distant crises areas (i.e. failing states), under, but not exclusively, a UN mandate, and to conduct combat missions in an extremely hostile environment (mountains, desert, jungle, etc). As such, they should prepare the ground for larger, more traditional peacekeeping forces, ideally provided by the UN or the Member States. Not surprisingly, the development of the battle group concept implies the availability of strategic lift and combat support capabilities. In this respect, the concept is linked to the Helsinki Headline Goal process and its ambitions to make up key identified capability shortfalls.

The forces are under the direct control of a unanimous European Council (heads of state, or often heads of government of countries where the head of state is largely a symbolic position, of member states) of the European Union.

There is no fixed structure, a standard group would include a headquarters company, three infantry companies and corresponding support personnel. Specific units might include mechanized infantry, support groups (e.g. fire or medical support), the combination of which allows independent action by the group on a variety of tasks. The main forces,

extra support and *force headquarters* (front line command) are contained within the battlegroup package.

3. Missions and plans

In May 2004, the Headline Goal 2010 (HG2010) was launched and focused on qualitative, rather then on quantitative, requirements of military capabilities. Building on the Petersberg tasks, the document laid out five possible military scenarios in which European personnel under European Security and Defense Policy (ESDP) could be involved: Separation of parties by force; Stabilisation, reconstruction and military advice to third countries; Conflict prevention; Evacuation operation; Assistance to humanitarian operations.

Whereas, the smaller Battle Groups in Headline Goal 2010 are justified by the expanded Petersberg Tasks, as laid out in both the European Security Strategies (ESS) and the draft Constitutional Treaty (Title V of the EU Treaty of Amsterdam). De facto military task-list that was expanded, under the Common Security and Defense Policy, from *humanitarian and rescue tasks, peacekeeping tasks and tasks of combat forces in crisis management, including peacemaking* to include also joint disarmament operations, military advice and assistance tasks, conflict prevention, post-conflict stabilization, and *supporting third countries in combating terrorism in their territories*.[2]

Planners claim the battlegroups have enough range to deal with all those tasks, although such tasks ought to be limited in *size and intensity* due to the small nature of the groups. Such missions may include conflict prevention, evacuation, aid deliverance or initial stabilization. In general these would fall into three categories; brief support of existing troops, rapid deployment preparing the ground for larger forces or small scale rapid response missions.

The Headline Goal process is still, in effect, a crisis management planning exercise with little thought given to strategic reconstitution. What is taking place inside NATO, admittedly not very successfully, is much more about intensity and reach. Consequently, states that are both NATO and EU members are undertaking two very different force planning exercises with the same forces. That might best be termed – creative.

Despite all declarations and plans, the original outlines in the HG2003 had still not been fulfilled. EU Member States signed the Declaration on Strengthening Capabilities of 11 December 2008. This paper outlines a vastly increased quantity of capabilities, based on the 2003 goals (60 000 troops deployable in 60 days), but with a more ambitious framework, such as the ability to conduct two simultaneous operations of up to 10 000 troops for 2 years; two rapid response operations using inter alia Battlegroups; civilian-military humanitarian assistance mission up to 90 days; a dozen ESDP civilian missions of varying formats with a major mission (up to 3000 experts) lasting several years. The declaration also called for: the establishment of a European air transport fleet; an airlift command and an airbase for a European force; observation satellites (the MUSIS programme) and taking account of military requirements in space surveillance.[3]

Member States participating in the BG concept offer their 'battle group packages' for periods of six months at a time at a EUMS (EU Military Staff)-chaired Battle Group Coordination Conference (BGCC). In 2007, 25 EU member States are participating in a way or another in the BG programme, and 15 BGs have been or are being created.

On January 2007 the EU Battlegroup Concept reached Full Operational Capability. Since that date the EU is able to undertake if so decided by the Council two concurrent single battlegroup - sized rapid response operations, including the ability to launch both such operations nearly simultaneously. (Two BG were ready - one built around France as the framework nation with Belgium and Luxemburg providing support components, and other is built around Germany, with Finland and Holland providing support.)

These 'ready-to-go' forces are intended for particularly rapid deployment in response to crises and/or requests from the UN. They are designed to be in place and able to begin

implementing their mission within 15 days of an initial green light, and no later than 10 days after the formal decision to launch an operation.

The situation of the battle groups (the chart of implementation of battlegroups concept), from 2007 onwards is as follows (Source – Wikipedia): *French-Belgian Battlegroup*, Jan-Jun 2007, lead nation France; *Battlegroup 107*, Jan-Jun 2007, Participants Germany, Netherlands and Finland, lead nation Germany; *Italian-Hungarian-Slovenian Battlegroup*, Jun-Dec 2007, lead nation Italy; *Balkan Battlegroup*, Jun-Dec 2007, Participants Greece, Bulgaria, Cyprus, Romania and Slovenia, lead nation Greece; *Nordic Battlegroup*, Jan-Jun 2008, Participants Sweden, Finland, Estonia, Ireland and Norway, lead nation Sweden; *Spanish-led Battlegroup*, Jan-Jun 2008, Participants Spain, Germany, France and Portugal, lead nation Spain; *French-German Battlegroup*, Jun-Dec 2008, Participants France, Germany, Belgium, Luxembourg and Spain, lead nation France; *British Battlegroup*, Jun-Dec 2008, Participants United Kingdom; *Spanish-Italian Amphibious Battlegroup*, Jan-Jun 2009, Participants Italy, Spain, Greece and Portugal, lead nation Italy; *Battlegroup Greece*, Jan-Jun 2009, Participants Greece; *French Battlegroup*, Jun-Dec 2009, Participants France, *Battlegroup Belgium*, Jun-Dec 2009 Participants Belgium; *Polish-led Batt*legroup Jan-Jun 2010, Participants Poland, Germany, Slovakia, Latvia and Lithuania, lead nation Poland; *UK-Dutch Battlegroup*, Jan-Jun 2010, Participants United Kingdom, Netherlands, lead nation United Kingdom; *Italian-Romanian-Turkish Battlegroup* Jun-Dec 2010, lead nation Italy.

Other Battlegroups: Italian Battlegroup; Spanish Battlegroup; German-Czech-Austrian Battlegroup; Czech-Slovak Battlegroup, complete the planning of general framework.

While the capacity of numbers of troops has been met, one question remains as to their interoperability functionality. The Battlegroups have not yet been deployed and the limited degree of interoperability (although a certain degree has been achieved) between European forces raises question of the Battlegroups effectiveness of dealing with high risk situations.

4. Issues raised by the Battle Group concept

Multinationality - battlegroups are based on the principle of multinationality and could be formed by a framework nation or by a multinational coalition of member states. For Paris and London it appears that the combat core of the BG (i.e. about 500-600 infantry soldiers) have to be drawn from the same country; and if not they have to belong to countries that have already trained together, such as the Dutch and the British; the French, the German and the Belgians; or the Nordic BG (the only BG which exists on a permanent basis and in which Sweden represent about two-thirds of the manpower).

Command structures - political control of the BG 1500 is exercised by the PSC. For military action the BG has to be led by a FHQ (Force Headquarters, at the operational level) under the supervision of an OHQ (Operational Headquarters, at the strategic level). The OHQ could be set up from existing cells already part of national Europeans OHQ (France's CPCO - Centre de Planification et de Conduite des Opérations ; Britain's PJHQ - Permanent Joint Headquarters; Germany's EFK – Einsatz Führungs Kommando; Italy's COI - Comando Operativo di vertice Interforze and Greece's OHQ in Larissa) . These cells are activated and their manpower increased by 'augmenters' i.e. officers coming from various EU countries. In early 2007, five European operation headquarters (OHQs) and four force headquarters (FHQs) had been declared by different EU countries. All of them are connected to Brussels (EU Military Committee) through the confidential, secure and global intranet network in defense affairs connecting EU's countries 'Ops WAN'. Interoperability and military effectiveness are key criteria.

Deployability - a battlegroup is associated with a deployable force headquarters and pre-identified operational and strategic enablers, such as strategic lift and logistics. In certain circumstances and for certain theatres of

action, a BG could be deployed by air or by sea. Deployability raises secondary questions that are far from being properly addressed in a coherent manner by EU members particularly when a multinational BG is involved.

Today there are two critical obstacles to deploying the EUBGs, however: size and political will. Size - If the EUBGs were deployed as a stand-alone force in a high-intensity operation in a hostile environment, the risk of failure would be extremely high. Political Will - Recent events have highlighted the difficulty of reaching consensus on when to actually deploy the EUBGs. If the EUBGs are not used in the near future in the types of operations for which they were intended, however, the interest among the member states to maintain and further develop the concept could greatly diminish.

Sustainability - beyond logistical questions, there are issues relating to sustainability. For instance, what happens when, due to unexpected circumstances, the deployments lasts longer than anticipated? In such cases, there are no agreed rules concerning how to organize the changeover of one BG to another.

Force generation - is also an other problem of EU concern. If a Member State is to supply troops or major equipment to an EU operation, two conditions must be met: it must consider that it will benefit politically from its participation, and it must have the assets. But, heavy demands are being made on European countries today with the proliferation of crises in the world. We have also to admit that we have well-known shortfalls, in particular as regards strategic lift and joint logistics. We have made a significant step forward in terms of organization, we ought rather to say of transformation, with the battlegroup concept. BGs not only provide the EU with a minimum level of crisis response but also act as an important means of achieving interoperability, developing a shared culture and of learning about all the military and even political constraints involved in rapid response to emergencies. To sum up, on the military level, the assessment of ten years of European security and defence policy is a positive one.

5. Standards, training and certification of the Battlegroups

Standards and criteria embodied in the BG Concept and the BG Preparation Guide, form the basis for the Member States to develop specific instructions to ensure coherence between the constituent parts of the battlegroup package, taking into account the demands for multinationality.

A basic principle is that the battlegroup training is the responsibility of the Member States concerned. The EU facilitates the coordination among Member States. The certification of battlegroups also remains a national responsibility of the contributing Member States. The EU Military Committee, assisted by the EU Military Staff, monitors the battlegroup certification process which must be undertaken according to fixed EU-agreed procedures.

Training is a key requirement for battlegroups. Member States concerned conduct a series of exercises in this context prior to taking a battlegroup stand-by period.

The certification of the battlegroup package by the Member States will provide the EU with the necessary assurance that it is ready for a possible mission. The Operation Commander, who will be appointed by the Council on a case-by-case basis, has the authority to tailor the command and control structure and the battlegroup package assets and capabilities to the specific requirements of the operation.

The Member States conduct the generation of a battlegroup package and are responsible for offering a complete package formed by a framework nation or by a multinational coalition of Member States. The battlegroup package has no fixed structure and thus provides Member States with the necessary flexibility to form their own battlegroup package.

The planning horizon of the Battlegroup Coordination Conference (BGCC) is five years. It is up to the Member States how they constitute a battlegroup package and for what time frame it will be offered. Operation Headquarters are pre-identified for most of the battlegroup packages.

Under current arrangements, Battlegroup generation is expected to be a relatively straightforward task. However, if a Battlegroup's deployment was to be succeeded by larger follow-on EU forces or be extended beyond its initial mandated time-line, then the EU might well need to think about a common, more responsive and more flexible approach to Battlegroup force generation.

The true test as to whether or not these Battlegroups are effective military capabilities rather than just a new concept will be determined by the ability of these force packages to fight, to take and to accept loss of lives. Countries contributing to a Battlegroup are currently responsible for certifying their own commitments, and it is the framework nation's responsibility to certify the force package as a whole. However, in order to be efficient a battalion, its combat support and combat service support elements need to be bound into a single, homogeneous force, and unless each Battlegroup offers broadly similar capabilities, then the force packages are unlikely to be able to execute equally challenging missions.

The most effective solution to achieving a balanced and consistent Battlegroup roster would therefore be to develop a centralized certification process with the EU Military Committee, through the EU Military Staff, performing this task and assuming responsibility for declaring each Battlegroup ready for operational duty.

If a deployment was anticipated to last for longer than four months, all elements of the EU decisionmaking machine, including the Member States, should have a clear understanding
that any initial Battlegroup mission was only a first response whilst a longer-term solution is generated. The EU needs also identify what it should be doing next and be confident that this longer-term solution will be in place before the Battlegroup is due to withdraw.[4]

With regard to Rapid Response, during the last Battlegroup co-ordination conference, Member States have committed the required number of Battlegroup packages for 2007, 2008 and 2009. Indications have been given that the first half of 2010 will be completely filled. The Member States providing Battlegroups in the first half of 2007 have decided to provide naval enablers for these Battlegroups. From January 2007 onwards the EU have the full operational capability to undertake two Battlegroup-sized rapid response operations nearly simultaneously. (See Council Secretariat factsheet on EU Battlegroups).

Regarding the global approach on the deployability it was recognized that improving strategic mobility was crucial, in order to enable the Headline Goal 2010, and specifically the full operational capability of the EU Battlegroups in 2007, to be realised. In view of the known shortfalls in strategic lift assets (both in NATO and the EU), focusing on the more effective use of all available means for transport co-ordination was seen as the key to improving strategic transport capability.

Five tasks were identified concerning the co-ordination, interaction, roles and responsibilities of transportation enablers, and these tasks were undertaken by the EUMS under the auspices of the EU Military Committee and the Political and Security Committee. Most of the remaining tasks within the framework of the global approach on deployability have been completed.

Member States participating in the BG concept offer their 'battle group packages' for periods of six months at a time. In 2007, 25 EU member States are participating in a way or another in the BG programme, and 15 BGs have been or are being created. Two are now permanently ready for action on behalf of the Union.

The BG 1500 concept has been a real political success. It now mobilizes almost all of the EU Member States. The BG concept remains a good test of the will of most EU countries to move towards deepening ESDP. However, it cannot (yet) be seen as providing EU leaders with a robust, resilient and trustworthy military instrument able to fulfil those missions for which it was created.

As a 'ground forces package' the efficiency of the BG is intrinsically limited. Its core - the infantry battalion - is probably insufficient to assume and exercise control of large urban areas. Moreover, the different

EU-led operations in Africa have required various capabilities beyond ground forces. Airlift, reconnaissance aircraft and fighter-bombers have all participated in operations. In the future, one can expect a deployment to use sealift, requiring different categories of surface ships and probably even submarines to secure the force in transit.

Some problems should be improved: existing heterogeneity of training, equipment and manpower among various European forces in relation to their potential vis-à-vis BG 1500; how the EU Military Committee defines commons norms and rules of engagement to the operational employment of BG; ways and means to promote the development of an EU capacity to lead a military operation by EU OHQ.

6. Conclusions:

The Battlegroups were intended to be quick response tools – quick to deploy but then to withdraw and hand the challenge on after an initial period of stabilization. In so doing they were designed to complement the other mechanisms available to the EU - as only one component of EU capabilities they are intended for deployment alongside non-military instruments, a reflection of the EU's balanced approach to managing crises. Battle groups were also designed to act as a catalyst for defense reform in countries with less experience of expeditionary operations in order that the burden of rapid response should not fall unreasonably on three or four EU countries.

Some types of missions envisage combat operations that, could involve intense combat and Battle groups have been prepared with such tasks. Consequently Battle groups are reinforced with combat support and combat service support. With some Battle groups' combat support intended to be provided by sea and air power, the total number of personnel in some of the force packages may now reach 3,000.

The Operation Commander, through his Operation HQ (OHQ), is responsible for force generation and the deployment of the Battlegroup and the detailed force generation methodology remains the business of the OHQ. It is likely that each OHQ will implement the system that best suits the needs of the particular Battlegroup in question.

Countries contributing to a Battlegroup are responsible for certifying their commitments at the unit level and it is the responsibility of the framework nation to certify the force package as a whole. In addition the EU Military Committee, through the EU Military Staff, oversees the process by visiting Battle groups preparing for duty and liaising closely with their Operation Commanders.

To guide the certification process, the EU has developed a 'BG Standards & Criteria' checklist that provides benchmarks in nine areas: *availability, flexibility, employability, deploy ability, readiness, connectivity, survivability, medical force protection and interoperability*. And Battle groups are also encouraged to rely on existing NATO standards wherever possible, to avoid duplication and promote interoperability.[5]

Multinationality can weaken the bonds of military cohesiveness and brings an additional burden for training, logistics, command culture and national rules and regulations – challenges that must be overcome if the EU is serious about the delivery of effective military capability. Joint interaction can help develop common understanding and also uncover issues such as national caveats and regulations for the use of specified equipment, which can then be taken into account in planning and during deployments. The Battlegroup concept is the cornerstone of the EU's current action plan to improve European military capabilities.

European military option would remain in the form of ad hoc national or multinational responses under a lead nation. Rapid response capability will relieve military forces of many of the security, stabilization, and reconstruction missions that currently demand so much of their time and for which they are poorly trained and equipped. Military forces cannot by themselves establish functioning governments, capable internal security forces, and prosperous economies; they require the assistance of civilian agencies. Involvement of civilian agencies will in turn free up much-

needed military personnel for high-intensity military operations.

The battle group concept provides the EU with a specific tool in the range of rapid response capabilities, which contributes to making the EU more coherent, more active and more capable. This concept also has the potential to be a driver for capability development and for making the armed forces of member states more capable of undertaking rapid long-range deployments.

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OPTIMIZING MILITARY LOGISTIC CAPABILITIES BY USING ROBOTIC TECHNOLOGY

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Abstract: *This paper's authors try to optimize military logistic capabilities by means of the economic concept and calculus of a possible application within a flexible fabrication cell with circular organization in order to achieve final processing of certain types of radiators for the armored vehicles' industry. Hence, the following will be stressed: the analysis of production load, the set of the flexible fabrication cell's configuration, the determination of the in-system-included robot's value and the entire flexible manufacturing cell (F.M.C.), the annual economic calculus and the benefits resulted from the implementation.*

Key words: *flexible, fabrication cell, optimization, military logistic capabilities, robotic technologies.*

1. INTRODUCTION

The mission of NATO's transformation is the creation of those new capabilities that allow military forces to support operations in the entire spectrum of conflict, logistics optimization time (time required to prepare and provide logistical support of military action), constituting a critical goal. The overall objective of the Romanian Army's logistics development in anticipation of 2025 consists in achieving a logistics system adapted to the size, configuration and its missions, ensuring technical compatibility and equipment logistics with those of allies, support from abroad forces participating in multinational operations.

In modern warfare, logistics has valences having in mind the ongoing refocusing of its strategies, quality of employee human factor and the high technical level built-in equipment to fight. A military logistics system based on the use of cybernetics, automation, electronic equipment and robotic components requires optimal interconnection and exchange of information on procurement, supply, storage and transport.

This is possible if we realize that much of contemporary technological developments were created based on military scenarios.

In this context, the implementation of robotic technology in flexible manufacturing cells, designed to serve military logistics activities not only in the technical aspect, but this approach should be approached from a multidisciplinary perspective that integrates human factors, organizational, technical and economic system to achieve superior logistics capability.

The introduction of flexible manufacturing cells is pursuing many economic purposes. It involves a reduction of personnel costs, an increase of loading equipment, a reduction in execution time, leading to reduced inventories and consequently the cost of capital in circulation.

In the normal production process are "loss of productive capacity" which, to be recovered by traditional, labor require supplementation or increased physical exertion, which is contrary to the current trend of maximum increase in labor productivity.

The path of recovery, in terms of productivity growth is therefore automation and robotics.

a)

b)

Fig.1 a), b) Flexible cell served manufacturing industrial robots

The robot is a "worker" steel electronic brain that successfully solves problems work psychology.

From the special qualities of the robot can be distinguished:

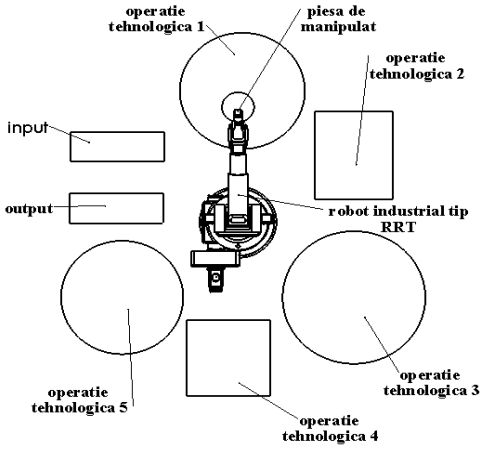
- extremely disciplined;
- inexhaustible physical force;
- conscientious;
- high dexterity and speed of application;
- extremely flexible.

According to a recent study by I.F.R. (International Federation of Robotics) in major industrial highly developed countries, were found following the economic effects resulting from the use of industrial robots in production:

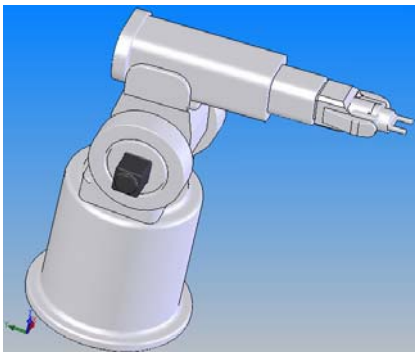
- increase labor productivity by up to 50-60%;
- increase the quality of automated;
- increase product competitiveness;
- reduce physical exertion and, hence, improving working conditions;
- increase flexible production;
- revivification of absolute equipment by recycling them into a new organizational framework;
- computerization of production, namely the widespread use of modern technology and computer numerically controlled machine.

2. BURDEN OF PRODUCTION ANALYSIS

The proposed design and calculation of possible applications in a flexible manufacturing cell composed of 5 circular organization working points in the final processing of some types of radiation, cell that is served by an industrial robot which will aim handling semi therein. Robot for implementation has 3 degrees of freedom (2 rotations and one translation) plus the clamping device (fig.2).



a)



b)

Fig. 2 Robot type RRT SIL created with Solid Works: a) cell with circular organization, b) 3D modeling robot

We know the following parameters:

- rotational speed of the first vertical mode: 0.75 [rad / s];
- horizontal rotational speed of the second module: 0.75 [rad / s];
- speed of translation of module for the device prehensile: 0.10 [m / s].

Regarding the robot, its degree of loading is approximately 85.5%, while desktop and trajectory made during the cell is about 4 minutes. Based on the analysis of the production load cell configuration is established.

In the process the cell is a type of landmark, like the water heater (fig. 3), processing consisting of:

- radiator enclosures fit on a machine that;
- carcasses as appropriate are welded on a welding machine;
- water heater is passed through a test bench made with such a device;
- excess material on carcasses radiator is bent and broken by a bending machine;
- reception and final assessment are performed manually by human operator;
- finally takes place pallets radiators, operation performed by the robot included in the system.

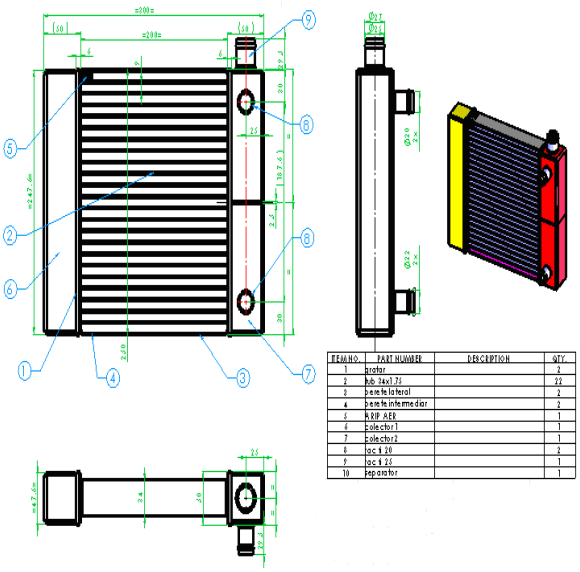


Fig .3 Near water heater type made with Solid Works

The dimensions of parts and times of each operation is found in Table 1, respectively in Table 2.

Table 1 Values spotted water heater

Type milestone	L[mm]	l[mm]	G_{gross}[kg]	G_{net}[kg]	SAF[pcs/year]	Stiffness [L/l]
Radiator	247	200	3280	3050	2400	1,235

Table 2 Processing time for each operation separately and annually

Operation	Match	Welding	Samples	Bending	Front
Processing time [min / pcs]	10	18	10.5	8	4
Total processing time[min/pcs]	50.5				
Annual processing time [min/pcs]	1212000				

3. ESTABILISH FLEXIBLE MANUFACTURING CELL CONFIGURATIONE

In order to form F.M.C. the following parameters were considered functional:
• the price of the material is made landmark: Pm=5.74[RON/kg];
• share-supply transport costs: Tra = 5%;
• utilization of the material is on average 95%;
• gross hourly wage workers tariff performers: St = 3.4 [RON / h];
• share to help fund social security including unemployment, health insurance and risk fund: C.A.S.=30%;
• recovery of waste resulting price is Pdes. = 40% of material has made parts;
•directed the manufacturing department is directed by 400% and the company is manufacturing10%;
• the working time of a worker in one year is 1880 [hours / year], productivity is achieved by 5050 [RON / person * year] and the cost at 0.1 RON of the production achieved is 0.08 RON;
• expected duration of recovery of investments related to the introduction of F.M.C. is 6 years;
• force prices of machinery involved in establishing CFF be considered:

- machine that: 20.000 €;
- welding machine: 26.500 €;
- device samples: 10.100 €;
- bending machine: 17.800 €;
- front manual;

• cost of equipment installation and compatibility in F.M.C. is 5.500 [RON /

system];
• working arrangements of the system is D = 260 [days / year], S = 2 [shift / day], h = 8 [hours/shift];
• annual average stopping time for revisions and repairs fund 10% of annual time;
• minimum grade allowable use of time available fund is 80%;
• transaction cost of processing a type of landmark to another is 7.5 RON for each point of affinity;
• robot included in the system has the following characteristics:

- degrees of freedom: 3;
- average speed of travel on the path: 0.3 [m / s];
- positioning accuracy: 1 [mm];
- workspace volume: 15 [m^3];
- electric driven.

Following the introduction F.M.C. is presumed achieving annual savings, than those calculated, of 90.000 [RON / year]. These savings fall within the savings can not be quantified, such as increased competitiveness.

Table 3 presents the calculated values related economic indicators landmark study.

Table 3. Economic data relating to the landmark gender calculated water heater

Type marker	Pi [pcs/year]	Ni [pcs/year]	Ni/Pi	ai [RON/batch]	ci [RON/pcs]	k* [batch/year]	Qi* [pcs/batch]
Heater	195,423	24,000	0.122	68	171.93	72	333

Calculate the optimal number of batches per year using the relationship:

$$k^* = \sqrt{\frac{\sum_{i=1}^{n} N_i \cdot c_i \cdot \xi \cdot \left(1 - \frac{N_i}{P_i}\right)}{2 \cdot \sum_{i=1}^{n} a_i}}, \qquad (1)$$

where: $k^* \rightarrow$ optimal number of batches per year [batch / year]; $P_i \rightarrow$ capacity [pcs / year]; $N_i \rightarrow$ series of annual manufacturing [pcs / year]; $a_i \rightarrow$ manufacturing cost of a batch of songs like "i" [RON / batch]; $c_i \rightarrow$ cost a marker of type "i" [RON / pcs]; $\xi \rightarrow$ rate storage, $\xi = 2.0$ [RON / year].

Optimal batch size Q_i^* was calculated using the relationship:

$$Q_i^* = \frac{N_i}{k^*}. \quad \text{[pcs/batch]} \qquad (2)$$

4. THE DETERMINATION OF THE VALUE INCLUDED IN THE ROBOT SYSTEM. THE VALUE OF ALL F.M.C. AND CALCULATION OF ANNUAL SAVINGS

First will determine the amount of industrial robots included in the cell knowing that the number of robots included in the system is given by:

$$\frac{Number\ of\ machine\ tools}{4.38} \rightarrow \frac{4}{4.38} \rightarrow 0.91 \rightarrow \rightarrow 1\ robot, \qquad (3)$$

taking into account that, in general, the structure F.M.C. includes a robot to 4.38 average processing units.

The characteristics possessed by industrial robot RRT SIL is allocated a score based on graphs of analysis, namely:

$g_m = 3$.....1.8 points
$v_{med} = 0.3\ [m/s]$.....0.75 points
$p_p = 1\ [mm]$.....4.5 points
$v_{s1} = 15\ [m^3]$.....1.25 points
$m_p = 3.30\ [Kg]$.....0.17 points

Total of points = 8.47, (4)

where: $g_m \rightarrow$ is the number of degrees of freedom of the robot; $v_{med} \rightarrow$ the average speed of travel on the path in $[m/s]$; $p_p \rightarrow$ is the positioning accuracy in *[mm];* $v_{s1} \rightarrow$ the robot's workspace volume in $[m^3]$; $m_p \rightarrow$ is the load-bearing capacity of the robot or the maximum weight of the parts handled in the cell measured in $[Kg]$.

In this way the robot can be estimated with the price:

$$Robot\ \ price = 12822 \cdot Number\ of\ \ points \cdot \cdot CurrencyEURO = 212774.679\ \ [RON]. \quad (5)$$

Assuming that the whole transfer system is provided by the robot, we can estimate the cost F.M.C. thus:

1. Work units:

- 1 match module:
  $1 \cdot 74.000 = 74.000$ [RON]
- 1 welding module:
  $1 \cdot 98.050 = 98.050$ [RON]
- 1 samples module:
  $1 \cdot 37.370 = 37.370$ [RON]
- 1 bend/break module:
  $1 \cdot 65.860 = 65.680$ [RON]
- Cost units working compatibility:
  $1 \cdot 5.500 = 5.500$ [RON]

Total: 280.780 [RON] (6)

2. Transfer system:

- 1 robot

$1 \cdot 212.774{,}679 = 212.774{,}679$ [RON]

Total: 212.774,679 [RON]

Total of the F.M.C.: 1.093. 554,679[RON]≈1.093.555[RON].

Economy at cost price per year (EPC) is calculated as follows:

$$EPC = \sum_i \sum_j s_j \cdot \frac{n_{tij} \cdot s_{tij}}{60} \left(1 + \frac{CAS}{100}\right) \quad [RON/year], (7)$$

where: $s_j \rightarrow$ the annual series of landmark *"j"* [pcs / year]; $v_{tij} \rightarrow$ the processing time of the landmark *"j"* in operation "and" [min / pcs]; $s_{tij} \rightarrow$ the gross hourly tariff wage worker who carries out "and" the landmark *"j"* [RON/ hour].

Fund for this type of machine "and" (F_{tpi}) is calculated by the relationship:

$$F_{tpi} = D \cdot s \cdot h - \frac{D \cdot s \cdot h \cdot 10}{100} = 224.640 \quad [min/year], \quad (8)$$

and for each processing module in hand will get the following values:

- for match module:

$$\sum_j s_j \cdot n_{t1j} = 24.000 \cdot 10 = 240.000\ [min/year], \quad (9)$$

- for welding module:

$$\sum_j s_j \cdot n_{t2j} = 24.000 \cdot 18 = 432.000\ [min/year], \quad (10)$$

- for samples module:

$$\sum_j s_j \cdot n_{t3j} = 24.000 \cdot 10.5 = 252.000\ [min/year] \quad (11)$$

- for bend/break module:

$$\sum_j s_j \cdot n_{t4j} = 24.000 \cdot 8 = 192.000\ [min/year]. \quad (12)$$

Knowing the above values, we can compute the total value and EPC:

$$\sum_i \sum_j s_j \cdot n_{tij} = 1.116.000\ \ [min/year],$$

EPC=120.900 [RON/year]. (13)

5. ECONOMIC BENEFITS RESULTING FROM IMPLEMENTATION

The additional benefits (profit) BS are calculated by the relationship:

$$BS = \frac{\sum_i \sum_j s_t \cdot n_{tij}}{60 \cdot F_{tm}} \cdot W \cdot \left(1 - \frac{C_{1000\,pm}}{1000}\right) = 9992.553 \quad [RON/an], \quad (14)$$

where: $F_{tm} \rightarrow$ the fund's annual working time of a worker [hours / year]; $W \rightarrow$ the labor productivity achieved [RON / year * person]; $C_{1000\,pm} \rightarrow$ the cost of freight carried to 1000 RON production business [RON].

Where to obtain:

$$E_{an} = EPC + BS + EENC = 220.892{,}55 \quad [RON/year]. \quad (15)$$

The economy a year being 104.129,934 RON recovery in investment will be in $\frac{493554{,}579}{220.892{,}55} \rightarrow 2.23$ years.

The project is proposed to recover the investment in 6 years. By making the cell, the

investment is 3.77 years to recover faster, thus reaching the goal proposed and at the same time, resulting in additional savings of 832.764,975 RON.

6. CONCLUSIONS

Such a robot equipped and designed can operate in closed loop with the computer that you control and can be placed in a flexible manufacturing cell successfully making over any industrial challenges.

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THE BENEFICIARIES OF SECURITY FIELD EXPERTISE - THE ROMANIAN APPLICATION

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Abstract*: Modern information services have constantly improved their analytical function, which allows them to develop relationships with the main social partners, who, due to their positions within the power structures, decisively intervene into the national security policy, extending to the international one. In Romania, the activity of disseminating the information from the intelligence services to the beneficiaries is submitted to the algorithm required by law. What does arise from, as an element of newness in this matter, is the opinion of the intelligence services representatives, who consider desirable to increase the number of lawful beneficiaries of the strategic and security information. Increasing the number of beneficiaries would contribute to a better implementation of preventing the threats and aggressions to security.*

Key words*: beneficiaries, expertise, security, providers,*

1. THEORETICAL INSIGHTS OF THE RELATION BETWEEN THE BENEFICIARIES AND THE PROVIDERS OF SECURITY EXPERTISE

The philosophy of the existence and the evolution of intelligence services was conditioned by the degree of social relevance demonstrated and by the usefulness recognized by the social partners, whom number increased during the modern period. An occult aura has been attributed for a long time to the intelligence activity, due to the hermeticism under which it evolved. Indeed, the field was closed, and the slight tendencies of permeability of its relation to society occurred punctually, under circumstances that were not predictable, they occurred unexpectedly and they surprised.

A kind of discrete transparency of the intelligence services made itself felt during the recent years, due to the promoting of policies of change took upon themselves by the services leaders, who wanted these institutions to become more "friendly" and certain malignancy tendencies to be diluted, the ones that were sporadically manifested by voiceful persons, holding representative positions in society. The intentions to dismantle the services were more virulent during the recent years, and this is the reason why changing some of the strategic elements was necessary. Juxtaposing the transparency and the intelligence services concepts must be understood as an unambiguous process shifted by a category of special institutions towards the rest of society. The services transparency cannot be approached as a process that presumes a total opening but is rather to be seen as an intention to clarify the main goals made, to set forth the policies expressed in the human resources field, to recognize the position they hold in the international intelligence area, to recognize the failures, in the event of making them, in order to lower any image damages.
Intelligence activities conducted by the services can be structured on multiple levels of achievement, the tenet allows to tier some taxonomies made by multiple criteria. In the contents of this paper we will delimit, within the context of intelligence activity, the strategic level from the operational one, levels between which exists a high potential of interference. Practically speaking, the steps or sequences of intelligence activity are conducted through an arrangement ordered by specific criteria, their interference or dissociation under certain circumstances being subject to the aggregation of the threatening factors of to the final aimed

purpose. "Although the gathering of information is becoming a recognized field for scientific study, especially in the Western world, theorizing on the subject remains at an early stage" [1].

The strategic level information have the highest degree of social relevance, without excluding the ones circumscribed to the operational level, between the two there are moments of interference within the process of accomplishment of the information product. The information selected for the strategic level has passed through the phases of the operational level, where they were processed, and were finally disseminated according to the previsions of the law.

Modern intelligence services set their priorities that support the strategic level in a manner meant to correlate it and make it able to respond to the security policy pursued by the belonging state.

In order of the activity effectiveness, and of the desirable purposefulness, modern intelligence services work upon security projects that respond to the requests made by the decisional factors, or to the national security objectives established by the national operational policy documents. Security projects are time-consuming structures, intended to correlate the efficiency-purposefulness with the expenditure – costs allocated to achieve that specific desirable purpose relevant to the security field.

The strategic type information has a reduced disseminating share, considering that the degree of addressability is low, the main beneficiaries being placed on top decisional positions. The power of information for the strategic level is what gives weight to the intelligence activity, provided that they are used for national projections in security policies promoted and planned by all the power institutions of the state. Depending on how the state is organized, the power institutions have precise tasks in ensuring the security policy, the emphasis being different from one country to another, on the president or the prime minister, being impossible to invoke a generally valid archetype.

The strategic level information are produced by the services, the stages being multiple and complex. In the world of intelligence services there is much talking over the two main stages, the gathering of information one and its analysis one. Certainly both stages - obtaining the information and processing, integrating and analyzing it - are equally important, the two being permanently tangent. The extreme risk occurs during the stage of information gathering, and its valuation is made during the analysis phase.

Obtaining the information is done through several means, which are different and specialized. Extracting the information from open sources is the easiest process, the difficulty degree occurs during the analytical sequence from which the final information product results. The special operations that have, as a final purpose, the issuing of the information that will be routed to the strategic level, are ordered into field and analytical activities, the interference between them being constant. The strategic information is rigorously theorized and gets this attribute in the circumstances in which it contributes to ensuring the security needs or priorities, and the beneficiary applies the outcome.

If we place the strategic information in the context of current marketing, we can assign its appropriate result with the satisfaction degree of the beneficiary using it. The relationship between services and beneficiaries is an interesting and a based upon law one, with obligations directed to the services who inform the decisional factors of the state, and the decisional factors are presumed to intervene through the enforcement of those measures that remove the threats to security or to achieve the prevention through another manner of expression, namely undertaking actions with positive impact on security: creating favorable alliances, assuming international commitments, cooperating with other international structures and organizations with security responsibilities, etc. … "the product of the intelligence activity is represented by any means, from an official report to a brief conversation, through which an intelligence analyst sends the processed data to the decisional factors or to the military commanders who need them and can use them"[2].

The strategic information is a harmonious sizing into the decision-making conglomerate, which articulates multiple actions and

reasoning, designed to help maintain the security of a state in the broader international security context.

In addition to the strategic information, the national security information are also disseminated to the beneficiaries, information that have a wider degree of addressability than the ones aimed by the first category of information. The national security information is also a product worked within the services, and through its dissemination, the removal of threats that are propagated in the areas of ensuring security is aimed. In these cases it is acted punctual, either by immediate removal of destabilizing factors, or through a preventive type of approach, which does not allow the consumption of facts, situations and intercessions with negative implications in terms of security.

After the national security information is obtained, the beneficiary is placed on a slightly individualistic position and has the freedom of decision regarding the usability of the information product. There is no obligation for the provider to be further informed, the responsibility being individually and politically assumed, and less in terms of legal consequences. In fact, imposing the legal consequences is controversial and most of the states have refrained themselves from issuing rules or algorithms. In these cases the principle of ministerial responsibility is invoked, in the context of assuming the good governance. The relativity of the problem is so big that it is elegantly excluded from the domestic political agendas submitted to official debates. The decision is assigned to the decision-maker that acts according to his expertise in the security field, to his way of perceiving the inclusion of threats or the incidence of risk factors into the depth of the state of poise and normality that call forth security.

2. THE DISTRIBUTION OF THE BENEFICIARIES OF INFORMATION DISSEMINATED BY THE PROVIDERS - THE ROMANIAN APPLICATION

Shading on a background of general problems of information, it can be said, about the activity of Romanian services, that it is directed towards collecting, verifying and exploiting the information. One of the final stages, namely the exploiting one is materialized by providing information to the beneficiaries.

The security related information and the strategic level information are disseminated to the beneficiaries. The Romanian legislation stipulates for the beneficiaries of the information provided by the services, without dividing them on criteria imposed by the access to certain categories of information. In accordance with the laws of our country, there are many lawful beneficiaries of such information, as follows: Article 11 of Law nr.51/199: The President of the Senate, the President of the Assembly of Deputies and also the Presidents of the standing committees on defense and enforcement of public order of the two Chambers of Parliament, the ministers and the heads of ministries departments, for the information concerning issues related to the areas of activity that they coordinate or are accountable for; the prefect, the general mayor of Bucharest and the heads of the county councils, and of Bucharest, for the issues that concern the authority of those specific bodies; bodies of prosecution for the information regarding the perpetration of crimes.

One of the shortcomings of this law is that the Romanian President is missing from the gallery of the lawful beneficiaries of information coming from the intelligence services. From the legal and procedural point of view, that legislative omission is resolved by Law no. 415/2002 on organizing and functioning of the SCSD – the Supreme Council of State Defense (CSAT). The president of this structure is the President of the state, and, as such, he automatically becomes the beneficiary of the secret information.

As it is set out in legislation, the categories of beneficiaries are different and although the field rules do not provide further clarification in this area, it appears by default that the dissemination of information is made according to the decisional power assigned by the legal credentials.

The strategic information are routed towards the state President, the President of the Senate, the President of the Assembly of Deputies, the Prime Minister, and the other categories of national security information are routed towards

the remaining beneficiaries. Different information products are obtained during the process of information activities, products through which the entitled factors act in a preventively manner in order to remove the threats or the aggressions against national security. Because of the pattern and of the material power the intelligence services have in Romania, they can meet expanded information requirements, ensuring gradually the information needs.

The distribution of information seeks to address the problems arising in different parts of the country, where the decisional powers are set down to the prefect or the president of the county council. In their area of liability they may intervene in order to reduce some of the risk factors, to remove some of the vulnerabilities and, last, but not least, to prevent some threats to national security. The potential for action is the more important because the services are working on the ante factum sequence, and, consequently, are acting on the preventive component, which establishes one of the main functions of the intelligence activity, namely the preventing function.

In the context of information activity, data regarding some criminal activities can be obtained. These offenses may be treated as ordinary criminal, but there are situations in which they show a high social risk, which, by its effects contribute to violating the security of Romania or of its partners. In these situations, the data obtained in connection with any possible consumed criminal acts are transmitted of the authorized prosecution authorities, for their resolution. In Romania, the intelligence services do not enforce the law, they have the obligation to forward the obtained information to the prosecution institutions authorized to do so. As a matter of fact, in the democratic countries the intelligence services stay away from all the evidence activity, leaving this task to the authorized prosecution bodies. The possibility exist for the services to make some steps related to the acts of observation sphere, but those steps have a limited expression in terms of probation and they support the undertaken information activity.

A category of beneficiaries higher than the institution of the prefect and, respectively, of the county council president is represented by the members of government. The members of government are located on the same level of customized decision powers, according to their authority, except for the Prime Minister, who has a superior decisional capacity, considering he is on an upward hierarchical position.

The President of the Senate, the President of Assembly of Deputies and the presidents of the standing committees on defense and enforcement of public order of the two Chambers of Parliament receive information from services. As representatives of the legislation forum and having direct competence in the security issues, the information transmitted are oriented on those directions needed to insure the smooth functioning of the protected field and to maintain the state of national security, as a product of options and decisional intervention in accordance with the best correlation between the national and the international interests.

President of Romania is the biggest beneficiary of the intelligence services. Due to semi-presidential form of government in Romania, the Prime Minister shares the executive powers with the President of the state. This fulfills important functions, especially in foreign policy field and in the defense and security field (domain reserved). In the context in which the President is the first violin on the security stage, he is the best consumer of strategic information. Surely this type of information is not contained into the daily portfolio, because no intelligence service in the world can constantly produce information for the strategic level. What is introduced in the daily map from the president's table are the security information or the information bulletins, which have a periodical frequency or are requested by the president, in order to prepare some political events or to properly perform some pending activities.

Due to the representation hold within the internal and external policy sphere, the President of Romania is the biggest beneficiary, having at the same time both the attribute and the obligation to be also the most competent decisional factor in the security field. His decisional capacities are exceeding the national security emergence area to the upper sections of security insurance.

3. EXTERNAL INFORMATION FLOW AND ITS MAIN FEATURES

The relationship between information providers and its recipients is based on external information flow, which is a continuous process.

In general, information flow is the amount of information exchanged between the transmitter and the beneficiary of the information and assigned the following characteristics: length, speed, reliability, cost and laden degree.

Applying this path to the relationship between the intelligence services in Romania and the legal beneficiaries leads to the assumption that information is a highly perishable product.
The length of information flow between the provider and the beneficiary must fit within the tolerance limits designed to ensure the transfer of information, without any jam along the circuit, to the intermediate structures. In the Romanian formula, there is only a single link between the providers and the beneficiaries, the NIC – National Intelligence Community, which operates a filtrate volume of information, that have already been subject to some corroboration and analysis activities, conferring them accuracy and adhesion. Regarding the NIC, it operates with national security information that meet certain criteria, the final form being assigned by the issuing services. We can argue that the primary type information referred to the NIC is already a complete one, verified and therefore safe. As a consequence, NIC is favored because it accumulates only information with a high degree of relevance, which improves the analytical process. Analytical work is accessible, in terms of reducing the ballast elements, those which duplicate the contents and the redundant data.

In any collective type system there is also the risk of waste accumulation, bypassing the process, and information services are no exception.. The appropriate management projects and programs, along with the internal procedures adapted to the modern business intelligence requirements, helps to increase the quality and to reduce the unnecessary treasuresness of unnecessary information.

The speed of information movement towards the beneficiaries is in a congruent relationship with the length of the information flow. If there are more intermediate links between the information provider and the beneficiaries, those links can hamper the development within the circuit and the shifting speed decreases. For these reasons, between the providers and the beneficiaries there must be the fewest possible superstructures, in order to disqualify the information and its subject to perishable character. Returning to the idea exposed above, in Romania, the information flow has a speed which is unconditioned by external elements, NIC being the only intermediary entity, but one that doesn't intervene across the path of all the information categories issued by the services the service. In case of threats, aggressions or imminent risks, the information can be sent both to NIC, in order to achieve the integration process, and to the beneficiary, in order to promptly achieve the act of prevention as it must be done.

The reliability of the information flow represents the measure of intelligence services professionalism within the institutional relationship they have with the beneficiaries. The request of maintaining viable the information flow and to exclude any malfunctions that may intervene at a particular moment, and under specified conditions, is placed on the provider, who must build his own internal mechanisms very well, in order to create the information finished product, which falls outside his own system. From this framework, the beneficiary's contribution, which helps maintaining the reliability of the process, should not be excluded. If the beneficiary does not intervene to ensure the preventive function, it means that the ultimate goal of the intelligence activity is not achieved. Reliability, in this context, is not reduced to a kind of staff office correspondence but it is assimilated and integrated into the final purpose of intelligence activity, as an integrating process.

One of the problems of modern intelligence services is subject to costs, which are included in budgets, and subject to accounting purposes which does not exceed any field of activity. Information costs as much as each state wants to offer to obtain them. The real cost of

information is not always reflected by the available budget of the service producing it. The intelligence services never receive the budgets they wish for, and this fact can lead to the occurrence of dysfunctions in the activities they undertake. In fact, the budget allocated to the intelligence services is one of the hottest topics that are debated by the political class and by the civil society representatives. Those who talk the least about their own budgets are the intelligence services themselves, which are in a defensive position to the other social partners and do not claim for any possible failures that might occur because of the poverty or the lack of financial availability. In the secret services zone is it a known fact that an added value of the information is obtained by the professionalism of the workers who successfully compensate for the lack of money.

CONCLUSIONS

In an ever changing world and under the spectrum of constant threats, the intelligence activity will retrieve its once known supremacy. Although in certain cases the intelligence services are put to index, paradoxically, the results of their work are accepted and used. The cases of demonizing the services are fewer and fewer and are reported to isolated incidents. The social role of services is recognized and accepted under conditions in which the most important national and international decisions are taken based on predictions made by them.

Services maintain the most expressive social relationship with the lawful beneficiaries of security information, who intervene with the decisional power conferred by law into maintaining the national and international security.

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REGARDING THE CERTIFICATION AND APPROVAL OF UNMANNED AERIAL VEHICLES (UAVs)

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Abstract: *UAVS, constitutes an important branch of aerospace, UAVs sites because construction and operating costs incomparably smaller than the well-known aircraft will be used increasingly over the coming decades.*

Unmanned aircraft successfully interwoven with the limits of design simplicity rules and laws as they are designed and constructed. Using this category of aircraft is not without weight, and their usefulness is confirmed every day.

Keywords: *UAV systems (UAS), aerial vector, Civil Aviation Authority, aerial code.*

1. Introduction

One of the key factors of higher education reform is to refocus and reorganize scientific research. This activity should be tightly woven with the education process, taking into account the need to train professionals who can compete with their qualifications and performance at the frontiers of knowledge, the Romanian universities more competitive market leading skills and institutional support for training of elite performance among the younger generation.

Given the continued development of the field unmanned aircraft (UAV) project aims to substantiate the certification and approval documentation required for UAV's and familiarity with the terms of this area of activity of the aviation industry.

1.1. Short presentation of unmanned aerial vehicles - UAVs. Unmanned aircraft in the general sense is the vector actually and equipment that are located on its board. Together executing specific tasks which were built and designed.

UAV: A powered vehicle that does not carry a human operator, can be operated autonomously or remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload. Ballistic or semi-ballistic vehicles, cruise missiles, artillery projectiles, torpedoes, mines, satellites, and unattended sensors (with no form of propulsion) are not considered unmanned vehicles. Unmanned vehicles are the primary component of ***unmanned systems.***

UAV is contiunes field expansion in both constructive solutions and the tasks that can be fulfilled by them, whether using UAVs to the top sites were military excusiv currently have a wide use in civilian areas. UAV sites today know a great variety of shapes, sizes, configurations and construction characteristics.

The main reasons to use this type of aircraft is reduced construction and operating cost compared with older sisters with human pilot.

Note that air vectors satisfying simple missions do not require specialized training of human operators on the ground, but the situation changes in UAV sites that have a high degree of complexity of construction and equipment on board, it is necessary both to a specialized training of human operators as well as a logistics training. Another important indication is that missiles are not part of the UAV category sites for simple reason that they can be reused after the mission although they may be (self) guided. There is now passed to another concept in this field UAVs - unmanned aerial vehicle system.

1.2. Classification UAV sites

The most important criteria for the classification of unmanned aircraft:

a. in terms of weight:

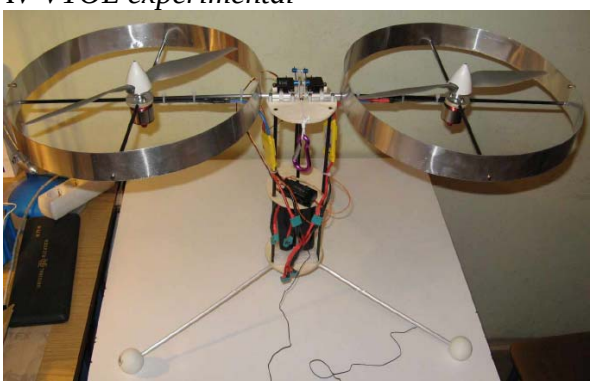
Category	Weight	Sample
Micro	Sub 5 kg	Dragon Eye
Mini	5 – 50 kg	RPO Midget
Light	50 – 200 kg	Raven
Medium	200 – 2000 kg	A-160
Heavy	> 2000 kg	Global Hawk

b. in terms of andurance and range of:
- andurance / low range: up to 1 hours (short mission) and the range under 100 km
- andurance / medium range: between 1 and 5 o'clock and range between 100 and 1500 km
- andurance / high range: 5 to 24 hours and range between 100 and 250 km
- andurance / veryhigh range: over 24 hours and the range between 250 and 22000 km

c. in terms of altitude at which it operates:
- Low altitude - up to 1000 m,
- Average altitude - between 1000 and 10000 m
- High altitude - more than 10,000 m

1.3 Types of UAVs

Category micro unmanned aerial vehicle
MAV VTOL experimental



The final goal is microUAV experimental audio-video surveillance enclosed large perimeters. Quiet diesel engine provides the air carrier near the zones of interest.

Tehnical data

Lenght	800 mm
Maximum weight	1,5 kg
Weight	0,2 kg
Engine	2x0,2 kw electrical
Operational autonomy	20 min
Operational altitude	1000 m
Materials used	carbon and kevlar

Category verylight unmanned aerial vehicle Helicopter Raptor 90V2

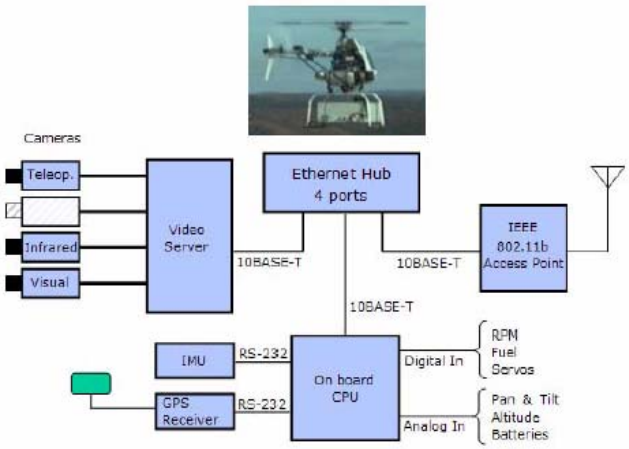
Raptor 90 is a helicopter UAV used in data acquisition by photogrammetry. It is fitted with wireless and inertia for carrying out the tasks in the system manually or automatically using a specialized software for GPS navigation. For shooting Station is equipped with a high resolution photo.

Tehnical data

Fuselage length	1410 mm
Fuselage width	190 mm
Fuselage height	465 mm
Diameter rotor bearing	1580 mm
Anti-torque rotor diam.	260 mm
Weight	5 kg
Misions	Image acquisition

The GPS receiver has the following characteristics:

Receiver type	16 channels
Frequency	4 Hz
Accuracy	2,5 m
Accuracy time	50 nanosec
Operational limits	18 km şi 515 m/sec



System hardware aboard Raptor 90 V2

Neptune RQ-15A

Neptune was developed by TRS Technologies for a range of maritime missions. The vector is driven by a small piston engine, it can land on water. Introduced in fuselage bulkhead equipment includes a GPS system, wireless control equipment, data acquisition system and flight management sensors in real time.

Tehnical data

Length	1,8 m
Span	2,1 m
Max. speed	156 km/h
Min. speed	111 km/h
Max. distance operational	75 km
Autonomy	4 h
Total weight	36 kg
2 stroke engine	15 CP
Ground crew	1

Category light

Jordan Falcon

Part of the family KADDB - JAI UAV, it provides capabilities and performance on a wide range of air applications (recognition day and night, overflight and data acquisition). Complete system that includes an air carrier catapult launch and landing a parachute recovery. Internal equipment are multiple, GPS, autopilot, rangefinder, generating 900 W and 240 wh battery.

Tehnical data

Max. speed	180 km/h
Cruising speed	120 km/h
Min. speed	80 km/h
Max. distance operational	450 km
Autonomy	4 h
Empty weight	40 kg
Total weight	60 kg
2-stroke combustion engine with water cooled	200 cm^3
Ground crew	4

Category heavy

A. Shadow 600

Shadow is designed and developed by AAI Corporation, which took it as a goal for autonomy for 12-14 hours and a payload of approx. 40 kg. 85% is built from composite materials and equipped with digital avionics.

Tehnical data

Span	6,7 m
Length	4,87 m
Wing area	3,71 m^2
Weight useful	41,3 kg
Total weight	265 kg
Max. speed	200 km/h
Cruising speed	148 km/h
Min. speed	120 km/h
Max. distance operational	200 km
Autonomy	14 h
Operational ceiling	4877 m
Engine	52 CP

2. Some aspects regarding certification Unmanned Aircraft

2.1 Romanian legislation

According to Romanian Air Code have the following definitions:

"3.16. *certification* - recognition that a service, product, or a piece of equipment, organization or person complies with applicable requirements and issue the relevant certificate attesting to his compliance, certification may also result in conferring a right, under regulations in force;

3.17. *certificate* - the document issued as a result of certification in accordance with specific regulations applicable;

3.19. *airworthiness certificate / license* -individual document certifying the airworthiness of aircraft;
3.20. *certificate of registration / identification* - individual document certifying the registration of aircraft, giving it its nationality;
3.21. *type certificate* - the document that defines the type design of an aircraft and certifies that this project type comply with the airworthiness requirements applicable; "

Overview of unmanned aircraft standpoint Legislative:

Unmanned aircraft (UAV) in the sense RACR-AZAC have the following description:

"Unmanned aerial vehicle on board (UAV) - a vehicle that meets the conditions specified in RACR-AZAC.100 section (1). E - unmanned aerial vehicles on board, with an operating mass of less than *150 kg*.

Onboard unmanned aerial vehicles subject to this regulation are divided into following categories:

(i)Category A: unmanned aerial vehicles on board, with MTOM less than *25 kg*, with the following limitations:

Aerodina

- UAV piston engine: cylinder capacity of less than or equal to *150 cm*^{3};
- UAVs with electric motor: the total power exceeding *15 kW*;
- UAV engine turboprop: total power exceeding *15 kW*;
- UAV with jet engine: thrust of less than or equal to *30 daN*, with a thrust / weight without fuel higher than 1.3.

Aerostat

- UAV hot air: the total mass of gas cylinders on board, more than *5 kg*;
- UAV with inert gas: maximum structural mass of less than *25 kg*.

If an unmanned aerial vehicle on board (UAV) Class A encompasses different types of propulsion, the limit is then set in proportion to the engine under the maximum authorized above.

(ii)Class B1: any UAVs not meeting of Class A, with mass of than *150 kg*. "

UAV sites must also have the following as:

AZAC.110 Documents admissibility A.RACR-flight;

(1) Each aircraft must have a national permit to fly;

(2) Aircraft that have electronic radio equipment on board to licensed radio issued under the law.

2.2 International legislation

Canadian Aviation Regulations:

"Unmanned Air Vehicle" means a power driven aircraft, other than a model aircraft, that is operated without a flight crew member on board. Unmanned air vehicles have been given many names, but are most commonly referred to as unmanned aerial vehicles (UAV), unmanned air vehicles, remotely operated aircraft or remotely piloted vehicles. Unmanned air vehicles may take the form of airships, aeroplanes or rotorcraft. Basically, they could be considered to be any unmanned aircraft that performs a useful mission and can be remotely controlled or has autonomous flight capability.

How unmanned air vehicles are different from model aircraft:

"Model aircraft" means an aircraft, the total weight of which does not exceed *35 kg* (77.2 pounds), that is mechanically driven or launched into flight for *recreational purposes* and that is not designed to carry persons or other living creatures. Although some micro unmanned air vehicles may weigh less than *35 kg*, they are operated by research institutions and other organizations for non-recreational purposes.

How unmanned air vehicles are regulated:

Section 602.41 of the CARs states, no person shall operate an unmanned air vehicle in flight except in accordance with a Special Flight Operation Certificate (SFOC). Section 623.65 outlines information that should be submitted when making an application for a SFOC. Be sure to make your request as early as possible and provide as much information as possible. You must be able to demonstrate the predictability and reliability of the unmanned air vehicle, essentially that it has the ability to perform in the desired environment. The requirement for a SFOC is intended to ensure the safety of the public and protection of other users of the airspace during the operation of the unmanned air vehicle. The following constitutes an application to conduct the flight of an unmanned air vehicle:

(a) the name, address, and where applicable, the telephone number and facsimile number of the applicant;
(b) the name, address, and where applicable the telephone number and facsimile number of the person designated by the applicant to have operational control over the operation (Operation Manager);
(c) method by which the Operation Manager may be contacted directly during operation;
(d) the type and purpose of the operation;
(e) the dates, alternate dates and times of the proposed operation;
(f) a complete description, including all pertinent flight data on the aircraft to be flown;
(g) the security plan for the area(s) of operation and security plan for the area(s) to be overflown to ensure no hazard is created to persons or property on the surface;
(h) the emergency contingency plan to deal with any disaster resulting from the operation;
(i) the name, address, telephone and facsimile numbers of the person designated to be responsible for supervision of the operation area (Ground Supervisor), if different from the Operation Manager during the operation;
(j) a detailed plan describing how the operation shall be carried out. The plan shall include a clear, legible presentation of the area to be used during the operation. The presentation may be in the form of a scale diagram, aerial photograph or large scale topographical chart and must include at least the following information:
- the altitudes and routes to be used on the approach and departure to and from the area where the operation will be carried out;
- the location and height above ground of all obstacles in the approach and departure path to the areas where the operation will be carried out;
- the exact boundaries of the area where the actual operation will be carried out;
- the altitudes and routes to be used while carrying out the operation;
- any other information pertinent to the safe conduct of the operation requested by the Minister.

Unmanned Air Vehicles Operating Beyond Visual Range

More and more UAV operators are making applications for Special Flight Operations Certificates (SFOCs) where the UAV is to be operated beyond visual range. Once the applicant demonstrates the ability to conduct a safe operation, the Minister shall issue the special flight operations certificate. The SFOC process allows each application to be considered on it's own merits, and the operator must evaluate the risks associated with the proposed operation and provide satisfactory risk mitigation measures.

Civil Aviation Authority. (SUA)

1. Definition of a Small Aircraft

Any unmanned aircraft, other than a balloon or kite, weighing not more than *20 kg* without its fuel but including any articles or equipment installed in or attached to the aircraft at the commencement of its flight.

2. Models Over 20 kg

NOTE: All model aircraft, except gliders, weighing more than *20 kg* (weight of model and equipment, but excluding fuel) require an exemption to fly.

2.1 An EXEMPTION is used to allow an exception to the established law. Such an exception is usually only made subject to various additional conditions to ensure adequate safety.

2.2 A model aircraft, except a glider weighing over 20 kg can only be operated under the terms of an Exemption issued by the CAA.

2.3 It is unlikely that an exemption will be issued without the condition that the model must be flown within the 'control' of a recognized model association and at a suitable site.

2.4 The maximum weight for a model aircraft to be treated under the guidelines of CAP 658 is 150kg. Above this weight full airworthiness regulations may apply.

Builders contemplating the construction of a model weighing more than *150 kg* should contact the CAA prior to commencing construction.

European regulations (EASA, JAA and EUROCONTROL)

UAV system: The Policy is applicable to the UAV system. An UAV system is defined as follows in the policy:

UAV System: A ***UAV System*** comprises individual UAV System elements consisting of the flight vehicle (***UAV***), the "***Control Station***" and any other UAV. System Elements necessary to enable flight, such as a "**Communication link**" and "***Launch and Recovery Element***". There may be multiple UAVs, Control Stations, or Launch and Recovery Elements within a UAV System. "Flight" is defined as also including taxiing, takeoff and recovery/landing.

Civil Aviation Authority New Zealand

Current UAV activity in New Zealand UAVs in use with a weight capability of *105g to 20kg*. They can travel up to *200kph*. They all have GPS, autopilot, altimeters and video cameras and are currently authorized to a height limit of *400m* by CAA.

NZ Model Aeronautical Association (NZMAA):

Advised that the NZMAA does not wish to be caught up in UAV regulations in a way that would restrict their activities.

NZMAA currently has models in 3 categories: Less than *15kg; 15-25kg and 26-100kg*.

Models less than *15kg* do not require any CAA approval. The *15kg* and over models are well regulated on a "one off" basis under existing rules. Models less than *100g* are not classified as model aircraft at all.

3. Conclusions

A review of unmanned aircraft and equipment by classifying their wishes with laws and regulations in the field for clarification of this relatively new field of aeronautics.

Implementation, exploitation and the difference in default and equipment lead to differences in costs and capabilities of these aircraft already have a history own evolution alongside the other known types of aircraft.

Legislation on unmanned aircraft (UAV) in December 2009 in Romania when it is not yet complete and aligned with international law, one reason may be that work with UAVs our country is still at an early stage.

Self-regulation may be possible at the sub-*100kg* (or *10,000 joule*) weight/energy level via certificated UAV organizations, but above this level specific UAV operator certification is likely to be essential.

In future is necessary to take into account the folowing aspects:

- Integration of UAV into the national airspace system;
- Communications with UAV operators;
- Identification of UAVs;
- Airworthiness and maintenance.
- Pilot training, experience and qualifications
- Required navigation performance (RNP) and a dependence on good and reliable GPS coverage;
- Flight termination systems;

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PROJECT RISK MANAGEMENT

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Abstract: *Research is well known risky of the most varied and complex, an important recommendation is that the degree of risk and uncertainty are higher at the beginning of the project and not always fall gradually to end, hence the likelihood that successful completion of a research project is also lower compared with other types of projects are more predictable results and financial costs.*

Keywords: *risk, preventive actions, contingency actions, the priority score*

1. Introduction:

Theoretical concepts

Risk is a problem (situation, event, etc..) Which has not yet occurred but could occur in the future, where the first results set is threatened or potentiated. In the first situation, risk is a threat, and in the second, risk is an opportunity.

The probability of materialization of risk is the possibility or the event that a risk will materialize. Is a measure of the possibility of developing risk quantification determined favorable or when the nature of risk and available allow such an assessment.

Impact of risk is the consequence of the results (objectives), if the risk would materialize. If risk is a threat, consequence of the results is negative and if the risk is an opportunity, the result is positive. Express consequences of *risk exposure* risk materializes, in relation to predetermined objectives, expressed as a combination of probability and business impact.

Materialisation of the risk means the translation risk related uncertainty (possible) in the certainty (of the fait accompli). The risk materialized becomes a possible problem in a difficult, if risk is a threat, or a favorable situation where risk is an opportunity.

Attenuation risk. Mitigating risk applies to measures taken to reduce the likelihood (possibility) of risk occurrence and / or mitigate the consequences (impact) on outcomes (goals) if the risk would materialize. More concise, mitigating risk is reducing exposure to risk, whether it is a threat.

Quantifying risk. This chapter contains the quantification of project risk.

The probability of occurrence

Likelihood of risk is given in the following table:

Level	Score	Description
Very low	1	Very low probability of occurrence, it is still necessary to monitor the risk that certain circumstances may lead to a risk with a certain probability of occurrence, on the project
Low	2	Low probability of occurrence, based on current information available and risk triggering circumstances were also less likely to show.
Medium	3	Average probability of occurrence, the risk is likely to occur
High	4	High probability of occurrence, based on project circumstances
Very high	5	Probability of occurrence and the circumstances of the occurrence of risk are likely to manifest

Impact / effect

Score impact of risk is given in the following table:

Level	Score	Description
Very low	1	Minor effect on the project. It is not possible to quantify the impact, which is very low.
Low	2	Minor impact on the project, such as deviations of less than 5% from the field, program or project budget.
Moderate	4	Measurable impact on the project, such as deviations of 5 to 10% from the field, program or project budget
High	8	Significant impact on the project, such as deviations from 10 to 25% from the field, program or project budget
Very high	16	Major impact (catastrophic) on the project, such as deviations of more than 25% of the area, program or project budget

Priority

Priority score is determined by the score of probability of occurrence and impact of the risk score, the relationship:

Priority Score = Score probability X Score impact

Risk matrix

Matrix scores priority is given below>

Probability		Impact / effect				
Level	Score	Very low	Low	Moderate	High	Very high
		1	2	4	8	16
Very low	1	1	2	4	8	16
Low	2	2	4	8	16	32
Medium	3	3	6	12	24	48
High	4	4	8	16	32	64
Very high	5	5	10	20	40	80

The following table includes scores of priority, the priority classification and the color assigned to each priority class of risk:

Priority score	Classification of risk priority	Risk color
1 – 5	Very low risk	Blue
6 – 10	Low risk	Green
12 – 20	Moderate risk	Yellow
24 – 40	High risk	Orange
48 – 80	Very high risk	Red

Sheet risk

Sheet risk is the document that describes in detail each identified risk, which I plan to draw up risk management. Sheet risk is completed by the Risk Management team members to the risks identified for each project.

Risk Management Plan

Contains actions that are applied to avoid, transfer or mitigate risk, based on priorities. For each identified risk are specified:

- Probability score;
- Impact/effect score;
- Priority score.
- Preventive actions, applied to reduce the likelihood of risk;
- Contingency actions, applied to reduce the impact of emerging risks;

Data output and the resources allocated to each type of action. Information necessary for risk management plan is taken from the files of risks.

2. Risk management project.

Categories of risk

1. Project	5. Domain
2. Human resources	6. Certification, approval
3. Financial resources	7. Benefits
4. Planning, equipment	8. Other categories

Risks identified:

Category	Description	Code
1. Project	Risk of delay of funding the project itself	1.1
2. Human resources	The risk of not constitute research team want the project approved for funding	2.1
3. Financial resources	Risk of curenccy devaluation	3.1
	Risk of increase in price of materials and equipment purchase	3.2
	Risk of increase of licesing fees of pay contributions	3.3
	Risk of delayed payments for completed project	3.4
	The risk of project budget matching funds available	3.5
4. Planning, equipment	The risk that equipment might be damaged by delivery	4.1
	Risk that equipment supplied is not of quality espected	4.2
	Risk of malfunctions after instalation	4.3
5. Domain	The risk that the proposed research project is not approved for funding	5.1
	The risk that ongoing research program not to complete the desired results	5.2
	Risk of accidents / damage finished products made	5.3
6. Certification, approval	Risk that final products are not certified and / or approved	6.1
7. Benefits	Risk that foreigner does not require collaboration with research center	7.1
8. Other categories	Risk of accidentes and illnesses in during the program of research	8.1

Top risks identified, in descending order of priority score are:

Code	Description	Probability / Impact	Priority	Preventive actions	Contingency actions
5.2	The risk that ongoing research program not to complete the desired results	High 4 / Very high 16	64	Documentation research continues on the project steering	Documentation research continues on the project steering
2.1	The risk of not constitute research team want the project approved for funding	Low 2 / Very high 16	32	The proposal for funding by research projects is envisaged, and the establishment of research teams in each project	Teams of specialists will be listed as reserves in those projects
5.1	The risk that the proposed research project is not approved for funding	High 4 / High 8	32	Study of research priority areas for funding and proposed projects with chances of approval	Resolve the matter by proposing a 2 or more research projects on this subject with the chance of approval
3.5	The risk of a project budget matching funds available	Medium 3 / High 8	24	Establish strict rules for allocating the project budget and its application	Addressing the situation by restricting the area of research or finding additional sources of funding
5.3	Risk of accidents / damage finished products made	Medium 3 / High 8	24	Documentation and compliance NSSM and technical standards of operating the product	Searching for ways to resolve the situation by continuing to investigate and research on type 2 and 3 of the product
6.1	Risk that the final products are not certified and / or approved	Medium 3 / High 8	24	Documentation of procedures and criteria for the certificate in the field and their application	Searching for ways to resolve the situation by removing the urgency of conformity that led to the postponement of certification.
8.1	Risk of accidents and illnesses in during the program of	Medium 3 / High 8	24	NSSM and training on specific rules.	Searching for ways to resolve the situation in the law. Ensure

	research			Ensure risk of workplace accidents. Access to the cabinet for occupational medicine	medical examination after the event.
4.3	Risk of malfunctions after installation	Medium 3 / Moderate 4	12	Documentation on the instructions for use of equipment located on site	Searching for ways of resolving the situation in view the user manuals or contact the supplier

Risk sheet

RISK SHEET		
PROJECT DESCRIPTION		
Project name:	The establishment and operation center of research, innovation and unmanned aircraft in the area and production (UAV)	
Project manager:	*Prisacariu Vasile*	
Risk manager:	*Human resources and management*	
DESCRIEREA RISCULUI		
Risk code:	*5.2.*	
Identified by:	*Prisacariu Vasile*	
Data identification:	*12.12.2009*	
Risk category:	*Domain*	
Risk description: *Make a brief description of identified risk:* The risk of ongoing research programs may not be completed with the results you want - this risk can be due to: the original research data to be incorrect, wrong methods and risk materializes effect may be to arrive at the results wrong from research and impossibility of the project.		
Risk probability: Likelihood of risk is high, given that research has a high degree of uncertainty.	Risk impact / effect: The consequence is the risk materializes affect budget revenue and expenditure of the Research Center. The impact can be considered very high because of the financial implications involved in this venture.	
REDUCTION THE RISK		
Recommended preventive actions: *Documentation of continuing the research on project.*	Contingency actions recommended: *Documentation of continuing the research on project.*	
APPROVAL:		
Documentation Reference: *- research Program* *- national legislation*		
DEVELOPED:	APPROVED - RISK MANAGER:	
Spec. Human resources and management	Name: Prisacariu Vasile	
Signature:	Signature:	
Data: 12.12.2009	Data: 12.12.2009	

Sheet risk is the document that describes in detail each identified risk, which I plan to draw up risk management. Sheet risk is completed by the Risk Management team members to the risks identified for each project.

Sheet risk include the following information:

Project description: project name a covered risk, name a project manager, name one manager with risk reduction.

Reducing risk: preventive action recommended, a recommended contingency actions.

Approval: reference documentation a signature of design / approval.

3. Conclusions

Every project is influenced by the external environment (the context) and aims to influence in turn, the objectives of a project under certain requirements, and the results expressed level of meeting them. Since it is difficult taking into account all factors that affect or might affect a project and that it has a character of novelty, as I noted above, a project requires a certain degree of risk, both in the design of and during implementation. For risk management at project level is envisaged completion risk and consult their records by the responsible staff.

In project management, risk management includes the following activities:

Planning how risk will be managed in the particular project. Plan should include risk management tasks, responsibilities, activities and budget.

Assigning a risk officer - a team member other than a project manager who is responsible for foreseeing potential project problems. Typical characteristic of risk officer is a healthy skepticism.

Maintaining live project risk database. Each risk should have the following attributes: opening date, title, short description, probability and importance. Optionally a risk may have an assigned person responsible for its resolution and a date by which the risk must be resolved.

Creating anonymous risk reporting channel. Each team member should have possibility to report risk that he/she foresees in the project.
Preparing mitigation plans for risks that are chosen to be mitigated. The purpose of the mitigation plan is to describe how this particular risk will be handled – what, when, by who and how will it be done to avoid it or minimize consequences if it becomes a liability.
Summarizing planned and faced risks, effectiveness of mitigation activities, and effort spent for the risk management.

Risk management can therefore be considered the identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events or to maximize the realization of opportunities.

The strategies to manage risk include transferring the risk to another party, avoiding the risk, reducing the negative effect of the risk, and accepting some or all of the consequences of a particular risk.

The benefits of risk management in projects are huge. You can gain a lot of money if you deal with uncertain project events in a proactive manner. The result will be that you minimise the impact of project threats and seize the opportunities that occur. This allows you to deliver your project on time, on budget and with the quality results your project sponsor demands. Also your team members will be much happier if they do not enter a "fire fighting" mode needed to repair the failures that could have been prevented.
This is the 10 golden rules to apply risk management successfully in your project:
Rule 1: Make Risk Management Part of Your Project;
Rule 2: Identify Risks Early in Your Project;
Rule 3: Communicate About Risks Rule 4: Consider Both Threats and Opportunities;
Rule 5: Clarify Ownership Issues;
Rule 6: Prioritise Risks;
Rule 7: Analyse Risks;
Rule 8: Plan and Implement Risk Responses;
Rule 9: Register Project Risks;
Rule 10: Track Risks and Associated Tasks.

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NUMERICAL PANEL METHOD FOR INCOMPRESSIBLE POTENTIAL FLOW - MAPLE SOFT APPLICATIONS

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**"Henri Coandă" Air Force Academy, Braşov

Abstract: *- The panel method is one of the most widespread and used tools for aerodynamic analysis and design which has the property that no volumetric grid is required, namely only the bounding surface must be discretized. This paper deals with the Maple soft applications for numerical panel method. Based on this powerful mathematical computation tools, several numerical solutions were obtained for different bodies.*

Key words: *aerodynamics, boundary elements, CFD, flow simulation, finite differences*

1. INTRODUCTION

Despite advances in the development of sophisticated grid generation techniques and compressible flow modeling methods, analyses based on incompressible and inviscid potential flow assumptions continue to remain a very good technique for aerodynamic computation. Compared to the generation of a good quality volumetric grid, construction of a surface mesh for a complex geometry is a simpler problem especially since the required geometric information is often already available in the form of CAD files and efficient grid generation techniques for curved surfaces have been developed.

The incompressible potential flow model provides reliable flowfield predictions over a wide range of conditions. For the potential flow assumption to be valid for aerodynamics calculations, the primary requirement is that viscous effects are small in the flowfield, and that the flowfield must be subsonic everywhere. If the local flow is at such a low speed everywhere that it can be assumed incompressible, Laplace's Equation is an exact representation of the inviscid flow. For higher subsonic mach numbers with small disturbances to the freestream flow, the Prandtl-Glauert Equation can be used and converted to Laplace's Equation by a simple transformation. This provides the basis for estimating the initial effects of compressibility on the flowfield, namely liniearized subsonic flow. In both cases, the flowfield can be found by the solution of a single linear partial differential equation. One of the key features of Laplace's Equation is the property that allows the equation governing the flowfield to be converted from 3D problem throughout the field a 2D problem for finding the potential on the surface. The solution is then found using this property by distributing singularities of unknown strength over discretized portions of the surface: panels. Hence the flowfield solution is found by representing the surface by a number of panels and solving a linear set of algebraic equations to determine the unknown strengths of the singularities.

2. PROBLEM FORMULATION

The equation for the potential in a form suitable for use in panel model calculation is the following

$$\varphi = V_\infty\left(x\cos\alpha + y\sin\alpha\right) + \sum_{j=1}^{N}\int_{\text{panel } j}\left[\underbrace{\frac{q_j(s)}{2\pi}}_{\substack{q_j \text{ is the 2D}\\ \text{source strength}}} - \underbrace{\frac{\gamma_j}{2\pi}\theta}_{\substack{\text{vortex singularity}\\ \text{of strength } \gamma_j(s)}}\right] \quad (1)$$

where V_∞ is the free stream velocity, α the angle of attack and $\theta = \tan^{-1}(y/x)$.

The numbering system starts at the lower surface trailing edge and proceeds forward, around the leading edge and aft to upper surface trailing edge, so N+1 points define N panels. The approach is to break up the surface into straight line segments, assume the source strength $q(s)$ is constant over each line segment (panel), but with different value for each panel, $q(s) = q_j,\ j = 1, 2.....N$, and the vortex strength γ is constant and equal over each panel.

Most airfoils are not described by equations but are defined by a table of coordinates. Frequently, these coordinates are the results of a computational aerodynamic design program, and simple algebraic formulas can not be used to define the shape. The representation of a smooth surface by a series of line segments is presented in Fig. 1.

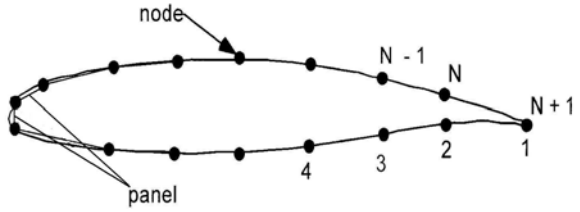

Fig. 1 Representation of nodes

If the i^{th} panel is between the i^{th} and $i+1^{th}$ nodes and the i^{th} panel's inclination to the x axix is θ_i (fig. 2), then the sin and cos of θ are given by

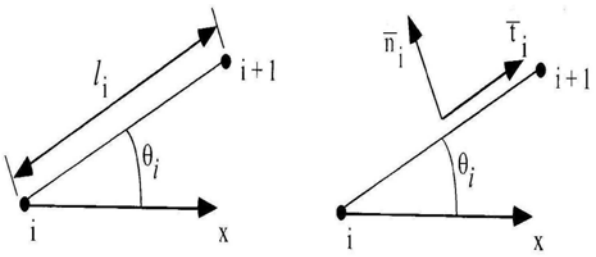

Fig. 2 Nomenclature for coordinate system

$$\begin{cases} \sin\theta_i = \dfrac{y_{i+1} - y_i}{l_i} \\ \cos\theta_i = \dfrac{x_{i+1} - x_i}{l_i} \end{cases} \tag{2}$$

and the normal and tangential unit vectors are

$$\begin{cases} \vec{n}_i = -\sin\theta_i \vec{i} + \cos\theta_i \vec{j} \\ \vec{t}_i = \cos\theta_i \vec{i} + \sin\theta_i \vec{j} \end{cases} \tag{3}$$

The unknowns have to satisfy the flow tangency condition on each panel at one specific control point and the solution has to satisfy the Kutta condition. The control point is the mid-point of each panel as shown in fig. 3.

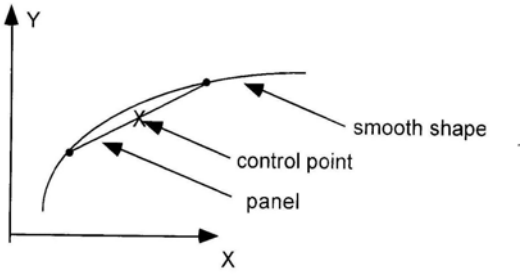

Fig. 3 Control point representation

The coordinates of the control point are

$$\begin{cases} \bar{x}_i = \dfrac{x_i + x_{i+1}}{2} \\ \bar{y}_i = \dfrac{y_i + y_{i+1}}{2} \end{cases} \tag{4}$$

and the velocity components at the control point $(\bar{x}_i, \bar{y}_i)$ are $u_i = u(\bar{x}_i, \bar{y}_i)$ and $v_i = v(\bar{x}_i, \bar{y}_i)$.

The flow tangency boundary condition is given by $\vec{V} \cdot \vec{n} = 0$,

$$\left(u_i \vec{i} + v_i \vec{j}\right) \cdot \left(-\sin\theta_i \vec{i} + \cos\theta_i \vec{j}\right) = 0 \tag{5}$$

or

$-u_i \sin\theta_i + v_i \cos\theta_i = 0$, for each i, $i = 1, 2,.....N$.

The remaining relation is found from the Kutta condition. This condition states that the flow must leave the trailing edge smoothly. Because of the importance of the Kutta condition in determining the flow, the solution is extremely sensitive to the flow details at the trailing edge, and for this reason the last panels

on the top and bottom are small and of equal length. The trailing edge panel nomenclature is presented in fig. 4

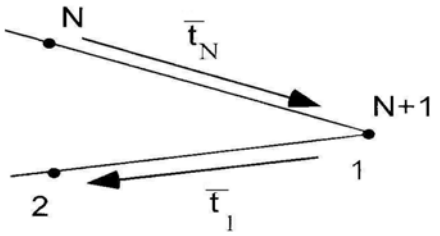

Fig. 4 Trailing edge

Also, the magnitude of the tangential velocities on the upper and lower surface are equal

$$u_{t1} = -u_{tN}$$

or

$$\vec{V} \cdot t\big|_1 = -\vec{V} \cdot t\big|_N \tag{6}$$

Carrying out the operation one gets the relation

$$\begin{aligned} &\left(u_1 \vec{i} + v_1 \vec{j}\right) \cdot \left(\cos\theta_1 \vec{i} + \sin\theta_1 \vec{j}\right) = \\ &-\left(u_N \vec{i} + v_N \vec{j}\right) \cdot \left(\cos\theta_N \vec{i} + \sin\theta_N \vec{j}\right) \end{aligned} \tag{7}$$

which is expanded to obtain the final relation:

$$\begin{aligned} &u_1 \cos\theta_1 + v_1 \sin\theta_1 = \\ &-u_N \cos\theta_N + v_N \sin\theta_N \end{aligned} \tag{8}$$

The expression for the potential in terms of the singularities on each panel and the boundary conditions derived above for the flow tangency and Kutta condition are used to construct a system of linear algebraic equations for the strengths of the sources and the vortex. The velocity components at any point i are given by contributions from the velocities induced by the source and vortex distributions over each panel,

$$\begin{cases} u_i = V_\infty \cos\alpha + \sum_{j=1}^{N} q_j u_{sij} + \gamma \sum_{j=1}^{N} u_{vij} \\ v_i = V_\infty \sin\alpha + \sum_{j=1}^{N} q_j v_{sij} + \gamma \sum_{j=1}^{N} v_{vij} \end{cases} \tag{9}$$

where q_i and γ are the singularity strengths and the $u_{sij}, v_{sij}, u_{vij}$ and v_{vij} are the influence coefficients (for instance, the influence coefficient u_{sij} is the x-component of velocity at x_i due to a unit source distribution over the j^{th} panel).

In order to find $u_{sij}, v_{sij}, u_{vij}$ and v_{vij} it is necessary to work in a local panel coordinate system $\left(x^p, y^p\right)$ which leads to a straightforward means of integrating source and vortex distributions along a straight line segment. The system is locally aligned with each panel j, and is connected to the global coordinate system, like in fig. 5

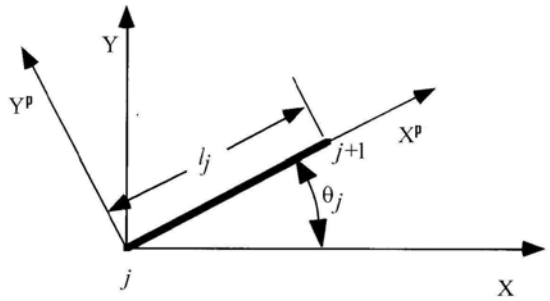

Fig. 5 Local panel nomenclature

The influence coefficients determined in the local coordinate system aligned with a particular panel are $u^{(p)}$ and v^p and are transformed back to the global coordinate system by

$$\begin{cases} u = u^{(p)} \cos\theta_j - v^{(p)} \sin\theta_j \\ v = u^{(p)} \sin\theta_j + v^{(p)} \cos\theta_j \end{cases} \tag{10}$$

The velocity field induced by a source in its Cartesian coordinates (taking into account that the source is located at the origin, $r = 0$) is

$$\begin{cases} u(x, y) = \dfrac{Q}{2\pi} \dfrac{x}{x^2 + y^2} \\ u(x, y) = \dfrac{Q}{2\pi} \dfrac{y}{x^2 + y^2} \end{cases} \tag{11}$$

If the source is located along the x-axis at a point $x = t$, the velocities induced by the source distributions are

$$\begin{aligned} u_s &= \frac{1}{2\pi} \int_{t=0}^{t=l} \frac{q(t)}{2\pi} \frac{x - t}{(x - t)^2 + y^2} \\ v_s &= \frac{1}{2\pi} \int_{t=0}^{t=l} \frac{q(t)}{2\pi} \frac{y}{(x - t)^2 + y^2} \end{aligned} \tag{12}$$

To obtain the influence coefficients, one can write u_s and v_s in the local panel coordinate system with $q(t)=1$ (unit source strength):

$$u^{(p)}_{sij} = -\frac{1}{2\pi}\ln\left(\frac{r_{i,\,j+1}}{r_{ij}}\right)$$
$$v^{(p)}_{sij} = \frac{v_1 - v_0}{2\pi} = \frac{\beta_{ij}}{2\pi} \qquad (13)$$

where r_{ij} is the distance from the j^{th} node to the point i, which is taken to be the control point location of the i^{th} panel. The angle β_{ij} is the angle suptended at the middle of the i^{th} panel by the j^{th} panel (fig. 6).

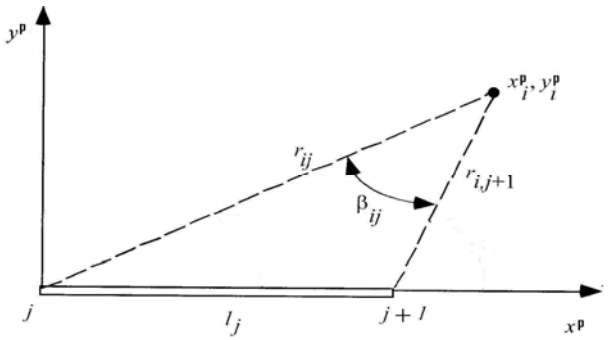

Fig. 6 Angles and radius

The source induces normal velocities and no tangential velocities. Thus, $u^{(p)}_{sii} = 0$ and $v^{(p)}_{sii}$ depends on the side from which the panel control point is approached. Approaching the panel control point from the outside leads to $\beta_{ii} = \pi$, while approaching from the inside leads to $\beta_{ii} = -\pi$.

Based on the same analysis used for the source singularities one can get the formulas for the influence coefficients due to the vortex distribution

$$u^{(p)}_{vij} = +\frac{1}{2\pi}\int_{t=0}^{t=l_j}\frac{y^{(p)}_i}{\left(x^{(p)}_i - t\right)^2 + y_i^{(p)2}}dt = \frac{\beta_{ij}}{2\pi}$$

$$v^{(p)}_{vij} = \frac{1}{2\pi}\int_{t=0}^{t=l_j}\frac{x^{(p)}_i - t}{\left(x^{(p)}_i - t\right)^2 + y_i^{(p)2}}dt = \frac{1}{2\pi}\ln\left(\frac{r_{i,\,j+1}}{r_{ij}}\right)$$

where the definitions and special circumstances described for the source singularities are the same in the current case of distributed vortices. In this case the vortex distribution induces an axial velocity on itself at the sheet and no normal velocity.

In order to get a system of equations of the form

$$\sum_{j=1}^{N} A_{ij}q_j + A_{i,\,N+1}\gamma = b_i \quad i = 1, 2,.....N \qquad (15)$$

which are solved for unknown source and vortex strengths, it is necessary to write the flow tangency conditions

$$-u_i \sin\theta_i + v_i \cos\theta_i = 0 \qquad (16)$$

for each i, i=1, 2,……N, where the velocities are given by:

$$u_i = V_\infty \cos\alpha + \sum_{j=1}^{N} q_j u_{sij} + \gamma\sum_{j=1}^{N} u_{vij}$$
$$v_i = V_\infty \sin\alpha + \sum_{j=1}^{N} q_j v_{sij} + \gamma\sum_{j=1}^{N} v_{vij} \qquad (17)$$

Taking into account formulas for $u_{sij}, v_{sij}, u_{vij}, v_{vij}$, one can get the system

$$\begin{cases} A_{ij} = \dfrac{1}{2\pi}\ln\left(\dfrac{r_{i,\,j+1}}{r_{i,\,j}}\right)\sin(\theta_i - \theta_j) + \dfrac{\beta_{ij}}{2\pi}\cos(\theta_i - \theta_j) \\ A_{i,\,N+1} = \dfrac{1}{2\pi}\sum_{j=1}^{N}\left[\ln\left(\dfrac{r_{i,\,j+1}}{r_{i,\,j}}\right)\cos(\theta_i - \theta_j) - \beta_{ij}\sin(\theta_i - \theta_j)\right] \\ b_i = V_\infty \sin(\theta_i - \alpha) \end{cases}$$

The final equations associated with the Kutta condition are

$$\begin{cases} A_{N+1,\,j} = \dfrac{1}{2\pi}\left[\sin(\theta_1-\theta_J)\beta_{1,\,j}+\sin(\theta_N-\theta_J)\beta_{N,\,j}\right]- \\ -\dfrac{1}{2\pi}\left[\cos(\theta_1-\theta_J)\ln\left(\dfrac{r_{1,\,j+1}}{r_{1,\,j}}\right)+\cos(\theta_N-\theta_J)\left(\dfrac{r_{N,\,j+1}}{r_{N,\,j}}\right)\right] \\ A_{N+1,\,N+1} = \sum_{j=1}^{N}\left[\sin(\theta_i-\theta_j)\ln\left(\dfrac{r_{1,\,j+1}}{r_{1,\,j}}\right)+\sin(\theta_N-\theta_j)\right]\cdot \\ \cdot\ln\left(\dfrac{r_{N,\,j+1}}{r_{N,\,j}}\right)+\sum_{j=1}^{N}\left[\cos(\theta_1-\theta_j)\beta_{1,\,j}+\cos(\theta_N-\theta_j)\beta_{N,\,j}\right] \\ b_{N+1} = -V_\infty\cos(\theta_1-\alpha)-V_\infty\cos(\theta_N-\alpha) \end{cases}$$

The coefficients derived above provide the required coefficients to solve a system of linear algebraic equations for N+1 unknows q_i, $i = 1, 2, ...N$ and γ,

$$\begin{cases} \sum_{j=1}^{N} A_{ij}q_j + A_{i,\,N+1}\gamma = b_i \quad i = 1, 2, ...N \\ \sum_{j=1}^{N} A_{N+1,\,j}q_j + A_{N+1,\,N+1}\,\gamma = b_{N+1} \end{cases} \tag{18}$$

At each control point, $v_n = 0$ and the tangential velocity is

$$u_{t_i} = V_\infty\cos(\theta_i-\alpha)+$$
$$+\frac{1}{2\pi}\sum_{j=1}^{N}\left[\beta_{ij}\sin(\theta_i-\theta_j)-\ln\left(\frac{r_{i,\,j+1}}{r_{i,\,j}}\right)\cos(\theta_i-\theta_j)\right]q_j+$$
$$+\frac{\gamma}{2\pi}\sum_{j=1}^{N}\left[\ln\left(\frac{r_{i,\,j+1}}{r_{i,\,j}}\right)\sin(\theta_i-\theta_j)+\beta_{ij}\cos(\theta_i-\theta_j)\right]$$

and the pressure coefficient,

$$C_{p_i} = 1-\left(\frac{u_{t_i}}{V_\infty}\right)^2 \tag{19}$$

3. MAPLE SOLUTION

Maple provide an interactive environment for solving symbolic, numeric and graphical computations. A simple way to solve the system of equations for q_i, i=1, 2,.....N and γ, is to build a procedure **proc**(V_∞, α) which gives the results for the inputs: free stream velocity V_∞ and angle of attack α. After declaring the local and global variables one can choose the number of panels, N and write the coordinates of nodes i, where i=1, 2,.....N+1. The matrix M of coefficients A_{ij} and vector B of b_i, are written in the following form:

M:=Matrix([seq(L[i],i=1..N+1)])

where

L[i]:=[seq(A[i,j],j=1..N+1)

and

B:=Vector([seq(b[i],i=1..N+1)]).

With the package LinearSolve one can get the solution of the equation

$$A \cdot x = B \tag{20}$$

namely,

$$x = [q_1, q_2, ...q_N, \gamma] \tag{21}$$

and after that, the tangential velocity u_{t_i} at each control point and the pressure coefficient C_{p_i}.

In the following figures are presented the NACA 4415 airfoil (fig. 7) and some results for C_{p_i} (fig. 8, Mach number 0.2, fig. 9, Mach number 0.4).

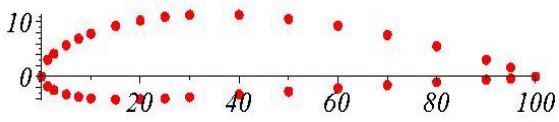

Fig. 7 Airfoil cordinates

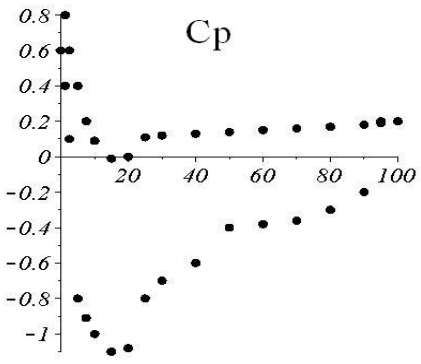

Fig. 8 Pressure coefficient

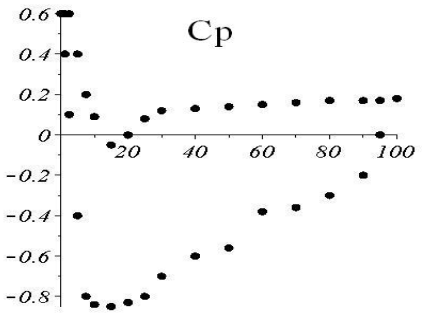

Fig. 9 Pressure coefficient

Also, a very simple way to solve the system of equations for the numerical source panel method (analyzed very well in the Fundamentals of Aerodynamics – fourth edition by John D. Anderson Jr.) is allowed by Maple soft.

For the flow around the circular cylinder, the ecuation for the source panel strengths $\lambda_1, \lambda_2, ...\lambda_N$ is

$$\frac{\lambda_i}{2} + \sum_{\substack{j=1 \\ (j\neq i)}}^{N} \frac{\lambda_j}{2\pi} \int_{j\,panel} \frac{\partial}{\partial n_i}\left(\ln r_{ij}\right) ds_j + V_\infty \cos\beta_i = 0$$

The velocity tangent to the surface at each control point can be calculated as a sum of the contribution from the freestream and from the source panels,

$$V_{ti} = V_\infty \sin\beta_i + \sum_{j=1}^{N} \frac{\lambda_j}{2\pi} \int_{j\,panel} \frac{\partial}{\partial s}\left(\ln r_{ij}\right) ds_j$$

where β_i is the angle between V_∞ and normal vector to the panel *i*.

In fig. 10 are presented the control points (1, 2,.....12) for source panel distribution around a circular cylinder,

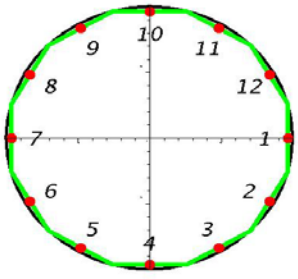

Fig. 10 Control points representation

Results for the pressure coefficients obtained from Maple calculation (red points in fig. 11) are compared with the exact analytical result (black line). The numerical pressure coefficient result is placed on the analytical line, that is the maple calculation is right.

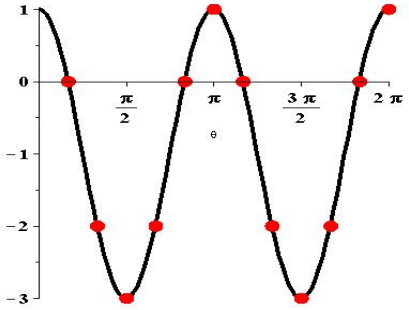

Fig. 11 Numerical and analytical results

4. CONCLUSIONS

The linear nature of the potential flow allows the principle of superposition in order to construct solutions to problems of interest by summing simpler solutions. Flows due to sources, doublets and vortices are the elementary building blocks out of which general solutions are constructed. Conventional computational fluid dynamics (CFD) methods require calculation for the entire three-dimensional field about the body, while the panel method also can calculate the entire three-dimensional field but it requires only calculation over the surface of the body.

One major computational task in a panel method is to obtain the matrices of panel influences at each others' control points. The key formulas are obtained by integrating over a panel the point source and doublet formulas weighted by the proper polynomial variations. These integrations, which express the panel influences at a general field point in space may be performed analytically over a plane panel to obtain exact closed form expressions, which however are rather complicated.

Maple soft is a very good tools to solve these types of problems and to explore mathematical models for computational aerodynamics.

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SOME TECHNICAL APPROACHES AND CONSIDERATIONS USED FOR AN AUTOPILOT DEVELOPMENT

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***Abstract**: The paper presents steps and the followed route for the development of autopilot equipment (SPARTACUS 4) available for different types of aerial platforms. The development driven function was the reliability and the low cost of the equipment.*

Keywords: UAV platforms, autopilot systems

1. INTRODUCTION

The main purpose of the autopilot is to enable the unmanned aircraft to accomplish their mission autonomously, without any (or with minimal) input from the operator. This leads to the fact that unmanned platform's performances are highly dependent on autopilot functions and reliability. This dependence is more demanding in case of multiple software functions implemented (waypoints navigation, datalink management, return home or failsafe procedures etc.) on the same autopilot architecture (hardware included) or in the case of large flight parameter range (aerial targets, loitering UAV's etc.) or in case of a low workload operator available for piloting and navigation. An autopilot is using the aircraft state, position and attitude information provided by the on-board sensors to drive the control surface actuators (servos), turreted sensor actuators or other predefined on/off peripherals (parachute lock device, airbag activation etc.).

During the autopilot development phases several types of attitude sensors were used and tested including an IR sensors board based architecture. Also the processing module was upgraded from 8/16 bits core microcontrollers to a 32 bits core, in order to balance the need for flight safety with as few as possible external constrains and the low cost development driven function

2. PHASES IN AUTOPILOT DEVELOPMENT

Several technical approaches were tested for the implementation of an automated flight. The first 2 solutions had a FMA infrared module used for roll/pitch/yaw data. Bellow are the general schematics used:

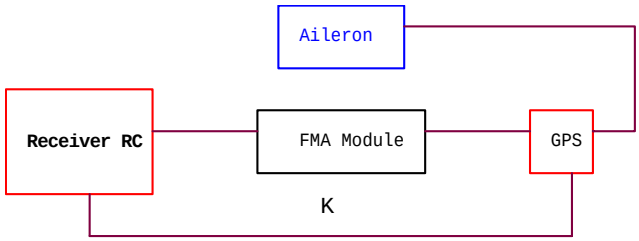


Figure 1: FMA Module and Altimeter configuration

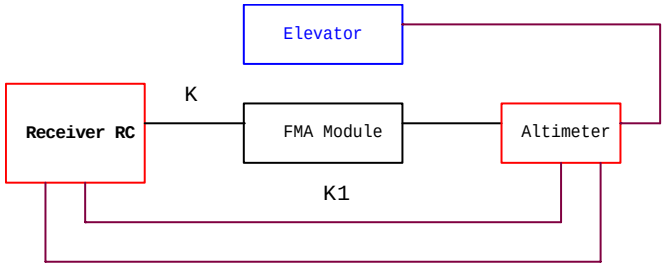


Figure 2: FMA Module and GPS configuration

The second approach had implemented waypoint navigation, but no trajectory calculation was made.

In phase 3, a rotating infrared sensor was proposed.

In phase 4 the autopilot architecture was developed around an EFIS Dynon telemetry system. The first autopilot was named Spartacus 1. This version was certified by FTC Craiova and had the following features:

- multiple waypoints flight plan;
- trajectory intersection computation;
- the gain and parameters fine tuning is made from the ground;
- Microchip dsPIC u-controllers were used.

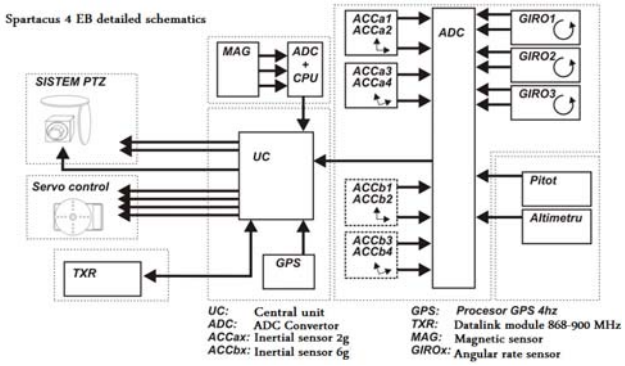


Figure 3: Spartacus 4 EB detailed schematics

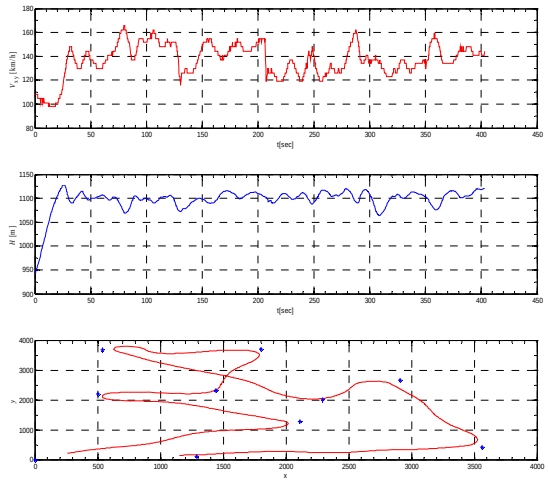


Figure 4: Waypoint navigation using the Spartacus autopilot version 4EB

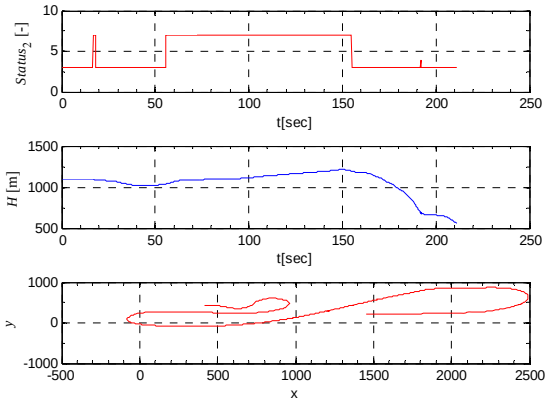


Figure 5: The failsafe function in case of RC loss

Currently SPARTACUS 4V – IN (V-version/IN-inertial)' architecture is under development, here in display, which was build up around on a 32 bits ARM core microcontroller processing unit and an IMU (inertial measurement unit) based on low cost inertial sensors (accelerometers and gyros).

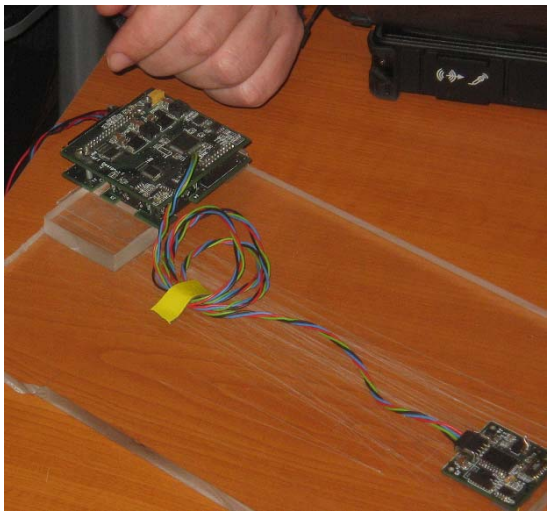
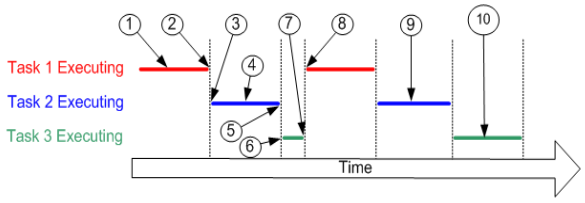


Figure 5: Spartacus 4V – IN

In order to optimize the autopilot reaction time a task scheduling algorithm was software implemented. The scheduler is the part of the kernel responsible for deciding which task should be executing at any particular time. The kernel can suspend and later resume a task many times during the task lifetime.

The scheduling policy is the algorithm used by the scheduler to decide which task to execute at any point in time. The policy of a

(non real time) multi user system will most likely allow each task a "fair" proportion of



processor time. The policy used in real time / embedded systems is described below.

In addition to being suspended involuntarily by the RTOS kernel a task can choose to suspend itself. It will do this if it either wants to delay (sleep) for a fixed period, or wait (block) for a resource to become available (eg data sensors availability) or an event to occur (eg human intervention). A blocked or sleeping task is not able to execute, and will not be allocated any processing time.

As a task executes it utilizes the processor / microcontroller registers and accesses RAM and ROM just as any other program. These resources together (the processor registers, stack, etc.) comprise the task execution **context**. While the task is suspended other tasks will execute and may modify the processor register values. Upon resumption, the task will not know that the processor registers have been altered - if the modified values are used, the task result might be incorrect. To prevent this type of error it is essential that upon resumption a task has a context identical to that immediately prior to its suspension. The operating system kernel is responsible for ensuring this is the case - and does so by saving the context of a task as it is suspended. When the task is resumed its saved context is restored by the operating system kernel prior to its execution. The process of saving the context of a task being suspended and restoring the context of a task being resumed is called **context switching**.

3. CONCLUSIONS

The autopilot architecture approach is very convenient regarding the price and development time, because of the simplified algorithm implemented. Special attention has to be paid to the empirical coefficients during the implementation tests for every particular platform taking into account the different mechanical and aerodynamically characteristics.

For the moment, the autopilot is configured for two platforms: the mini-UAV Boreal 5 and the MM Şoim aerial target. During flight tests, some communications problems occurred which implied the human intervention for flight control and stabilization. Future work must be done in order to prevent the human workload appearance.

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IMPROVING THE HELICOPTERS' FLIGHT EFFICIENCY BY USING THE COANDĂ EFFECT

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***Abstract**: Coandă effect is the phenomenon in which a jet flow attaches itself to a nearby surface and remains attached even when the surface bends away from the initial jet direction. In free surroundings, a jet of fluid entrains and mixes with its surroundings as it flows away from a nozzle. When a surface is placed close to the jet, this restricts the entrained air flow into that region. As flow accelerates trying to equalize the momentum transfer, a loss of pressure results across the jet and the jet is deflected closer to the surface, up to attaching to it. The anti-torque NOTAR system is used because it replaces the use of a tail rotor on a helicopter. A fan inside the tailboom creates a large volume of low-pressure air, which exits through two slots and creates a boundary layer flow of air along the tailboom, due to the Coandă effect. The interaction of this air flow with the downwash from the main rotor creates a force oriented as an anti-torque force, an opposed to that of the main rotor. The airflow escapes the slots tangential to the external surface of the tailboom in a parallel direction to that of the external flow. The final result is the deflection of the external flow and generation of lift forces.*

***Key words:** slot, Coandă effect, attached jet, centrifugal zone, depressurized zone, jet thruster, lift*

1. AIMS AND BACKGROUND

Coandă Effect is a classic phenomenon in fluid mechanics and one of the fundamental discoveries of the Romanian inventor Henri Marie Coandă (1886 - 1972).

Henri Coandă was a Romanian inventor, aerodynamics pioneer and the designer and the builder of the world's first jet powered aircraft, the Coandă-1910, a revolutionary plane of the 20th century beginning.

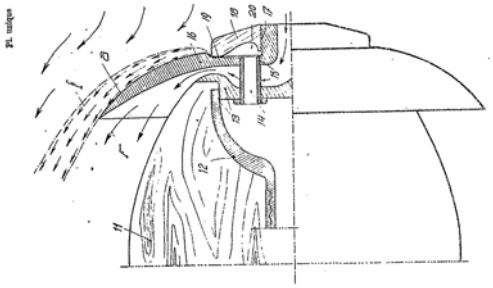


Fig. 1 Coandă patent "Perfectionnement aux propulseurs" [5]

In his first patents related to Coandă effect applications, in order to generate the jet of fluid over the upper surface of the fuselage, he was using mainly other means than a rotor, i.e. a burner or a combustion chamber. But in a patent he obtained in 1935, [5], he was enumerating the possibility to use also a centrifugal fan for supplying the necessary air flow.

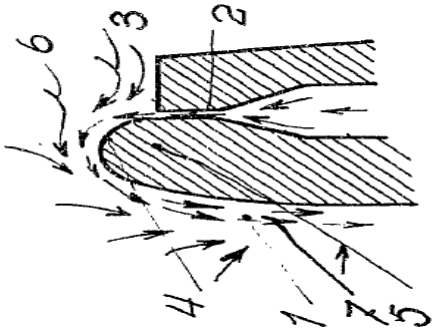


Fig. 2 Coandă patent "Procédé et dispositif pour faire dévier une veine de fluide pénétrant dans un autre fluide" [4]

After 2000, the Coandă legacy was valued by researchers from many countries, mostly by developments and patents on Unmanned Aerial Vehicles (UAVs).

The first design of a Coandă UAV was created in 1932 [3], by the Romanian inventor Henri Marie Coandă.

Fig. 3 Geoff Hatton and his invention

Among them, individual inventors as Robert Collins [6] and Geoffrey Hatton [8], and companies as GFS Projects Ltd. and AESIR Ltd. (both from UK) and a Romanian academic consortium [11], developed what we may consider a new class of aerial vehicles, the Coandă UAVs, using mainly the Coandă effect.

Fig. 4. MEDIAS-UAV (2009) [11]

In aeronautics, this effect is used today primarily in helicopters that have no tail rotors, as in NOTAR system [7].

NOTAR is the name of an anti-torque system which replaces the use of a tail rotor on a helicopter. It was developed by McDonnell Douglas Helicopter Systems and the name is an acronym derived from the name **NO TA**il **R**otor.

NOTAR uses a fan inside the tailboom to force a high volume of low-pressure air, to exit through two longitudinal slots and create a boundary layer flow of air along the tailboom utilizing the Coandă effect. The boundary layer driven by Coandă effect changes the direction of airflow around the tailboom, creating thrust opposite the motion imparted to the fuselage by the torque effect of the main rotor. Directional yaw control is gained through a vented, rotating drum at the end of the tailboom, called the jet thruster. [8][1]

Fig. 5. The NOTAR system used by NEO helicopter from YoungCopter

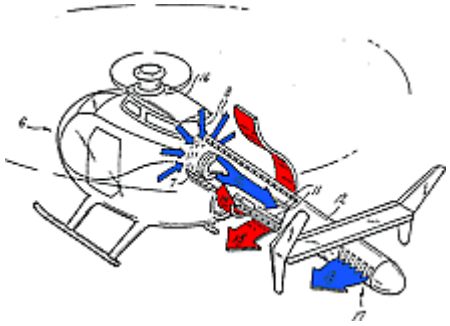


Fig. 6. The movement of air through the NOTAR system [7]

As a natural phenomenon, Coandă effect describes the tendency of a fluid jet to be attracted to a nearby surface (flaps or airfoils), consecutively his profile being characterized by a significant asymmetry.

In free surroundings, a jet of fluid entrains and mixes with its surroundings as it flows away from a nozzle. When a surface or another stream is placed close to the jet, this restricts the entrained air flow from surroundings into that region. As flow accelerates trying to equalize the momentum transfer, a loss of pressure results across the jet and the jet is deflected closer to the surface, up to attaching to it.

When studying Coandă effect, it is possible to notice the following aspects (Fig. 7):

1. The depressurized zone (3) has as effects:
   - Flow acceleration upstream in the slot (1), without increasing upstream pressure or temperature,
   - Displacement of the local fluid.
2. Detaching and re-attaching is characterized by hysteresis (i. e. the reattaching is

produced at smaller angles than the detaching).

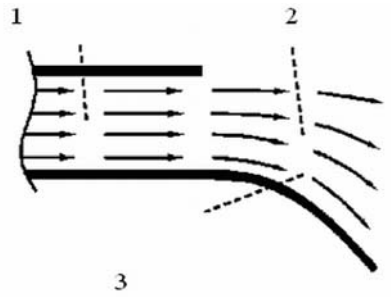
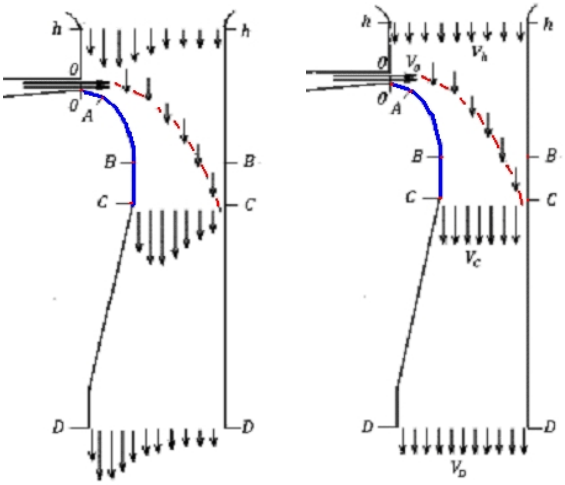


Fig. 7 Coandă effect (2D)

3. The global stream that results from the mixing between the main flow and the displaced one is adherent to the wall and is characterized by a lower temperature than the initial one.

2. A GLOBAL ANALYSIS OF THE MIXING PROCESS IN THE AIR EJECTOR

Let us consider an air ejector that we are going to analyse from the point of view of the mixture between two flows, the primary flow, the active one, through which energy is introduced into the system, and the secondary flow, considered to be a controlling flow (as in Fig. 8).



a) b)

Fig. 8 Coandă ejector with: a) non uniform speed distribution, b) uniform speed distribution

In Fig. 8, the primary flow is introduced in the inlet (section **0-0)**, by compression, or acceleration, or through absorption, directly from the environment. The absorption section, marked with (**h-h**), through which the inflow only advances, may be described as having the property that the total enthalpy i^* of the inflow is the equal with that of the environment, i_H^*.

The place around **A** is considered to be the longitudinal spot from the tailboom, where the loss of pressure of the flow is maximal. Section **B-B** shows the end of the Coandă profile (line **OAB**). Section **C-C** is where the absorption section ends and the mixing region extend to both walls. **D-D** is the exit section from the air ejector and is characterized by the fact that the static pressure is equal with that of the environment static pressure p_H.

The area **h-0-C-B-h** is considered to be the absorption area, where the total enthalpy, i^* of the flow is: $i^* = i_H^*$.

Area **0-ABC-C-0** is considered to be that of the junction where the both flows are mixing, where the whole generated flow is received through the permeable surface **C-0**. Area **C-D-D-C** is the area of acquiring uniformity for the aero thermo gasodynamic parameters in section **C-C** and it usually has a divergent form, which favourably contributes to the efficiency of the air ejector. Its existence leads to the increase of the generated flow, but it doesn't necessarily mean an increase of the propulsion force.

The research on the force increase will have to take into consideration the entire geometry of the air ejector. The known factors are:

- Geometry of the air ejector in its sections (**Ah, A0, AB=AC, AD**),
- Fuel conditions in the slot (p^*, p_0),
- Environmental conditions (p_H, ρ_H, i_H^*).

Also, for this global analysis of the mixture in the air ejector, the values of the energetic performance (η_C, η_D) on sections **00-CC**, **00-DD**, are considered to be known.

In Fig. 9 it is presented the distribution of the speed in a section of the Coandă air ejector, having two different regions, an asymmetrical one (*width=d*) and a uniform one

(*width*=D-d), where *s* is the length of the boundary layer at the wall.

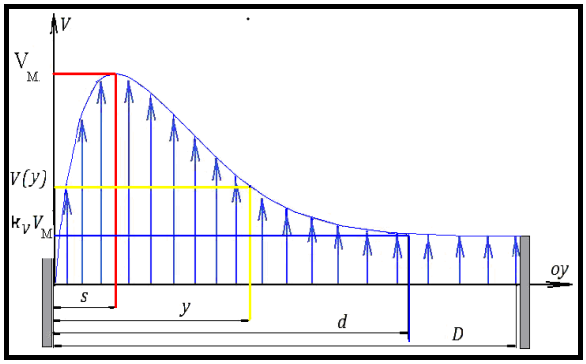


Fig. 9 Distribution of speed in a section

3. CASE STUDY - COANDĂ AIR EJECTOR WITH NON-UNIFORM SPEED DISTRIBUTION

Let analyse a Coandă ejector with non-uniform and variable speed distribution. [8]. In the D exit section, the static pressure p_D equals the environment pressure p_H. The power transferred to the fluid in D section is:

$$P_0=\eta P_D=\int_{A_D}\rho_H V_D(y)\left(i_D^*-i_H^*\right)dA_D=\frac{\rho_H V_{MD}^3 A_D \chi_{3D}}{2} \quad (1)$$

The gain in force is given by the difference between the two force distributions; with a maximal value corresponding to the A angle (fig.4):

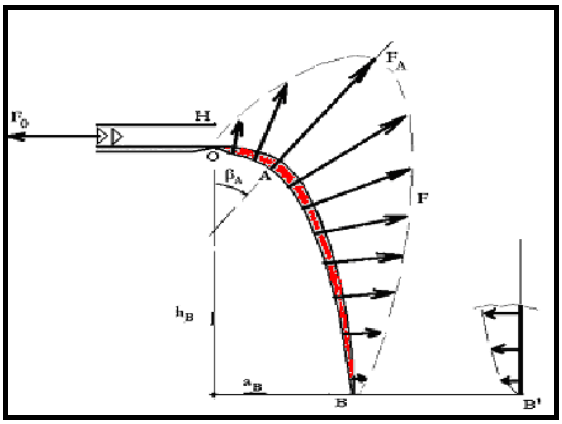


Fig. 10 Force distributions on Coandă airfoil

We may describe a Coandă flow by using two zones, each having special properties, the centrifugal zone and the suction zone.

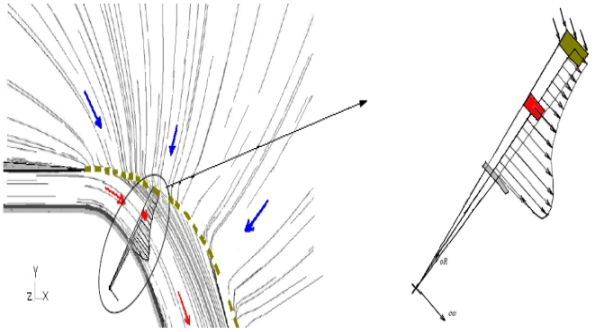


Fig. 11 Detailed analysis of Coandă flow

The equations for the centrifugal zone, associated to the mixing region **0-ABC-C-0** with the wall **C0** considered to be permeable, are:

$$\frac{1}{r}\cdot\frac{\partial(\rho\cdot u_\omega)}{\partial\omega}=0 \quad (2)$$

$$-\frac{u_\omega^2}{r}=-\frac{1}{\rho}\frac{\partial p}{\partial r} \quad (3)$$

$$u_\omega\frac{\partial u_\omega}{\partial\omega}=-\frac{1}{\rho}\frac{\partial p}{\partial\omega} \quad (4)$$

$$i^*=i_H^*\left(\frac{p}{p_H}\right)^{\frac{k-1}{k}}+\frac{u_\omega^2}{2} \quad (5)$$

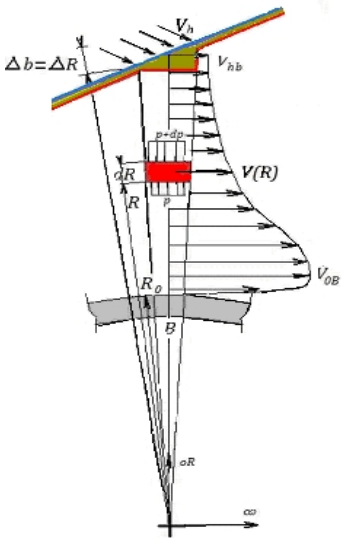


Fig. 12 Jet flow elements

For a small element of the jet flow (fig.6), the radial movement equation is:

$$\frac{dR}{R}=\frac{dp}{\rho u_\omega^2} \quad (6)$$

For $\boldsymbol{B_i}$ on the profile:

$$u_\omega = u_{\omega 0} f_u(R);\ u_{\omega 0} = u_0 f_{u0} \qquad (7)$$

and the total enthalpy is preserved:

$$i^*(R) = \frac{[u_\omega(R)]^2}{2} + \int \frac{[u_\omega(R)]^2}{R} dR\big|_R + i_c^* \qquad (8)$$

The static pressure is expressed by:

$$p(R) = p_H \left(1 + \frac{1}{i_H^*} \int \frac{[u_\omega(R)]^2}{R} dR\big|_R\right)^{\frac{k}{k-1}} \qquad (9)$$

and the static parameters, as density and temperature, are:

$$\rho(R) = \rho_H \left(1 + \frac{1}{i_H^*} \int \frac{[u_\omega(R)]^2}{R} dR\big|_R\right)^{\frac{k}{k-1}} \qquad (10)$$

$$T(R) = T_H \left(1 + \frac{1}{i_H^*} \int \frac{[u_\omega(R)]^2}{R} dR\big|_R\right)^{\frac{k}{k-1}} \qquad (11)$$

The gain in force at $\boldsymbol{B_i}$ is:

$$\varphi_{Bi} = \frac{1}{b_0} \int_{R1}^{R2} \left(1 + \frac{1}{i_H^*} \int \frac{[u_\omega(R)]^2}{R} dR\big|_R\right)^{\frac{k}{k-1}} \cdot f_{u0}^2 f_u^2(R) dR \qquad (12)$$

and the corresponding efficiency is:

$$\eta_{Bi} = \frac{1}{b_0} \int_{R1}^{R2} \left(1 + \frac{1}{i_H^*} \int \frac{[u_\omega(R)]^2}{R} dR\big|_R\right)^{\frac{k}{k-1}} \cdot f_{u0}^3 f_u^3(R) dR \qquad (13)$$

We may note that the attached flow is situated in the depressurised zone, and this area is defined by the slot exit frontier, **0-0**, **B-B** section and **D-D** exit with a maximal value in **A**.

4. FLOW MODELING AND SIMULATION WITH COMPUTER ASSISTED COANDĂ EFFECT

In order to model the Coandă effect onto the flow from the helicopter tailboom, computer simulation was made using Solid Works 2007 software; the theoretical results we obtained may be seen in the next pictures, tables and diagrams (Fig. 13, Fig. 14**,** and Fig. 15, Tab. 1).

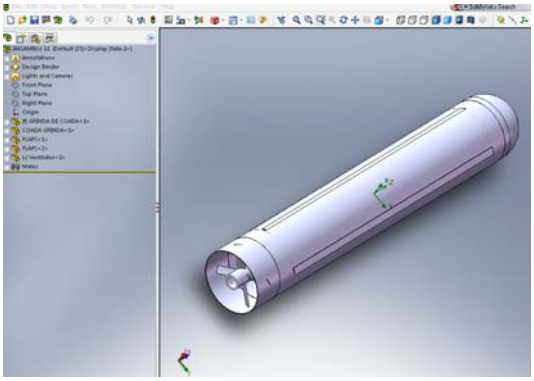


Fig. 13 Simulation of helicopter tail

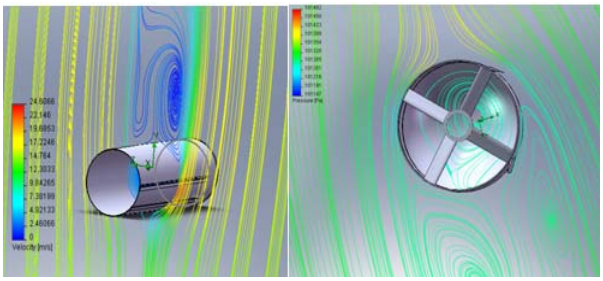


Fig. 14 A 3D view of Coandă effect flow through tailboom

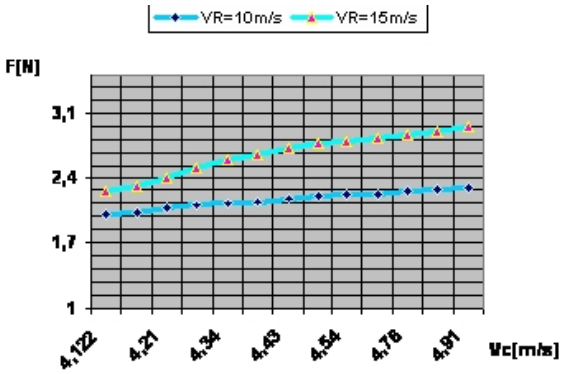


Fig. 15 The lateral force F, depending on the speed V_c, having a constant main rotor speed of V_R=15m/s, respectively V_R=10m/s.

5. EXPERIMENTAL RESEARCH ON THE APPLICATION OF THE HELICOPTERS

Coandă Effect Small Appliance is an experimentally validation of using Coandă effect on the helicopter tailboom.

The experimental results presented further in this paper are in very good agreement with the theoretical and computational study and with the execution of profiles that require permanent adjustments, consisting of:

- changes in flow air induced by the main rotor (here we have 2 variables that blades gave up their rotation speed),
- changes in flow induced by fan tailboom in blood flow adjustable
- profile geometry (in this case is the tailboom)
- Coandă slot ratio, (their geometry is including width and length equal to **l**).

We should also note that a fair and realistic fluid flow developing a Coandă effect has been obtained from practical experiments using hundreds of adjustments and amendments agreed to variables.

The experiment used as a real physical model (Fig. 19 and Fig. 17) is the model helicopter IAR316B, manufactured at a 1:10 scale, on which were installed the components of the equipment that measure and control the experimental parameters [8].

The experimental technical unit we used consists of an experimental stand and a model of a NOTAR type helicopter, using Coandă effect, and has the following components:

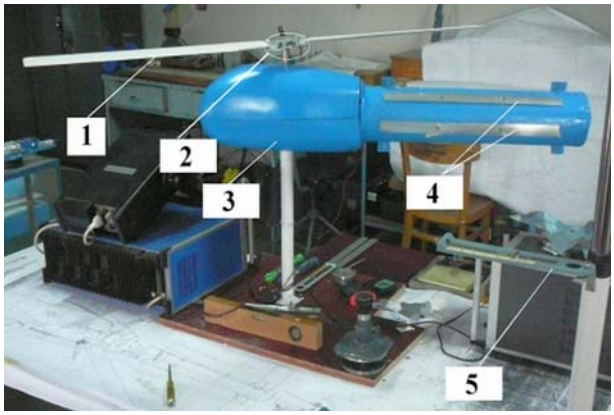


Fig. 16 Experimental device: 1-NOTAR carbon fibre helicopter blades, 2 - pitch hub, 3 - fibre glass helicopter structure, 4 - Coandă slots, 5 - dynamometer

A helicopter structure consists of two main components: a cabin and a tailboom of composite materials (glass and carbon fibre).

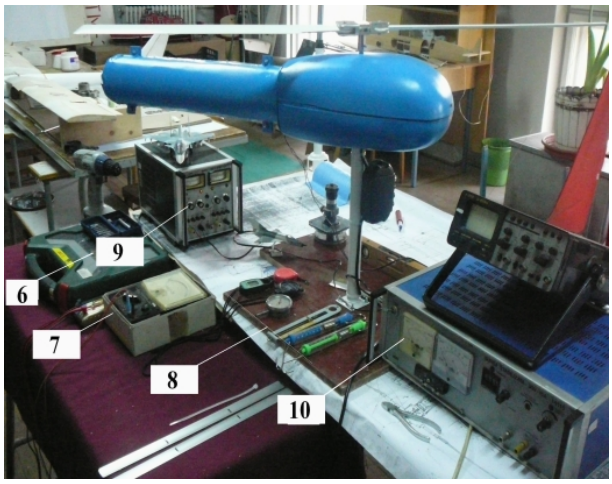


Fig. 17 Experimental device: 6 - tool kit with 7 - measuring and control equipment (multi volt-and- ammeter) 8 - measurement equipment (timer, dynamometers, electronic anemometers, mechanical comparator, roulette), 9 - dual source DC power, 10 - stabilized power source and electronic oscilloscope

Fig.10 hub and blades of carbon fibre highlighting the Coandă effect and performance measurement on the beam parameters of the experimental device queue seeks a lateral force F as possible. He looked fluid flow along the tailboom, the desired length to be studied, and of the lateral force F due to Coandă effect.

This was tested on a Coandă profile optimally adjustable, depending on the flows data load-bearing rotor, the intubated fan from the tailboom, and the location and geometry of the slot. This optimization allows the suppression of the anti-torque rotor, also eliminating its disadvantages. This and lead us to benefit from a new arrangement favourable for creating higher lateral forces with lower energy consumption, compared to the data found in basic formulas describing the efficiency of the helicopters.

Results of the experimental device (Coandă Effect Small Appliance) having dimensions (length $l = 30cm$, gap width $w = 2mm$ and pitch angle $up = 4^0$) are presented in the next table (Tab. 1).

Tab. 1 Experimental results of the Coandă Effect Small Appliance:

Nr. crt	P	p	P_c	V_{GC}		V_f	V_R	Q_R	Q_{gc}	$2Q_f$	E_{fc}	F
UM	[W]	[θ_p ^{0}]	[W]	Km/h	[m/s]	[m/s]	[m/s]	[m^3/s]	[m^3/s]	[m^3/s]	[N/W]	[N]
1	70	4	6	19,4	5,30	5,74	7,22	8,161	4,242	0,00688	0,0783	0,47
			7,2	21,6	6,00	5,93			4,804	0,00710	0,0708	0,51
2			8,4	25,3	7,02	7,24			5,621	0,00868	0.0678	0,57
			9,6	28,3	7,86	7,35			6,294	0,00882	0,0666	0,64
3			10,6	30,8	8,55	8,65			6,846	0,01038	0,0660	0,70
			12	33,4	9,27	9,35			7,420	0,01122	0,0658	0,79
4	95		6	19,4	5,30	5,91	8,31	9,393	4,242	0,00709	0,0950	0,57
			7,2	21,6	6,00	6,22			4,804	0,00746	0,0916	0,66
5			8,4	25,3	7,02	7,44			5,621	0,00892	0,0904	0,76
			9,6	28,3	7,86	8,12			6,294	0,00974	0,0875	0,84
6			10,6	30,8	8,55	8,89			6,846	0,01066	0,0896	0,95
			12	33,4	9,27	9,38			7,420	0,01125	0,0875	1,05
7	145		6	19,4	5,30	5,98	9,56	10,806	4,242	0,00717	0,1133	0,68
			7,2	21,6	6,00	6,37			4,804	0,00764	0,1083	0,78
8			8,4	25,3	7,02	7,88			5,621	0.00945	0,1047	0,88
			9,6	28,3	7,86	8,39			6,294	0,01006	0.1041	1,00
9			10,6	30,8	8,55	9,12			6,846	0,01094	0,1037	1,10
			12	33,4	9,27	9,43			7,420	0,01131	0,1033	1,24

Interpretation of results was plotted graphically as follows:

A first step was to highlight the relation between the lateral force F, due to Coandă effect, and the power at the rotor along the six-step power variation of the intubated fan in the tailboom; this research was repeated at three values of the pitch of the main rotor blades.

Fig. 18 highlights the changes in lateral force due to Coandă effect to adjustments of power applied to the rotor portal (three values: P=70W; 95W; 125W), maintaining a constant width w=2mm of slot, at the same value of pitch blades step (up=4^0). For each amount of useful power applied to the rotor bearing, the power (P_C) of the adjustable fan intubated in the tailboom was also modified in six steps of rotation speed.

It may be observed an approximately linear increase in lateral force F for each value of power P, and could approximate the family of linear functions useful $\mathbf{G_N}$-power applied force determining correspondence.

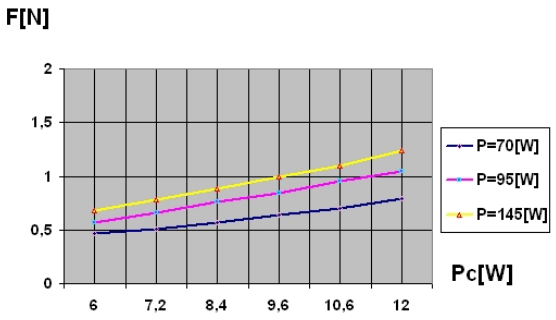


Fig. 18 Lateral force F variation due to Coandă effect to maintain constant: p = 4^0 and width w=2mm

Example: if we try to maintain a constant step up=4^0 and a slot width of w=2 mm, a power of **P**= 95W is obtained with a linear function that can find value $\mathbf{G_N}$ lateral force **F** due to Coandă effect: Where do I note the power of $\mathbf{P_C}$ fan intubated tailboom with index variable.

$\mathbf{E_f}$ efficiency of a propulsion device as the ratio of force produced (generated) of propellant and power consumed by it: in our case **F** is the lateral force developed by Coandă effect

and **Po** is power consumed by the intubated fan from the tailboom **Pc** (Fig. 19).

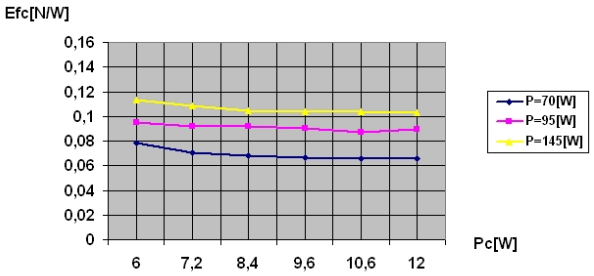


Fig. 19 Variation of tailboom efficiency Efc with the lateral force F and with the spent power in the three steps of PC operating rotor blades portant step in the value of p = 4º

6. CONCLUSIONS

This study was conducted in the idea of highlighting the usefulness of the devices developing a force due to the Coandă effect.

To conclude, we may state the following:

1. For the same available energy P_0, the D_f *force* gain may be obtained by decreasing the speed $V_D < V_M$, and increase in the same time the ejected air flow.
2. In order to obtain the highest possible force for an available energy, it is preferable to entrain into motion the highest amount of fluid possible having the lowest speed possible, instead of a small amount of fluid entrained into motion with a highest speed.
3. For a helicopter, Coandă effect is a more efficient method than a tail rotor to obtain the lateral force needed to control the horizontal manoeuvrability and stabilizing in the same time the aerial platform created by a flying mono rotor helicopter.
4. The numerical results that were obtained are close to those obtained by computational study, taking into account the geometrical dimensions of the tailboom and fluid velocities in the intubated tailboom rotor that generates the main carrier flow
5. The study shows the smooth growth index values $\mathbf{E_{fc}}$ a sharp increase in force **F** which requires a finding of finding optimal positioning slot; can do a pretty fair approximation of a helicopter (1:1 model).

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FUSELAGE AIRSTREAM SIMULATION FOR A COANDĂ UAV

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Abstract. *The objective of this paper is a study regarding the design of an unmanned aerial vehicle to ensure security by monitoring and collecting data from the atmosphere. Flight autonomy is realized using a propeller and additional for sustentation, thrust and orientation it uses the well Coandă effect. Atmospheric parameters are monitored by special gadgets, maintained by the ground operated vehicle. Flow dynamics study on the vehicle's cap during the auto-sustainable process is realized using Fluent 6.3 software.*

Key words: *UAV, self propelled, aerial surveillance, Coandă effect.*

1. AIMS AND BACKGROUND

Aerial surveillance of the environment, especially of the protected areas, is done to ensure their preservation. This surveillance is part of the structural and functional bio and ecological diversity dynamics study. Thus can be monitored – without human presence – different ecosystems, under, sometimes, hostile weather conditions.

A limitative condition was that the UAV doesn't use for thrust an internal combustion engine – which is pollutant and noisy.

The same importance has the condition that the vehicle meets several requirements considered normal for the observer. Thus, the vehicle has to have the ability to hover, maintaining its position and altitude towards the area that needs monitoring.

The thrust and vertical movement system uses a housed propeller, driven by an electric motor, and to improve thrust and sustentation efficiency, as well as horizontal maneuverability the well known but not so widely spread Coandă effect is used.

A study regarding the dynamic behavior of such a vehicle requires an analysis on a scale model, to determine and predict the contribution of the Coandă effect on modifying flow parameters on the vehicle' cap surface. For the wind tunnel tests, at first, the contribution of the ducted propeller was done using air with an adjustable flow. Air is supplied through a central vent, then it is guided by a round nozzle over the curved surface of the models, where the Coandă effect creates additional lift and increases the sustentation capability as in Fig. 1.

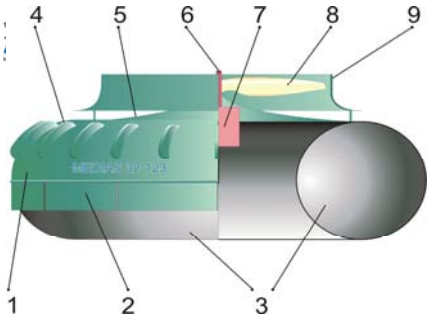


Fig. 1. UAV components, [1]
1 - curved upper cap; 2 - steering flaps; 3 - toroidal He chamber; 4 - counter-rotating fins; 5 - inner exhaust profiled cap; 6 - propeller's shaft; 7 - electrical motor and batteries; 8 - propeller; 9 - nozzle

2. AIR FLOW SIMULATION ON THE UAV CAP

To realize a complete study on the flow over the curved upper surface of the fuselage,

3 vertical adjustable nozzles were fitted, with different diameters (respectively 90, 130 and 170 mm), in order to create jets with different dynamic characteristics.

The flow simulation was realized using the Fluent 6.3 software, and tracking the parameter values in the flow direction for six representative positions, from the nozzle exit area to the exit off the curved upper cap.

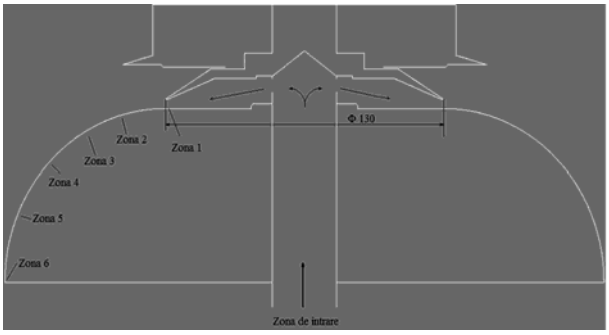


Fig. 2. Positions for the flow parameters (for diameter D=130 mm)

Various values for the static pressure on the flow surface, for dynamic pressure and for flow speeds were taken, using as input the air flow through the central section.

Static pressure and air flow speed for the three values of the nozzle diameter and for the three values required for the flow through the nozzle are plotted in Fig. 3 and Fig. 4.

Table 1 presents all this data, taking into consideration that air density at 20ºC is 1.2 kg/m^3.

Table 1. Static pressure, dynamic pressure and air jet speed

D	**Q= 0,1** m^3/s			**Q= 0,3** m^3/s			**Q= 0,5** m^3/s		
mm	**Ps**	**Pd**	**v**	**Ps**	**Pd**	**v**	**Ps**	**Pd**	**v**
90	Pa	Pa	m/s	Pa	Pa	m/s	Pa	Pa	m/s
Z 1	110	4	9.07	70	450	26.9	248	128	45
Z 2	-1.5	57	9.68	-30	510	29	-175	150	49.7
Z 3	-3	58	9	-37.2	582	30	-100	134	52.9
Z 4	-7.24	55	8.7	-15	400	27.8	-150	900	46.3
Z 5	0	40	8.17	-50	244	25	-150	614	34.7
Z 6	0	0	0.5	0	130	15	0	400	26.5
130	**Ps**	**Pd**	**v**	**Ps**	**Pd**	**v**	**Ps**	**Pd**	**v**
Z 1	7	50	9.3	84	389	27	200	110	43
Z 2	-4.35	55	9	-30	520	30	120	140	50
Z 3	0	35	10	-17	560	30	0	130	44
Z 4	-3	27	7.81	0	210	19.5	-10	600	31
Z 5	-5	30	7	-17	150	17.5	0	430	26
Z 6	0	13	4.5	10.5	200	18	658	518	28.5
170	**Ps**	**Pd**	**v**	**Ps**	**Pd**	**v**	**Ps**	**Pd**	**v**
Z 1	-15	24.7	6.3	-10	240	19.1	0	670	33
Z 2	-20	23	6.3	-15	207	19	-61	590	29.5
Z 3	-25	23	6.1	-15	207	18.5	-61	570	30
Z 4	-29	23	6.26	-20	200	18.1	-36	550	30
Z 5	-0.34	3	3.1	-20	220	18.5	-61	560	29.5
Z 6	-0.34	0	0.34	-5	180	17	-30	470	28.5

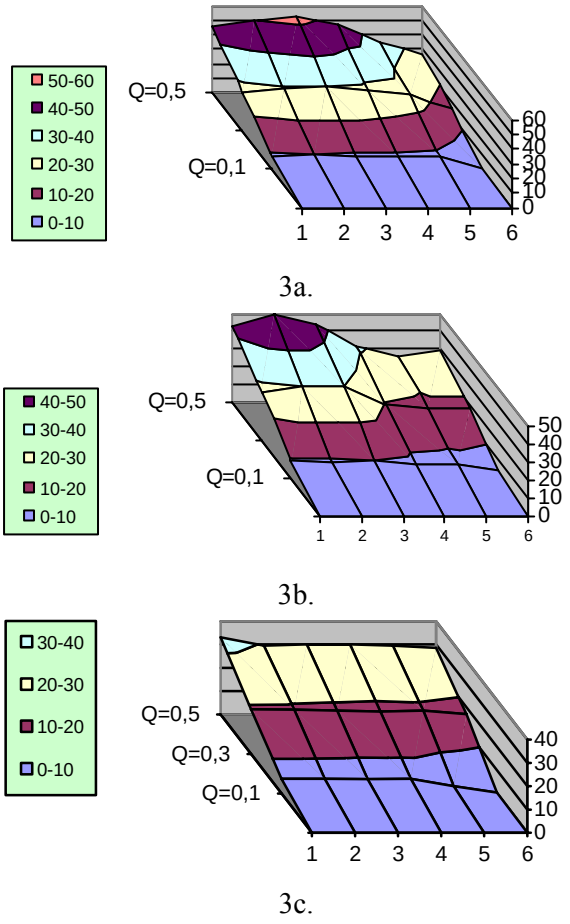
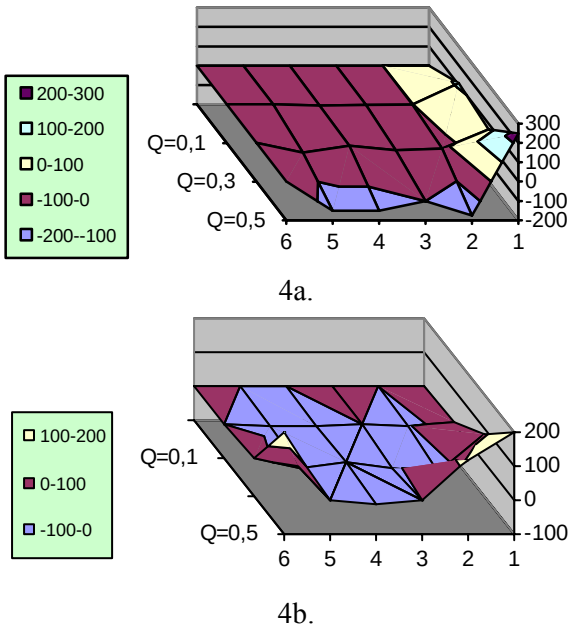
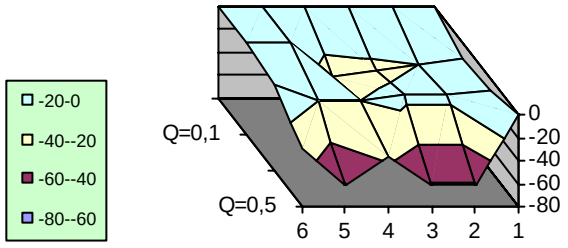


Fig. 3. Air jet speed variation for a nozzle with a diameter of:
a. *D*=90 mm; b. *D*=130 mm; c. *D*=170 mm.





4c.

Fig. 4 Static pressure variation for a nozzle with: a. *D*=90 mm; b. *D*=130 mm; c. *D*=170 mm.

3. DISCUSSIONS

Based on the charts analysis and data presented in Table 1 the following conclusions can be drawn:

- Along the six areas, in the motion direction, the flow is approximately even, while the increase of speed with the increase of current flow is observed. Top speed of 53 m/s is obtained for a nozzle diameter of *D*=90 mm, and minimum speed is obtained for a nozzle diameter of *D*=170 mm.
- At higher flow values, it is noticed that the current lines reach the extremity of the surface (area 6), following its curvature. The turbulence motion generated by high values for the Reynolds number has areas with whirlwinds which go with the flow and produce irregularities in static pressure values.
- On the vehicle surface, static pressure is minimum for *D*=90 mm diameter and maximum for *D*=170 mm diameter.
- Static pressure values increase with the increase of air flow values, being connected with the rise of speed values, and dynamic pressure values respectively.
- Static pressure variation along the flow is relatively uniform for a flow value of *Q*=0,3 m^3/s and it's less predictable for a flow value of *Q*=0,5 m^3/s. The software highlighted whirlwind variation, which create areas with static pressures lower than the medium values.
- Low static pressure values on the flow surface are highlighted, which leads to the idea of reducing upper thrust, due to the vehicles' shape and the flow of the air jet on the vehicle.
- Laboratory tests will verify the predictions generated by the theoretical study of the flow on the vehicles' surface.

4. ACKNOWLEDGEMENTS

The researchers are supported by the national CNMP-FP7 grant, called MEDIAS, No. 32123/2008.

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TOWARDS A NEW CLASS OF AERIAL VEHICLES USING THE COANDA EFFECT

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Abstract: *Most of the Unmanned Aerial Vehicles (UAVs) accomplishing their specific missions are designed to have propulsion according to one of the following two schemes. First, some of them have a fixed wing design, which resembles the one of a traditional plane. However, they offer a limited maneuverability and payload capacity. They also require a runway to take off and land, since the lift force is created by the plane's wings only as they move through the air. Others are employing rotors just as helicopters, thus achieving better results as far as hovering is concerned. This is important because the* ***V****ertical* ***T****ake* ***O****ff and* ***L****anding (VTOL) capability plays also a key part for an UAV. Nevertheless, their autonomy is highly diminished, the vehicles being dependent on the fuel amount or the energy accumulators carried on board.*
If we analyze the above mentioned demands for an efficient UAV, we may come to the idea of searching for a new design. Fluid mechanics is still offering interesting solutions which could overcome the differences between these two distinct heavier-than-air flying machines categories. During the past decade a new class of VTOL vehicles in the UAVs field, using the Coandă Effect has appeared. These have evolved to generate lift and maneuverability forces in a more efficient manner. Just as the first Coandă Aerodyne, more than 50 years ago, these flying machines use a central rotor fan to create the air movement over their fuselage. In the last decade, inspired by Coandă legacy, aroused in Europe a wave of new UAVs.

Key words: *UAV, classification, Coandă Effect, propulsion, VTOL, aerodyne.*

1. AIMS AND BACKGROUND

Most Unmanned Aerial Vehicles (UAVs) employ a fixed wing design like that of a traditional plane. But these designs offer limited maneuverability and payload capacity, require a runway to take-off and land and are unable to hover. Vertical Take-Off and Landing (VTOL) UAVs get around these problems, usually by employing rotors like a helicopter.

In the last decade we were the eyewitnesses of the development of a new family of UAVs, having new propulsion and lift systems, as a synergy to the requests of both methods to create lift and propulsion.

This paper aims to presents the evolution of the characteristics of this new class of aerial vehicles, with a close look on the main advantages and strengths and of the most adequate missions.

Apparently lifted by the propeller, as mini-choppers are, the lift forces of the new-born member of aerial vehicles family comes – mainly – from deflecting and streamlining the generated air flow along the outside upper curved surface, even the device is at rest.

This is because all this vehicles use a phenomenon known as the Coandă effect to create lift.

The upper propeller (it may be also a rotor or a fan) creates an airstream, adherent to the upper curved surface, where the Coandă Effect applies also and gets more air from above.

In the same time, the Coandă effect speeds up the air over the upper surface, and so lowers the air pressure next to it, which in turn

generates more lift in this region, creating the necessary lift forces.

The Coandă UAV is compensating in this way its own weight and hovers along the direction of the resultant lift forces generated on the upper surface of the fuselage. In this way, the aerial vehicle generates buoyancy, and is able to take off or land vertically.

Coandă Effect is a classic phenomenon in fluid mechanics and one of the fundamental discoveries of the Romanian inventor Henri-Marie Coandă (1886 - 1972).

Henri Coandă was a Romanian inventor, aerodynamics pioneer and the designer and the builder of the world's first jet powered aircraft, the *Coandă-1910* a revolutionary plane of the 20th century beginning.

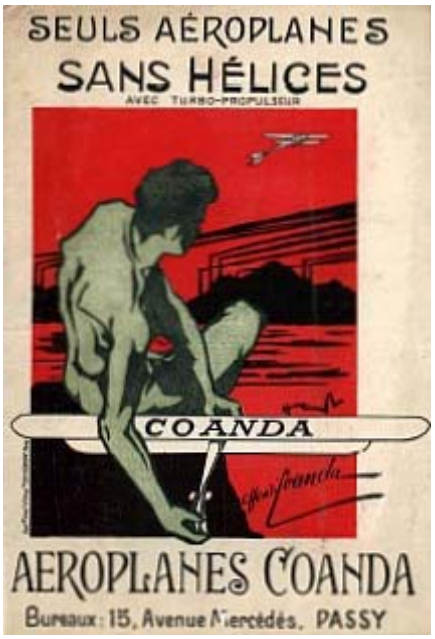


Fig. 1 The poster for the first Coandă jet plane

The Coandă effect became an obvious effect exactly 100 years ago, in 1910; at that time, Henri Coandă tested in a short flight an early type of jet engine aircraft, near Paris, France.

The effect presently named after Coandă Henri Coandă described 20 years later, when he made public his discoveries.

In aeronautics, this effect is used today primarily in helicopters that have no tail rotors.

The first design of a Coandă UAV was created in 1932 [3], by the Romanian inventor Henri Marie Coandă.

Dans son brevet n° 762.688 du 23 novembre 1932, le demandeur a décrit un propulseur dont la caractéristique essentielle réside en ce qu'il crée, par détente d'un fluide qui s'échappe d'un élément de forme approprié le long d'un guidage de profil également approprié, une zone de dépression en avant du mobile sur lequel est monté le propulseur, ladite dépression étant telle que le mobile s'y précipite, et ainsi de suite.

Fig. 2 Extract from a later Coandă patent with reference to his first Coandă effect patent [3]

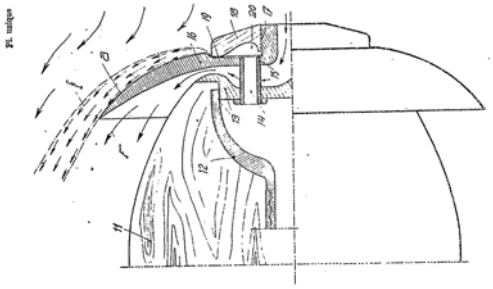


Fig. 3 Coandă patent "Perfectionnement aux propulseurs" [1]

In his first patents related to Coandă effect applications, in order to generate the jet of fluid over the upper surface of the fuselage, he was using mainly other means than a rotor, i.e. a burner or a combustion chamber. But in a patent he obtained in 1935, [1] he was enumerating the possibility to use also a centrifugal fan for supplying the necessary air flow.

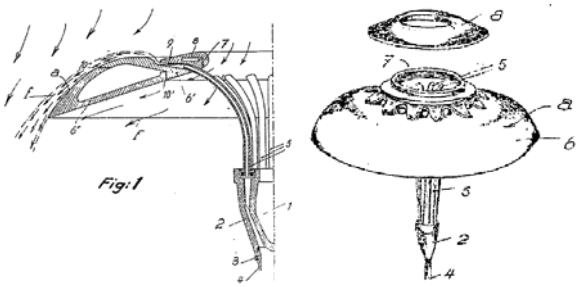


Fig. 4 Perfectionnement aux propulseurs [3]

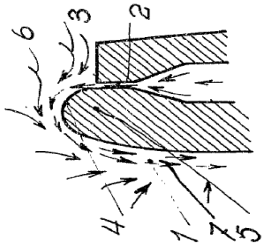


Fig. 5 Procédé et dispositif pour faire dévier une veine de fluide pénétrant dans un autre fluide [2]

In UK, 50 years later, Robert Collins valued Coandă effect capabilities in one of his inventions, which obtained a GB patent no. 2387158, granted in 2003. This new Coandă application was already presented in his paper „Coandă - A New Airspace Platform for UAVs" at the Bristol International UAV Conference, in April 2002.[4]

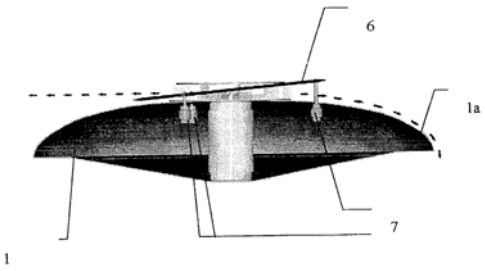


Fig. 6 Aerial Flying Device [4]

In the design of a Coandă UAV the rotor at the center of the hollow fuselage canopy pulls air in from above the craft and blows it out radially, over the top of the curved body. Because of the Coandă effect, the airstream remains 'stuck' to the canopy and follows the curved surface, leaving the body at its base. This, along with the downwards thrust of the fan, pulls the aircraft upwards.

Also in the 90's, another inventor from UK, Geoffrey Hutton, together with the GFS projects team, promoted also an aerial Coandă device, with a circular shape canopy.

GFS Projects is the final chosen name for Geoff's Flying Saucers - a new company created in 2002 with a £43,000 grant obtained from the UK Department of Trade and Industry.

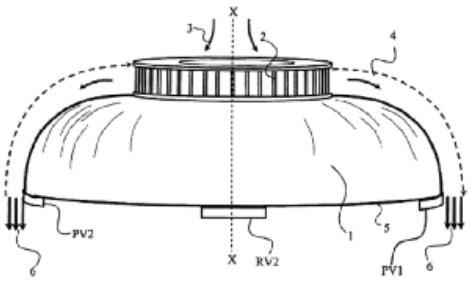


Fig. 7 Geoff Hatton's first Coandă UAV (2005)

When GFS projects built their first model, the circular shape turned to be octagonal, with flat flaps on four opposite sides of the trailing edge.

Fig. 8 Geoff Hatton and his invention

In 2006, Jean-Louis Naudin made and tested his first UAV (GFS-UAV model N-01A). This one, propelled by an electric engine, was using the Coandă effect to take off vertically, fly, hover and land vertically (VTOL).

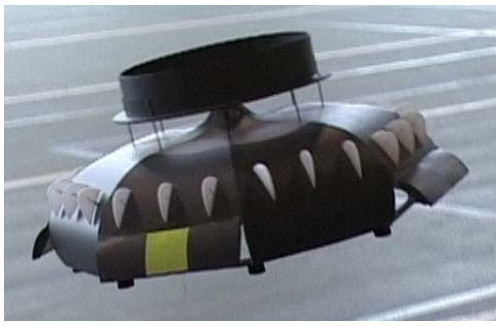


Fig. 9 J.-L. Naudin's first GFS-UAV (N-01A)

The design of the GFS-UAV N-01A was based on the Geoff Hatton' flying saucer from GFS Project limited. In the next year, Jean-Louis Naudin freely published the full plan of the GFS-UAV N-01A and a detailed tutorial to help UAV fans to replicate his GFS UAV.[7]

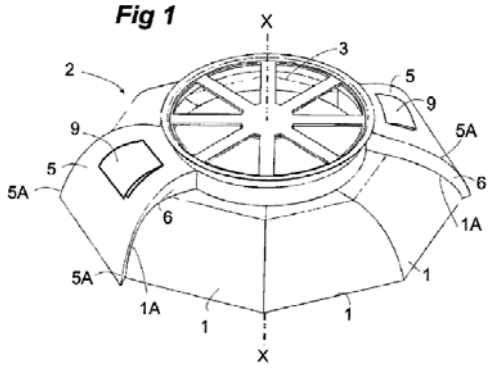


Fig. 10 Geoff Hatton's 2007-UAV model

In 2007 Geoffrey Hatton presented an optimized control for his family of Coandă UAVs, this time improving the airflow over the outer surface, especially in open air, when it may be disturbed by a lateral wind. [8]

In 2008, in Romania, an academic consortium, with researchers from Galați, Iaşi and Bacău universities, coordinated by the author, obtained, for the researches on Coandă effect, a national grant from CNMP, (contract no. 32-123), for the surveillance and protection of the natural environment, using a Coandă UAV.

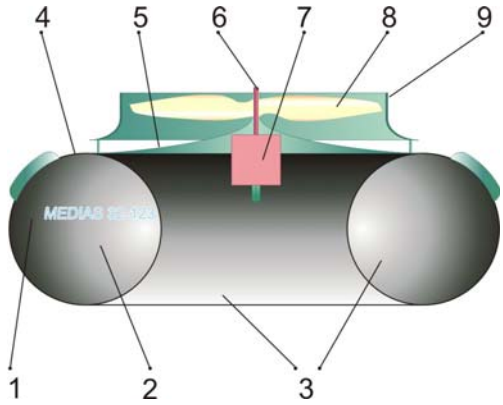


Fig. 11. MEDIAS components [10]

1 - curved upper surface; 2 - steering flaps; 3 - toroidal He chamber; 4 - counter-rotating fins; 5 - inner exhaust profiled cap; 6 - propeller's shaft; 7 - electrical motor and batteries; 8 - propeller; 9 – propeller duct

According the contract, this new UAV, named MEDIAS, had to be in the same time a modern and a nonpolluting aerial vehicle, easy to maneuver and safe to the environment and people.

As a main characteristic, MEDIAS with his adequate shape, uses the Coandă Effect (I) for lift and maneuverability. An air flow created by an electrically driven propeller (II) flows over the upper surfaces of a curved radial canopy and changes the pressure field above and under the vehicle, creating more lift and improving the stability of the flight.

A toroidal Helium optionally added inflatable chamber (III) is increasing the buoyancy and functionality of the MEDIAS VTOL UAV design and is increasing also the UAV's mission autonomy.

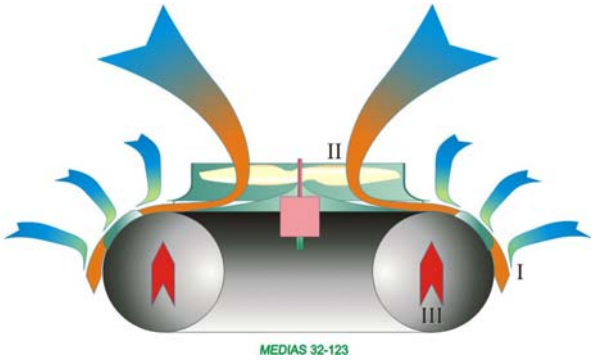


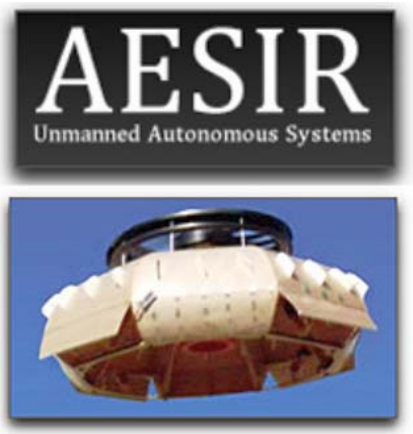
Fig. 12 The sustentation and propulsion components of MEDIAS UAV

This high propulsion efficiency will be obtained because, besides using Coandă effect, the vehicle has an innovative design, MEDIAS being a hybrid between the following:

I. An aerial vehicle - propelled and steered by Coandă effect and vertical air jets,
II. An aerial platform - which ensures its sustentation by using a propeller, preferably ducted, for a greater efficiency,
III. An aerostat - preferably filled with Helium - which improves some of the flight parameters.

However, the Coandă effect, as physical phenomenon used for sustentation, should allow it to lift and carry a significant weight compared to its estimated energetic consumption.

For an increase in efficiency, the electrical driven propeller itself was mounted in a central duct. In this particular arrangement, also the air volumes entrained by the Coandă effect became several times multiplied.



Meanwhile, on January 28th 2009, GFS Projects Ltd. changed into AESIR Ltd, a

privately owned company, established to develop a family of Coandă effect VTOL UAVs.

With a military support this time, AESIR Ltd presented in September 2009, at Defence & Security Equipment International, London, a new Vertical Take Off and Landing (VTOL) UAV, (named ODIN, after the chief god in the Viking mythology, in accordance with the company's name AESIR, considered to be the Pantheon of the Viking gods).

This new-born Coandă UAV was a 1...1.5 meter diameter octagonal craft, fitted with a Wankel Rotary internal combustion engine. It weighs up to 10kg and can carry a maximum of 10kg payload for up to an hour.

Fitted with an autonomous flight control system and managed through a simple to operate ground control system, ODIN has been primarily designed to operate as an Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) platform, a logistics craft or as an aerial communications re-broadcast station.

Also, due its versatility, it can be adapted to various tasks ranging from ISTAR and acting as a communications relay, to participating in missions of electronic warfare, asset protection, IED detection, or even being used as a weapon or loitering munitions.

Fig. 13 ODIN – The AESIR's demonstrator for a military Coandă UAV

In the same exhibition stand at London DSEi, AESIR presented VIDAR, a 300 mm, man portable craft designed to provide surveillance and situational awareness inside buildings and in-close-confined spaces. It has an electric engine powered by Lithium Polymer batteries to provide up to 15 minutes of flight time. It weighs 400g and is capable of carrying a 100g payload.

Fig. 14 AESIR's VIDAR UAV

The next projects of VTOL UAVs that AESIR Ltd. is developing are EMBLA and HODER.

Fig. 15 EMBLA, an emblematic UAV

Fig. 16 EMBLA - in its counter IED role on top of a Northrop Grumman Remotec Mk 8 EOD Wheelbarrow

EMBLA is a 600mm diameter electric engine craft which has been developed to show the militaries the capabilities of a Coandă effect VTOL UAV.

HODER is a heavy lift craft, with two or more engines, that weighs 1500 kg and is capable of carrying a 1000 kg as a payload for up to eight hours. (As an anecdotic aspect, Hoder is the name of the strongest of all the Norse gods).

As the main mission, HODER it is intended for cargo transport and resupply vehicle for front line forces, but can be adapted to become a long endurance craft by reducing the payload and increasing the fuel.

Fig. 17 HODER – The cargo transport VTOL-UAV

All these VTOL UAVs are using the Coandă effect in order to generate lift and have an excellent stability in their role as a surveillance platform.

2. STRENGTHS AND ADVANTAGES

All these VTOL UAVs are using the Coandă effect in order to generate lift and gain an excellent stability in their role as a surveillance platform.

Missions that a Coandă UAV will be capable to accomplish will diversify in the time to come, both in civil and in the military field.

The design of the Coandă UAV's has many strengths and advantages and that's why, in the next years, we could be the witnesses of a fast spreading of new models from this new class of vehicles.

Their strengths and advantages are:

1. First, a Coandă UAV it is not as vulnerable to impacts against walls, ceilings etc., as a more conventional unmanned plane or helicopter, so it may bump into horizontal or vertical walls, or other kind of obstacles, without losing altitude or being damaged
2. A Coandă UAV has no external rotating parts, so the vehicles could survive to low speed impact with the ground, buildings and other fixed objects.
3. Due to the elasticity of the toroidal He chamber, located at the inferior part of vehicle, the MEDIAS UAV has a better approach in landing on ground, with the payload unaltered, in very different weather conditions or locations, even if the approaching manoeuvres are not well conducted.
4. The optional added / filled He chamber improves the autonomy of the MEDIAS UAV because the MEDIAS design has a better ratio payload vs. total weight.
5. The air masses entrained by the Coandă effect flow over the upper surfaces are changing the both pressure fields, of above and under the vehicle, thus creating more lift and improving the stability of the flight.
6. Coandă effect amplifies and even multiplies the lift forces due the increased air volume entrained.
7. The payload is not located directly in the stream of air responsible for creating lift forces.
8. The airflow necessary to create lift forces is not as dependent of the altitude or the angle of attack as fixed-wing UAVs are, so the vehicles are more stable during the flight.

3. MISSIONS

The current main market for UAVs is in defence, with 57% of UAVs being classed as military according a 2009 study. [12].

They are often used to spy on hostile situations from a distance, to watch the area around a soldier or troops and have the potential to search for IEDs (Improvised Explosive Devices). This eliminates the need for the soldier to take any unnecessary risks.

A more desirable capability for a UAV in many of these situations is VTOL (Vertical Take Off and Landing) which gives the ability to hover and perch, and monitor an area from a fixed position, but this usually results in reduced flight times and Coandă UAVs are.

A small UAV, as so far VIDAR is, with its 0.3 m diameter and 0.5kg of weight (payload included), could be flown into an unknown building in order to generate floor plans ahead of an infantry assault, for instance.

A larger Coandă UAV, as EMBLA or MEDIAS are, could be sent out for about an hour to scout out the territory, flying at an altitude from few meters to up to 1000m, and bring it back.

Because 71% of all UAVs are fixed-wing [12], they have to keep flying / moving to avoid landing. Unlike fixed wing UAVs, Coandă UAVs don't have to keep flying, because they may land and take off whenever it will be needed.

As well as providing surveillance images, day or night, the UAV could also act as a communications relay, hovering to keep the communication for a strategic location or transmitting live information from troops on the ground.

It could also fulfil a logistics role, for example, by bringing ammunition or other small supplies/packages to forward operations posts.

In the civil field, the VTOL capability of the Coandă UAVs will offer them the possibility to accomplish missions with a great diversity.

Besides the measurement of the environmental parameters and monitoring of the nature reserves as a non-polluting UAV (e.g. MEDIAS) could accomplish, the civil Coandă UAVs shall be able to carry out a large variety of missions such as:

1. Fire and Rescue
   - Forest and crops fire detection and fire fighting management
   - Other major incidents
   - Emergency rescue (e.g. Mountain rescue)
2. Government
   - Law enforcement (Police, Civil Security)
   - Border security
   - Coastguard
3. Energy Sector
   - Oil and gas industry distribution infrastructure monitoring
   - Electricity grids / distribution network monitoring
4. Agriculture, Forestry and Fisheries
   - Environmental monitoring
   - Forest and crops disease management
   - Forestry or fishery protection and aerial inspection
   - Optimizing the use of water and soil resources
5. Earth Observation and Remote Sensing
   - Climate monitoring
   - Aerial photography, mapping and surveying
   - Natural disasters monitoring (water flows, avalanches, oil leak tracking, seismic events) etc.
6. Communications and Broadcasting
   - Camera aerial platforms (e.g. broadcasting, and film industry)

4. CONCLUSIONS

1. Coandă UAVs, as a recent application of 100 years old discovery, are in a position of winning terrain in front of other light UAVs (under 150kg).
2. There is a growing and stimulating competition for innovating and demanding patents, where for now, Europe is in pole position, but new signals of interest come from Asia.
3. The early start was made by independent inventors and civil companies, but in the next ten years, maybe, the militaries will be those to keep going the engine of the R&D for Coandă UAVs.
4. As the UK and Romanian research teams showed, the hovercraft legacy could be valued again in this new field of research.

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