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CONTENTS

Military Sciences

NUMERICAL EVALUATION OF THE BEHAVIOR OF A PLATE ON IMPACT WITH A RIGID PROJECTILE USING ELEMENT-FREE GALERKIN METHOD

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Abstract: *The impact of the projectile-plate is a complex phenomenon that is analyzed through analytical methods, based on simplifying hypotheses. In addition to the use of empirical laws, these aspects of the projectile-plate interaction and the effects on the structure are studied using numerical methods. This article presents the numerical evaluation of the behavior of a monolithic plate on impact with a rigid projectile using element-free Galerkin method and is shown the evolution of the impact with its effects (deformation with perforation of the plate). Also, an analyze of the variation of the total energy of the plate, kinetic energy of the bullet and bullet velocity over time are presented.*

Keywords: *impact, plate, projectile, element free galerkin method*

1. INTRODUCTION

The impact of the projectile-plate is a complex phenomenon that is analyzed through analytical methods, based on simplifying hypotheses. In addition to the use of empirical laws, these aspects of the projectile-plate interaction and the effects on the structure are studied using numerical methods.

Significant research has been conducted on the behavior of composite materials on impact. However, research on ballistic impact is still in an incipient phase.

"The Element-Free Galerkin (EFG) method is a very promising method for the treatment of partial differential equations. Because of the absence of element connectivity, nodal points can be added easily to the part of the domain where the solution is (expected to be) steep. This makes the EFG-method more flexible than the Finite Element (FE) method. The method looks very promising for computations in fracture mechanics, since nodal points can be arranged around crack tips in order to obtain accurate stress intensity factors" [1].

The element-free Galerkin Method is based on a series of equations of the theory of elasticity, used under special conditions of numerical approximation, by the method Mooving Least Squares or MLS [2].

A mesh free method establishes system algebraic equations for the entire problem area without using a preset mesh for domain discretization.[3]

2. FUNDAMENTALS OF THE EFG METHOD

The moving least-squares approximation of a function representing a field variable is used in the Element-free Galerkin technique [3]. The approximated value of $u(x)$ will be denoted by $u^h(x)$ represented by the expression:

$$u^h(x) = \sum_{i=1}^{n} H_i(x) \cdot b_i(x) \tag{1}$$

In a matrix form, relation (1) is written:

$$u^h(x) = \mathrm{H}^{\mathrm{T}}(\mathrm{x})\mathrm{b}(\mathrm{x}) \tag{2}$$

where n is the order of the completeness in this approximation, the monomial $H_i(x)$ are basis functions and $b_i(x)$ are the coefficients of the approximation function.

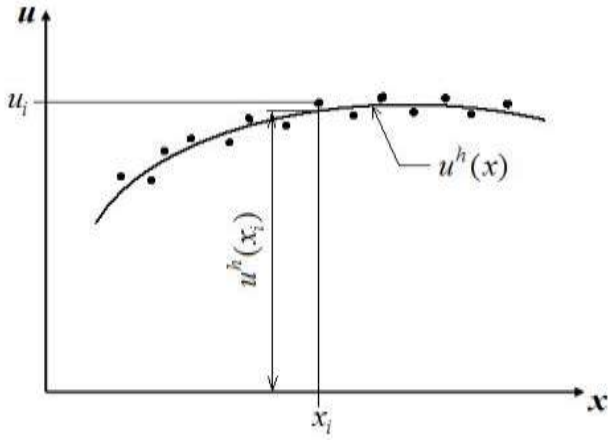


FIG. 1 Nodal parameters u_i and approximate function $u^h(x_i)$

As seen in Fig. 1, there is a difference between the nodal parameter and its approximated value for a node i in the moving least-squares approximation. The coefficients $b_i(x)$ for a point **x** depend on the sampling points $\mathbf{x_I}$ which are selected by a weighting function $w_a(\mathbf{x}\text{-}\mathbf{x_I})$. A weighting function is defined on a compact support defined by a sub-domain. Each sub-domain Ω_I is associated with a node I. Often a such sub-domain is a circle or a ball (3D space), like in the Fig. 2.

The moving least-squares technique is based on minimizing the weighted L_2-Norm (J) defined by the relation (3) or (4); NP is the number of nodes (points) within the support domain where $w_a(\mathbf{x}\text{-}\mathbf{x_I}) \neq 0$.

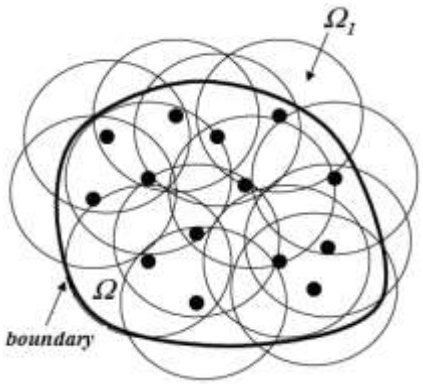


FIG. 2 A mesh-free discretization

$$J = \sum_{I=1}^{NP} W_a(x)(x - x_I)\left[u^h(x) - u_i(x_I)\right]^2 \tag{3}$$

$$J = (\mathbf{Hb} - \mathbf{u})^{\mathrm{T}} \mathrm{W_a}(\mathbf{x})(\mathbf{Hb} - \mathbf{u}) \tag{4}$$

In the relations (3) and (4) the following notations have been used:

$$\mathbf{u}^{\mathrm{T}} = (u_1, u_2, ..., u_{NP}) \tag{5}$$

$$\mathbf{H} = \begin{bmatrix} \{\mathrm{H}(\mathrm{x}_1)\}^{\mathrm{T}} \\ ... \\ \{\mathrm{H}(\mathrm{x}_{\mathrm{NP}})\}^{\mathrm{T}} \end{bmatrix} \tag{6}$$

$$\{\mathrm{H}(\mathrm{x_i})\}^{\mathrm{T}} = \{\mathrm{H_1}(\mathrm{x_i}), ..., \mathrm{H_n}(\mathrm{x_i})\} \tag{7}$$

$$\mathrm{W_a} = \mathrm{diag}[\mathrm{w_a}(\mathrm{x} - \mathrm{x}_1), ..., \mathrm{w_a}(\mathrm{x} - \mathrm{x}_{\mathrm{NP}})] \tag{8}$$

The coefficients **b** result from equation:

$$\frac{\partial \mathrm{J}}{\partial \mathrm{b}} = \mathrm{M}^{[\mathrm{n}]}(\mathrm{x})\mathrm{b}(\mathrm{x}) - \mathrm{B}(\mathrm{x})\mathrm{u} = 0 \tag{9}$$

where,

$$\mathrm{M}^{[\mathrm{n}]}(\mathrm{x}) = \mathrm{H}^{\mathrm{T}}\mathrm{W_a}(\mathrm{x})\mathrm{H} \tag{10}$$

$$\mathrm{B}(\mathrm{x}) = \mathrm{H}^{\mathrm{T}}\mathrm{W_a}(\mathrm{x}) \tag{11}$$

resulting:

$$\mathrm{b}(\mathrm{x}) = \mathrm{M}^{[\mathrm{n}]^{-1}}(\mathrm{x})\mathrm{B}(\mathrm{x})\mathrm{u} \tag{12}$$

Using the solution of the equations (1), (10), (11) and (12) the EFG approximation is obtained:

$$u^h(x) = \sum_{I=1}^{NP} \Psi_I(x) u_I \tag{13}$$

$\Psi_I(x)$ are shape functions having the expressions:

$$\Psi_{\mathrm{I}}(\mathrm{x}) = \mathrm{H}^{\mathrm{T}}(\mathrm{x})\mathrm{M}^{[\mathrm{n}]^{-1}}(\mathrm{x})\mathrm{B}(\mathrm{x}) \tag{14}$$

The weight function can theoretically be chosen at random as long as certain conditions are met. The most important synthetic conditions are: to be greater than zero within the support domain; to be zero outside the support domain; to be monotonically decreasing from the point of interest; and sufficient smoothness, particularly on the boundary. The most used weight functions are: the cubic and the quartic spline functions.

3. MATERIALS AND METHODS

The purpose of this paper is to evaluate the performance of an aluminum plate on impact with a 7.62 mm rigid projectile using element-free Galerkin method. A normal impact was considered, with an impact velocity of 500 m/s and the analyses time of $9*10^{-5}$ seconds.

Numerical simulations were carried out using the LS-DYNA software [4].

For the theoretical study, the aluminum homogeneous and isotropic plate, presented in Fig.3, has the following characteristics:

- Density: $\rho = 2710$ [kg/m^3]
- Young's modulus: $E = 0.690*10^{11}$ [Pa]
- Poisson's ratio: $\upsilon = 0.33$
- Yield stress: $\sigma_c = 315e6$ [Pa]
- Dimensions: 0.1 m x 0.1 m x 0.005 m
- Volume = 2.588e-5 [m^3]
- Node number = 61206
- Element number (SOLID164) = 50000
- Average element finit dimension = 0.001 [m]

The material model used for the plate was plastic kinematic hardening and a rigid material was considered for the bullet.

The plate was simulated by element-free Galerkin method and the nodes belonging to the four sides have all degrees of freedom blocked (DOF=0).

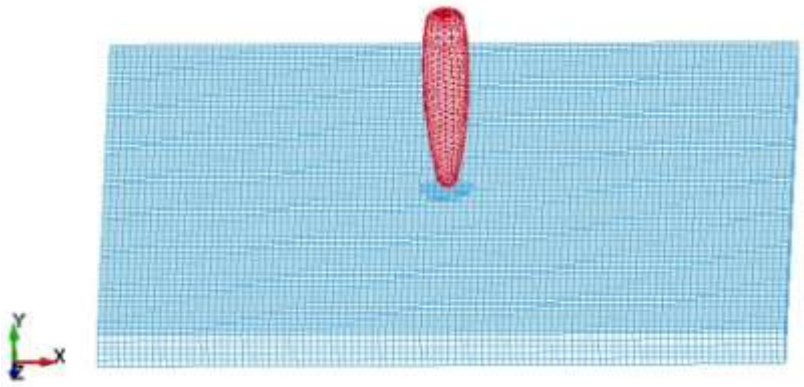


FIG. 3 Element-free Galerkin model

The interest was focused on the plate, that's why it was considered a rigid material for the bullet. The using of these assumptions covers the calculation results and save computer time.

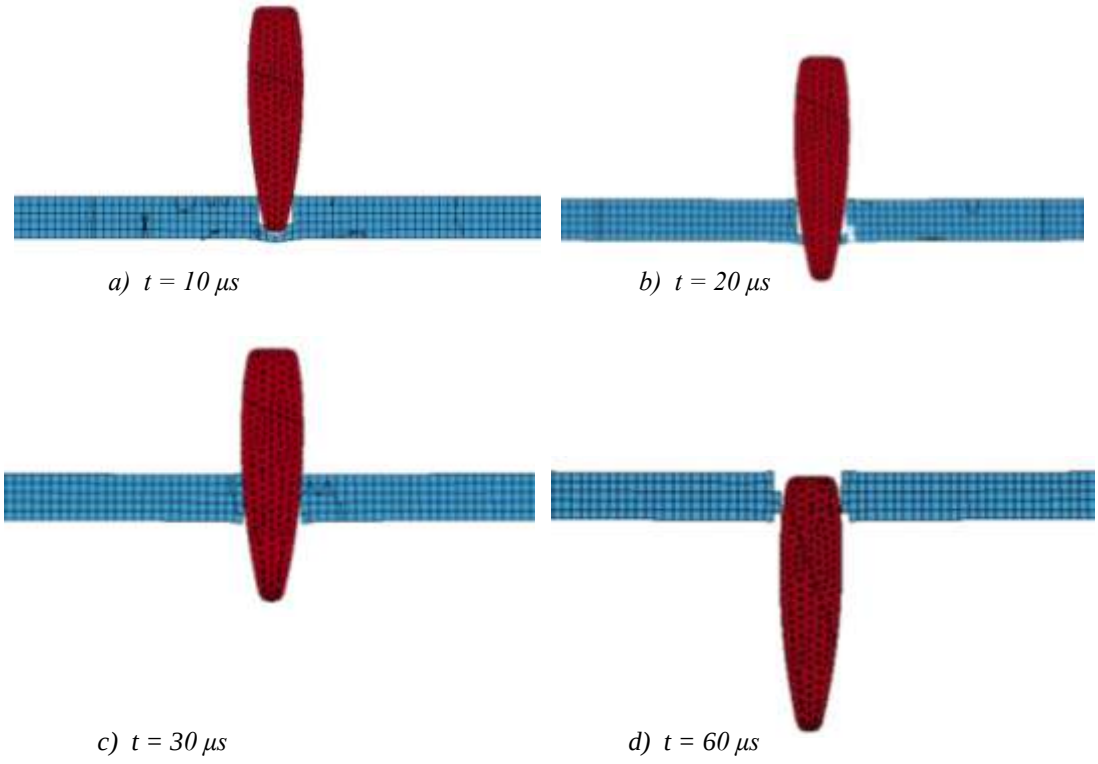
The characteristics of the bullet, presented in Fig. 4, are the following:

FIG. 4 Model of the bullet

- Caliber = 7.62 [mm]
- Density: ρ = 7850 [kg/m^3]
- Impact velocity = 500 [m/s]
- Volume = 6,8587e-7 [m^3]
- Mass = 0.00538 [kg]
- Node number = 6046
- Element number(SOLID168) = 3860
- Average element finit dimension = 0.001 [m]

4. NUMERICAL SIMULATION

In the Fig. 5 it is shown the evolution of the impact, with its effects (deformation with perforation of the plate), by presenting the deformed state during the analysis of 60 microseconds



a) t = 10 μs *b) t = 20 μs*

c) t = 30 μs *d) t = 60 μs*

FIG. 5 Time evolution of the impact

The time evolution of the plate total energy is presented in Fig. 6. It is observed that the total energy absorbed by the plate during the impact is reaching a maximum value of 10.5 Nm.

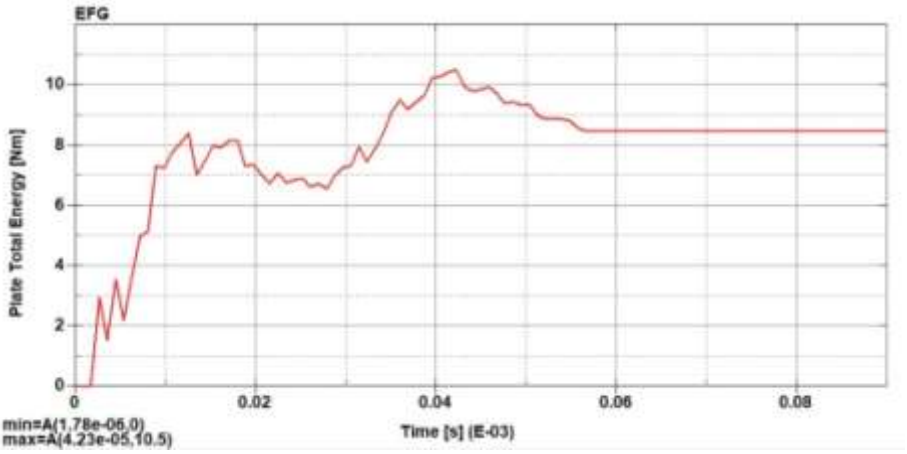


FIG. 6 Time evolution of the plate total energy

From the graphical representation of the bullet kinetic energy variation, presented in Fig. 7, results a variation between the limits of 594-673 Nm, meaning that there is a falling of the kinetic energy of the bullet by 11% and represents the remaining ability of the bullet to pierce or penetrate a plate similar in material and thickness.

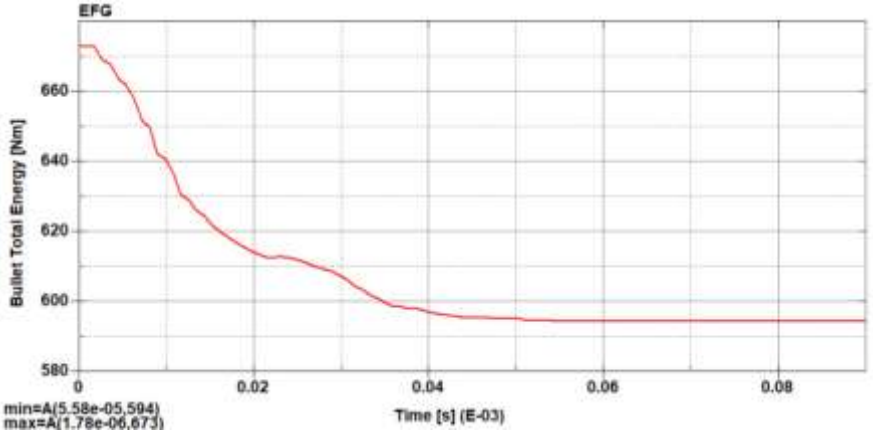


FIG. 7 Time evolution of the bullet total energy

Analyzing the allure of the curve in Fig. 8, can be observe a constant level at the beginning of the diagram that represents the period elapsed to cover the initial bullet-plate distance, then begins the process of penetration and perforation of the plate, the speed of the bullet decreasing from the initial value of 500 m/s to at the minimum value of 470 m/s.

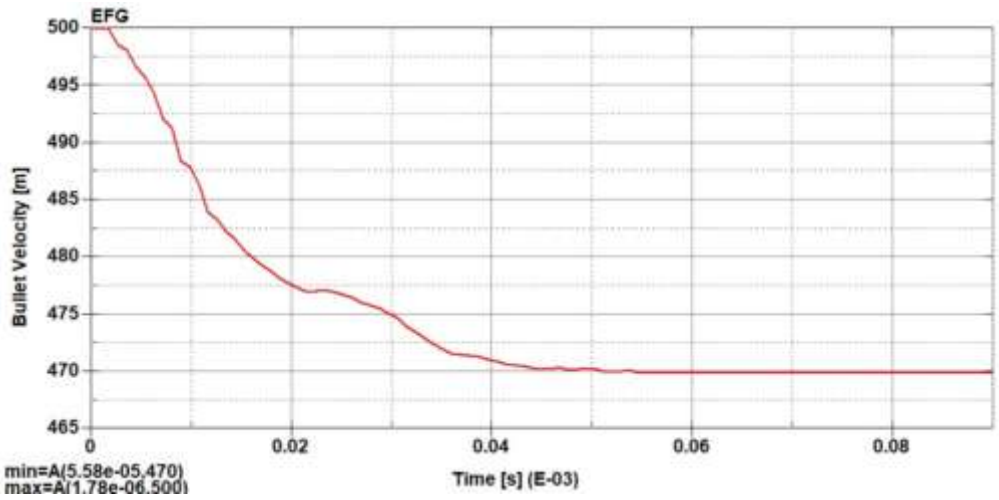


FIG. 8 Time evolution of the bullet velocity

5. RESULTS AND DISCUSSIONS

The results obtained by the element-free Galerkin method were introduced in Table 1, in order to be compared with the results obtained in the numerical simulation of the same impact, analyzed with the Finite Element method and the Smoothed-particle hydrodynamics method.

It can be seen that the values obtained are close and the errors are relatively small, below 10%, which is a very good match of the values obtained, implicitly a proper analysis.

Table 1. Comparison between three numerical methods

	EFG	MEF	SPH	Error EFG/MEF	Error SPH/MEF
Plate total energy [Nm]	10.5	9.89	10.9	6.17%	9.27%
Bullet total energy - max [Nm]	673	673	673	0.00%	0.00%
Bullet total energy - min [Nm]	594	604	543	-1.66%	-8.59%
Bullet velocity - min [m/s]	470	474	449	-0.84%	-4.47%
Bullet residual velocity [m/s]	470	476	450	-1.26%	-4.26%
processing time [s]	233	76	20		

6. CONCLUSIONS

A numerical investigation of the ballistic performance of aluminum plate on impact with 7.62-mm projectile was conducted, using the element-free Galerkin method, for the velocity of 500 m/s. A corresponding experimental study would be expensive and difficult.

The results obtained by elements-free Galerkin method were compared with the results obtained obtained in the numerical simulation of the same impact, analyzed with the Finite Element method and the Smoothed-Particle Hydrodynamics method and the errors are slightly lower, below 10%, this representing a very good concordance of the values obtained, implicitly an appropriate analysis.

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SATELLITE COMMUNICATIONS SYSTEM - A PERSPECTIVE ON NATIONAL SECURITY

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Abstract: *The potential offered by space is enormous, and Romania should appear on the map displaying space services and capabilities at national, NATO and EU level. The opportunities that arise from the implementation of a national space telecommunications program are in the governmental, civilian, commercial and military domanin. The Romanian Army must ensure its autonomy and freedom of action by using space capabilities safely.*

Keywords: *resilience; space program; satellite system; satellite communications.*

1. INTRODUCTION

The issue of increasing the resilience of critical infrastructures to ensure the stability of national security in the context of regional threats, to which the communication and information system has to adapt and update easily, led me to reiterate the need to implement a national space program. The dynamics of the current period regarding the development of communication and information system are based on the development of the information technology sector, as well as the need for society to evolve from the information age to emerging and disruptive technologies.

Space is an area where the economic and military areas intersect more and more aggressively. Ahead of the NATO summit in London, Secretary General Jens Stoltenberg said in a press release that it had been agreed at the North Atlantic Council meeting at the level of Foreign Ministers that *"space should be a new operational domain for NATO - alongside air, land, sea and cyber. Space is part of our daily life here on Earth. It can be used for peaceful purposes. But it can also be used aggressively"*[1]. As an extension of the statements of NATO Secretary General Jens Stoltenberg, Romanian army specialists mentioned in 2019 that *"...outer space can also be a future theater of confrontation between countries or world organizations to ensure the supremacy of information and action, as well as testing technical capabilities in the field of advanced technologies"*[2].

As an obvious consequence of the increased and aggressive interest in space, at the NATO summit in London in 2019, in the context of the security and safety of the Alliance, space was declared as: *"... an operational domain for NATO, recognising its importance in keeping us safe and tackling security challenges, while upholding international law"*[3].

The recognition of outer space at NATO level as a new operational domain is a consequence of the shift in interest from **observation** and **exploration** to **militarization** and even its **conquest**.

The issue of space at the international level is changing day by day, due to the aggressive competition between the great powers of the world, the emergence of new actors with ambitions in space, the involvement of the private sector and awareness of trade effects. The joining of digital technologies supported by space information opens up new opportunities in both the civilian and military domain.

2. THE NEED TO IMPLEMENT A NATIONAL SATELLITE SYSTEM

Outer space is becoming more and more congested, contested and competitive as space technologies allow for the full development and exploitation of space resources, as well as the proliferation of counter-space weapons (ASATs – *Anti-satellite*) aimed at spying, interfering with or degrading adverse space capabilities.

The international situation

Due to the development of space technology, the need for various purposes and domains such as government, commercial, civilian and military, along with significant cost reductions have led to a very large number of satellite launches in recent times. In the *Satellite Database* developed by UCS (Union of Concerned Scientists) there are 4852 operational satellites in the orbits of LEO, MEO, HEO and GEO arranged around the Earth.

In Fig. 1 we have highlighted the situation of the operational satellites of the *major players* in the space.

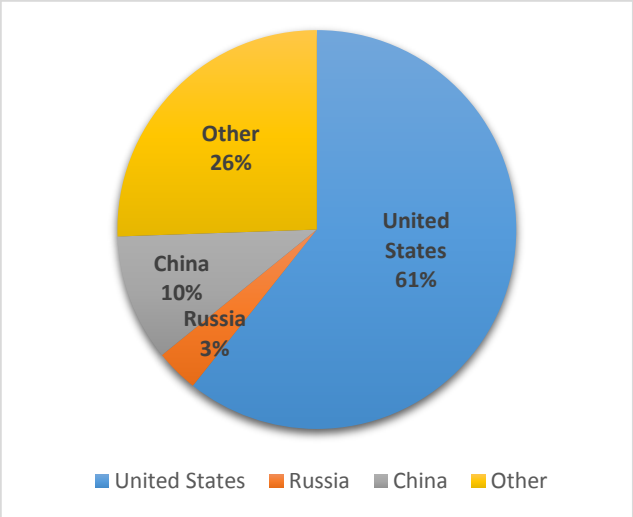

FIG. 1 The situation of operational satellites worldwide.
The graph was made using the UCS Satellite Database [4]

The United States (2944 satellites) has consolidated its position as a world leader with more than half of its operational space capabilities. China (499 satellites) has recently accelerated the process of expanding space capabilities in an attempt to consolidate its second position. Russia's efforts (169 satellites) to keep in touch with its leaders in the domain have also strengthened its position in outer space, including its anti-satellite capabilities. Other countries that stand out in this area are: UK (349), Japan (93), India (61), Germany (46) and France (30).

Returning to Europe, Table 1 shows the European states that have operational satellites and the orbits in which they are positioned. It should be noted that this situation also includes partnerships between 2 or more states and those of ESA (European Space Agency).

Table 1. Numerical situation of operational satellites at European level

Country	Orbit				Total satellites
	GEO	HEO	MEO	LEO	
Austria				1	1
Belarus	1			1	2
Belgium				2	2
Bulgaria	1			1	2
China/France				2	2
China/Italy				1	1
Czech Republic				3	3
Denmark				4	4
ESA	1	7	24	28	60
ESA/USA				1	1
ESA/USA/Russia		1			1
Switzerland				13	13
Estonia				1	1
Finland				15	15
France	2	2		13	17
France/Belgium/Sweden				2	2
France/Israel				1	1
France/Italy	2			1	3
France/Italy/Belgium/Spain/Greece				2	2
France/USA				1	1
Germany	2			42	44
Greece	2				2
Greece/United Kingdom	1				1
India/France				2	2
Italy	2			12	14
Lithuania				2	2
Luxembourg	32			8	40
United Kingdom	19		20	306	345
United Kingdom /ESA	1				1
United Kingdom / Netherlands				1	1
Norway	3			5	8
Netherlands	7			8	15
Poland				2	2
Russia	31	11	29	94	165
Russia/USA				2	2
Slovenia				2	2
Spain	10			12	22
Sweden	1			1	2
USA/France				1	1
USA/Germany				2	2
USA/Sweden				1	1
USA/United Kingdom/Italy				1	1
Turkey	4			5	9
Ucraina				1	1
Hungary				1	1
Total satellites	122	21	73	604	820

The table was compiled with information extracted from the UCS Satellite Database, updated Jan 1, 2022 [4].

Remarkably, a large number of European countries have developed this sector, which is considered essential in the context of the resilience of national security. From the analysis of the above table, it is observed that the trend is to launch satellites mainly in the Low Earth Orbit (LEO).

The difference in approach between NATO and the EU on space capabilities is due to the fact that NATO does not currently have its own satellite system, unlike the EU which is involved through the *European Defense Agency (EDA)* and the *European Space Agency (ESA)*. The table above shows the EU's implications for space by launching 60 of its own satellites (1 GEO, 7 HEO, 24 MEO and 28 LEO) and 3 satellites in partnership with the US, Russia and the UK (1 GEO, 1 HEO, 1 LEO). Satellites launched in partnership are used for government and / or commercial purposes and are aimed at space science, satellite communications and technological development.

Two of the European countries that have launched GEO satellites are Greece and Bulgaria, which we could take as an example and with which we could cooperate on the planning, preparation, financing and support of a satellite project.

Greece launched its first GEO satellite called Hellas Sat 2 in 2003 with Ku-band coverage over Europe, the Middle East and South Africa, offering high-power transmissions, video streams and Internet access services. The project cost about $ 178 million, including satellite, launch rocket and insurance. In 2017, Greece launched the second GEO satellite with the UK, called Hellas Sat 3 to expand satellite capabilities and replace some of the services used by Hellas Sat 2. Hellas Sat 3 provides FSS and BSS services in Europe, Ka-band in Europe and Ku-band in the East Middle and South Africa. Hellas Sat 4 was launched in 2019 providing Ku-band coverage in the Middle East and South Africa providing increased redundancy and backup capabilities to secure the DTH (direct-to-home) network [5].

Bulgaria launched its first GEO BulgariaSat-1 satellite in 2017, which provides broadcasting and telecommunications services to South East Europe. BulgariaSat in cooperation with Space Systems / Loral received $ 235 million in funding for the satellite project, including its acquisition, launch and operational delivery into orbit, ground systems and insurance [6].

The national situation

At national level there is the Government Decision no. 36 of January 27, 2017 on the organization and functioning of the Ministry of Communications and Information Society (current Ministry of Transport, Infrastructure and Communications) which is designated *"to ensure the efficient management and use of the orbital positions assigned to Romania"* [7].

Starting from the desideratum that the National Defence Strategy is *"the document that provides the basis for national defense planning"*[8], this is achieved through the coherent integration of areas such as: information, air traffic management, air defense, civil emergencies, C3 - command, control, communications, etc. One of the important national objectives is *"ensuring the security and protection of communications infrastructures and information technology with critical values for national security, as well as the awareness, prevention and countering of cyber threats carried out on them by actors with strategic motivation, extremist-terrorist ideology or financial"*[9]. This national security objective highlights the importance of critical communications and IT infrastructures that ensure national security.

The Defence White Paper, a defense planning document at the departmental level, states that for the development of capabilities, the Romanian army will focus its efforts on a number of directions of action, including *"continuation of the project of*

the military satellite telecommunications system"[10], simultaneously with *"modernization of C4ISR infrastructure, networks and systems at a tactical, operational and strategic level and their interconnection with those of SNAp and NATO"*[10]. The Defence White Paper is prepared by the Ministry of Defense to meet the objectives of the National Defence Strategy and is in line with the provisions of the NATO Strategic Concept, which states that this course of action is a priority to align ourselves with NATO's efforts and to recover the technological advance of many European states.

Another reference document is the Military Strategy of Romania (2021) elaborated in accordance with the National Defence Strategy (2020-2024) and The Defence White Paper - edition 2021. The Military Strategy of Romania states that in the period 2021- 2024, in addition to other projects of great interest in the field of emerging technologies, there is the priority to*"...launch of projects: military telecommunications satellite system, UAS systems, combat vehicles and high-performance tactical transport vehicles to ensure increased mobility and protection for personnel, NATO-type weapons system, ground-based air defense system"*[11]. The realization and development of the national telecommunications satellite system project would make a major contribution to national defense and the support of civilian authorities.

Romania's accession to the European Space Agency in 2011 allowed us access to state-of-the-art technologies, the accumulation of much-needed expertise in the perspective of implementing our own satellite program, as well as the connection with the profile industry at European level.

3. RESILIENCE OF NATIONAL SECURITY THROUGH THE IMPLEMENTATION OF A NATIONAL SPACE PROGRAM

In view of the allocation of the two geostationary orbital positions, in conjunction with national security and defense needs and the requirements of society as a whole, consideration should be given to*"...the opportunity for Romania to operationalize a satellite communications system capable of ensuring the resilience of critical terrestrial, civil and governmental communications and to increase the degree of interconnection, through redundancy between the systems of national public operators and governmental and defense structures"*[12].

In order to ensure the redundancy of the communication and information systems necessary for the critical infrastructures in Romania, the orbital positions assigned by the regulations of ITU (International Telecommunication Union) should be exploited. Based on the principle of equitable access to geostationary orbital positions according to Appendices 30 / 30A (1977) and 30 / 30B (1988), each ITU Member State has been assigned one GEO orbital position in each appendix. Romania ratified the Constitution and the Convention of the International Telecommunication Union, signed in Geneva on December 22, 1992 by Law no. 76 of November 8, 1993 [13], which was published in the Official Gazette part I, no. 272 of November 25, 1993 and benefits from 2 GEO orbital positions represented generically in Fig. 2.

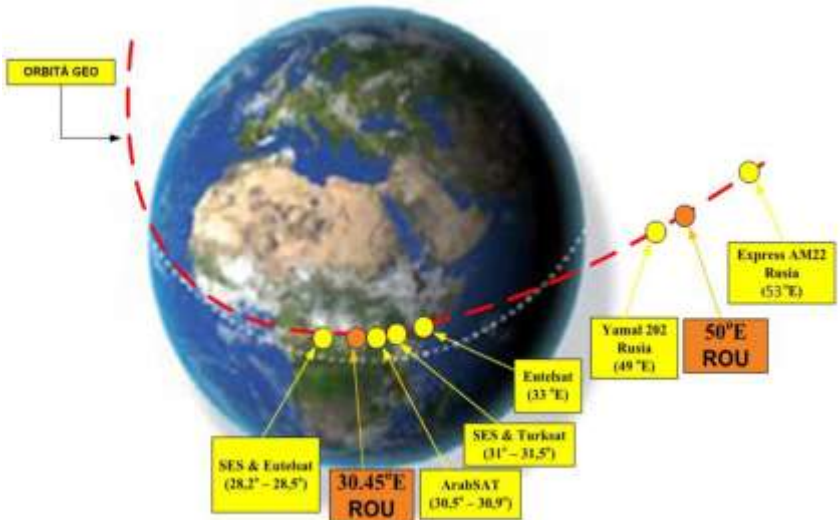

FIG 2 Graphical representation of geostationary orbital positions allocated to Romania [12].

In the *Final Acts WRC-15* [14] at the World Radiocommunication Conference held in Geneva in 2015, Romania's orbital positions were reiterated with a longitude of $30{,}45^0$E for Fixed Satellite Services (FSS) and a position with a longitude of 50^0E for Broadcasting Satellite Services (BSS).

The main objectives of the satellite telecommunications program for the National Security System *"strengthening Romania's role in NATO and the EU, reducing its dependence on satellite service providers, gradually developing its own satellite system to ensure the mission needs of the Ministry of National Defense and state institutions in times of peace, crisis and war, as well as and ensuring the redundancy of nationally organized terrestrial communications networks, which may be severely affected in special, emergency or calamity situations"*[15].

The need to develop a national satellite system is argued by military specialists in this domain [12], as follows:

- ensuring independence from external satellite service providers;
- ensuring the protection of satellite links;
- elimination of the contracting of satellite services from external providers;
- ensuring communication skills, with national and international coverage;
- active involvement in geopolitical relations;
- development of national industrial and space research sectors;
- economic and strategic opportunities by leasing unused bandwidth capacity to NATO and EU partners.

The arguments regarding the implementation of a national space program lead to the consolidation of Romania's position in NATO and the EU, but also to the openness to the provision of satellite services in the region. At present, Romania needs more and more satellite flows: in the military for the execution of missions in theaters of operations and for multinational and joint exercises, governmental for political decision-markers, intervention and civil protection structures, central and local administrations in situations of crisis or natural disasters, civil and commercial for the development of the economy by providing services to private operators of television, mobile communications, internet, etc. For example *"The Ministry of National Defense, in the period 2009-2018, spent approximately 7,500,000 euros for the rental and provision of satellite communications services"*[15], as it is shown in a press release of

the MoD. The national satellite system could ensure the resilience of critical communications by ensuring the redundancy of communications links at the governmental level, national defense, public operators, etc. in situations of crisis, war, calamity or natural disaster.

At the level of the Romanian army, the operationalization of a space system could support several components, among which:

- ISR (*Intelligence, Surveillance and Reconnaissance*) through Earth Observation (EO) and synthetic aperture radar (SAR) through space sensors;
- SATCOM (*Satellite Communication*), providing X-band military communications satellite services (7 - 10 GHz);
- GEOINT (*Geospatial Intelligence*) through Earth Observation capabilities;
- SSA (*Space Situational Awareness*) early warning of ballistic missile threats through SAR and space sensors.

4. CONCLUSIONS

There should be no delay in carrying out this national project in the context in which we see that the needs of military SATCOM are important in this tense period near the borders of Romania. In order to respond effectively to the specific challenges of hybrid conflicts, the military must be resilient, adaptable and visionary in developing capabilities and services specific to communication and information systems. By operationalizing a national space telecommunications program, Romania's national defense system is creating new capabilities to support the planning and conduct of military actions.

It is obvious that the geostationary orbital positions allocated to Romania by the ITU are resources that must be capitalized and exploited as soon as possible. The frequency spectrum used in these orbital positions must be protected from interference and ensure maximum efficiency. I believe that efforts to implement the national space program must be supported by a *Strategy for Space* through clear regulations at national level, economic and diplomatic efforts to create partnerships with strong and experienced states in the space industry and to develop training programs for specialists, experts and future leaders in the field of space operations.

A platform like *Systems Tool Kit* - STK would be useful for simulations, modeling, testing or designing hypothetical architectures in space issues. This would require military research and education for modeling, specialization and training.

Even the development of small-scale projects such as *CubeSat* can be a solution in education, leading to an increase in expertise in education and space research. CubeSat is a nanosatellite of a standard cube-shaped, where a 1 U (unit) have dimensions of 10 cm x 10 cm x 10 cm. A CubeSat system can be composed of a maximum of 27 U. According to ITU-R it has a mass of 1-10 kg, a lifetime of 1-3 years and is launched in the orbit of LEO or HEO.

Another form of training can be performed at NATO or EU level for the development of military instructors and experts to represent the core of specialists, in the exploitation of future space capabilities.

Space technology is an indispensable presence in today's society, providing fast and secure information on emergencies such as floods, earthquakes, fires, allowing the emergency structures appropriate cooperation by providing telephone services, GPS positioning, high resolution satellite imagery, communications satellite. It also supports

the efforts of the authorities on issues such as migration, border security, pollution, meteorological activity, transport safety, etc.

We can see that most European countries have launched at least one satellite, which is why Romania should neither delay the launch of the first GEO satellite nor the development of all related technologies to ensure monitoring, operation, security, maintenance, etc. Romania needs to ensure its independence from this essential resource.

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GEOPOLITICAL PERSPECTIVES OF THE ACTIVITY OF THE GERMAN MILITARY MISSION ON ROMANIAN TERRITORY BETWEEN 1940 AND 1945

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Abstract: *The German Military Mission arrived in Romania in 1940 with the stated purpose of training of the Romanian military in accordance with the new warfare technique. The activity and the role of this military mission impacted the Romanian army, both in terms of their training and in terms of the moral preparation of the Romanian soldier. These aspects are the main topics of this article, in which the method of historiographical investigation, as well as the comparative analysis were employed.*

Keywords: *political, economic and strategic interest; Little Entente; German Military Mission; Second World War, Soviet Russia.*

1. INTRODUCTION

The European geopolitical situation between 1938 and 1940 had significant consequences on Romania's security, the evolution of political events becoming inevitable. In this context, the dismemberment of Czechoslovakia and the dissolution of the Little Entente, following the Munich Agreement (29 September 1938), as well as the grim Ribbentrop-Molotov Pact (23 August 1939) were the most drastic events on Europe's political scene, Romania being directly affected by the territorial losses of 1940, following the Vienna Award: Basarabia, northern Bucovina and the northwestern part of Transilvania.

Although, in principle, the Little Entente, as a political organisation with a defensive role, was based on democratic criteria, thus managing to maintain, for a while, the territorial integrity of the signatory states – Czechoslovakia, the Kingdom of Romania and the Kingdom of Yugoslavia – and representing, at the same time, an obstacle to the arbitrary claims of Horthy's Hungary, Germany's path to expansion was one of the devastating consequences of the Munich Agreement. In the same vein, the Molotov-Ribbentrop Pact and the Soviet ultimatums of 26-27 June 1940 were decisive factors in the disintegration of the political balance in Central and Eastern Europe, which ultimately led to the outbreak of the Second World War.

The Molotov-Ribbentrop Pact led to the incorporation of the Baltic States into the Union of Soviet Socialist Republics (USSR), made Poland a pawn on the chessboard between the Kremlin and Berlin, while Romania and Finland were forced to give up important territories in favour of Moscow. Against this geopolitical backdrop, Romania appears as an actor-participant, ever *"since the first moment, on the German side in the ‹crusade against Bolshevism›"* [1], with the intention of regaining the territories uprooted in the summer of 1940.

On the same geopolitical coordinates, one can note that the June 1940 Soviet ultimatums *"inaugurated the black series of the summer of 1940, culminating in the forced handover of the Quadrilateral to Bulgaria, by the signing of the Treaty of Craiova on September 7, 1940, and Northeastern Transylvania in favour of Hungary, following the second arbitration in Vienna on 30 August1940"* [2].

Therefore, Romania's orientation towards an agreement with Germany, through the collaboration with the German Command, was put in practice through the sending of a German Military Mission to our country. Consequently, in 1941, Romania was in the position of being an ally of Nazi Germany, with the primary obviously subjective purpose of getting back the regions annexed by the USSR arbitrarily a year ago. Through the German Military Mission, the Romanian domestic policy also hoped for an integration of Romania in the politico-military system of the Axis Powers. We will further analyse the activity and importance of the German Military Mission in our country from the perspective of both the Romanian political, economic and strategic interest, and the power relations between the Third Reich and the Kingdom of Romania.

2. ROMANIA'S POLITICAL, ECONOMIC AND STRATEGIC INTEREST IN RELATION TO THE ACTIVITY OF THE GERMAN MILITARY MISSION ON THE ROMANIAN TERRITORY

According to Germany's strategic plans, ever since the years before the Second World War, Romania had a fundamental role [3, p. 18], from at least three perspectives: its border with the USSR, easy access to the Black Sea and oil resources essential for the economy of the Third Reich. In fact, among the Nazi foreign policy objectives, first of all there was the access to the economic power of the states of Southeast Europe [4]. At the same time, Romania was surrounded by rivals with territorial claims, such as the USSR, Bulgaria and Hungary. In such circumstances, the Romanian side, in its turn, was motivated by its orientation towards the German power from an economic point of view and from the point of view of ensuring territorial integrity and national security. On the one hand, this happened in order to obstruct Hungarian revisionism, and on the other hand, to protect Romania against a possible Soviet threat [3, p. 28]. In such circumstances, King Carol II of Romania (8 June 1930 – 6 September 1940) hoped that becoming closer to Germany would result in the Romanian territory being protected, but also in his remaining on his throne, given that the political regime changed when the national-legionary government was formed.

The history of the German Military Mission in Romania, as it is shown, for instance, by studies drawn up by Prof. Alexandru Oșca, dates back to the reign of King Carol II, when the German military attaché in Bucharest, Colonel Karl Richard Wahle, communicated in Berlin, on 14 July 1940, the following *pieces of information*: *"The military attaché of the air force and myself were asked to attend a meeting with the King in the afternoon of that day. The king opened the meeting by declaring that he was determined to go to Germany. That is why he asked us to send to the German Supreme Command his official request that the Military Mission is sent, in keeping with what he had already proposed to the Führer. So far, the king has not received a positive answer.* However, the Führer's answer would come later, due to the reserved attitude of the leadership in Berlin towards the foreign policy of Carol II. Under the dictatorial rule of Carol II, Romania undoubtedly progressed culturally, but authoritarianism became more and more widespread, with territorial losses in 1940 minimising the regime's credibility, culminating in the abdication of the king. A coalition government came to power, made up of far-right officers, led by General Ion Antonescu, and representatives of the Iron

Guard. The government went on with the idea of the need, seen in time as a solution, for a German military mission in Romania. This proposal was pointed out in the document entitled *"Proposals of the Romanian Government for sending a German Military Mission, based on the talks that took place on 15-17 September 1940 between General Antonescu, the leader of the Romanian State, and General von Tippelskirch, from the German Supreme Command"*: *Regarding the structure and functioning of the German Military Mission, the document provided that:‹ 1) it will function in connection with the Romanian General Staff and will have the necessary specialist officers; 2) the troops that will also be training units in the training centres will be the following: a) combat aviation ...; b) air defence...; c) large monitored and mechanised units. (...) The Romanian government proposed that a number of 3-4 staff officers from the German army should be send to the Higher War School. Also, young Romanian officers were to be sent to the training centres in Germany›"* [2, pp. 147-148].

The activity of the German Military Mission actually began in October 1940 [2, p. 139]. Its tasks derive from the directive signed by Field Marshal Wilhelm Keitel, on 20 September 1940, that reads: *"The apparent mission of the German troops is to help Romania, a new friend, in organising and training its armed forces. Their real missions, which must not become obvious either to the Romanians or to their own troops, are: a) to protect the oil region from destruction and its seizure by a third power, b) to offer Romanian armies the ability to carry out different tasks, in accordance with a plan drawn up in favour of German interests, c) should a war imposed on us by Soviet Russia occur, they must make preparations for the engagement of German and Romanian forces from Romania"* [2, p. 150]. As one can easily see, the military mission worked "undercover", its real purpose being that of the "transmission belt" [6, p. 5] between the Wehrmacht and the Romanian Army. The presence of German units in our country meant, in fact, that Romania entered under the German influence, as well as that it would from then on implicitly adopt the decisions of the Third Reich, especially regarding the attack on the USSR in the first part of 1941. During this campaign, the Romanian army had neither moral nor physical capacity against the USSR: the fundament of the armed forces was the cavalry, but it lacked modern artillery and did not have enough armoured units. In addition, the combat and moral training of the Romanian soldiers was not at its best.

From an economic point of view, Romanian oil was a determining factor for the German war effort. Oil was the only natural product capable of "feeding" the industrial and economic needs of the Third Reich. Therefore, it was a strategic resource that had to be secured, thus gaining priority in the analysis of German decision-makers. That is way, gaining control over Romanian oil was a good reason for the Germans' direct involvement in Romania, and we can assume that it also was one of the factors that motivated Germany to wage a war of aggression against the USSR in June 1941.

As such, the German Military Mission played an important role in preparing for the armed aggression against the USSR on 22 June 1941, as well as in establishing and maintaining a strategic partnership between the German Reich and the Kingdom of Romania until the end of August 1945, when our country left the Axis coalition, and fought alongside the USSR for the remainder of the war.

3. POWER RELATIONS IN THE LIGHT OF THE GERMAN MILITARY MISSION IN ROMANIA – OPERATION "BARBAROSSA"

Rather marginalised in the international arena, especially after Eastern Europe was divided between Germany and the USSR, but especially after the signing of the Ribbentrop-Molotov Pact, Romania was forced to choose the lesser evil: enter under

Germany's sphere of influence. However, as the former Romanian ambassador to Berlin, Ion Gheorghe, described it, it was *"an official act without any power of persuasion"* [7, p. 220], the relations between the two countries being all about *"ordinary political opportunism"* [8, pp. 218]. All Romania wanted from this alliance was to regain the lost regions of Basarabia and Northern Bucovina, annexed by the USSR.

The Third Reich saw Romania as the ideal basis, in terms of strategic position, for attacking the USSR, understanding that the Romanian army was a consistent support in carrying out operations against the Soviets. At the same time, however, oil resources were a vulnerability in terms of a possible Soviet response.

Through Romania's involvement in the German-Soviet war that began on 22 June 1941, the Romanian army was seen as a major partner of the Axis, alongside Japan and Italy, participating in the siege of Odessa, the conquest of Crimea or the Battle of Stalingrad. In all these actions, one must remember the contribution of the German Military Mission in the preparation of the Romanian army through the training and assistance provided.

On 22 June 1941, Germany and its allies – Finland, Hungary, Italy, Slovakia, Spain, Romania – attacked the USSR, in an operation codenamed "Barbarossa" (named after the Roman-German Emperor Barbarossa), which aimed to annihilate the Soviet Union and its communist regime.

In order to prepare for the "Barbarossa" operation, one of the most vital measures that the German Military Mission had to take was assessing the combat capabilities of the Romanian army. As quoted by historian Ottmar Trască, a report by the German Military Mission dated 14 February 1941 regarding the evaluation of the Romanian army, a not very positive state of affairs was highlighted: the officers were considered well trained theoreticallly, but *"without having the strength and will to resist to the last man"* [6, p. 7]. However, the report also pointed out that no information could be provided on non-commissioned officers, "*as there are no active non-commissioned officers at all"* [6, ib.]. The same could not be said about the Romanian soldiers, whose evaluation was positive: *"The Romanian soldier is a worthy (human –* A/N*) material, willing to learn; he is usually docile and willing to assimilate, seemingly even resilient and consistent; however, he generally has a low level of training. He lacks independent activity and thinking. His relationship with his superiors, in keeping with Romanian mentality, lies on the fear of punishments rather than on trust. The soldier's treatment is partly bad, and the living conditions in the barracks – according to our standards – are primitive. The pay does not even correspond to modest living needs"* [6, ib.].

The report also showed the situation of the Romanian divisions, which, according to the assessment, could not be used in independent offensive actions, but only in peace and security missions. As follows from this short analysis of the Romanian army, the assessments were extremely critical and ended with the following sharp conclusion: *"an independent offensive operation of the Romanian troops is out of the question"* [6, ib.]. Following the preparation of this report, it was decided that the Romanian divisions are not suitable for independent combat missions, but only for lighter attack missions. As a result, the plans for the use of Romanian troops in "Barbarossa" operations were changed, starting from these conclusions and as a result of opposition from Adolf Hitler. Although the German Military Mission improved the Romanian situation to some extent, it was nevertheless decided that the Romanian army was not *"suitable for difficult offensive missions"* [6, p. 9], at least during the first stage of Operation *Barbarossa.*

One of the final conclusions of the report made the following statement, extremely suggestive and leaving no room for comment: *"The German suggestions were adopted and followed with interest and sincere conviction. It can be seen that most of the General*

Staff and the Romanian command corps are sincerely striving to learn the principles of German combat. The command posts should generally be filled by the adequate persons" [6, p. 13].

Although the 1941 assessment showed an unprepared army from the point of view of the German Military Mission, nevertheless, in the 1942 campaign, the Romanian army exceeded expectations. During this large-scale operation, Romania played an active role, with Romanian and Finnish troops ensuring *"the southern and northern flanks and taking part in military operations alongside the Wehrmacht. From this point of view, Romania was also a base of operations for the German army. We know that, since the autumn of 1940, Reich troops had been deployed in Romania as part of a German military mission. Romania was also a supplier of raw materials, especially oil, which was very important for the German war machine. From June 1941, two Romanian armies, the 3rd and the 4th, participated in the operations together with the 11th German army in a group of armies called ‹General Antonescu›, the commander was Ion Antonescu himself, the head of the Romanian state. In the beginning, its goal was to liberate Basarabia and northern Bucovina ..."* [2, p. 67].

After the invasion of the Soviet Union, Romania took back Basarabia and Northern Bukovina, and after the German and Romanian troops conquered Ukraine, in July and August 1941, Romania was given the territory between the Nistru and Bug Rivers. Romanian authorities set up a military administration there and named the region *"Transnistria".* The purpose of the Romanian army's participation in this large-scale action – the reunification of its borders – was different from that of Germany, although both countries sought to achieve their goals by defeating the USSR. This made Romania feel, in its position as an ally of Germany, *"like an enclave"* [7, p. 190].

4. CONCLUSIONS

The *"Barbarossa"* operation had a series of consequences on the Jewish issue within the Romanian-German relations, the pogrom in Iași, from 28-30 June 1941, raising the interest of numerous historiographers. The policy promoted by the Antonescu government towards the Jews during the Second World War was broadly aligned with his foreign policy, being *"under the sign of tactical and pragmatic considerations"* [2, p. 618] of those times. As stated by Ion Antonescu in the Nuremberg Trials, *"during my time in power in Romania, I sought to consolidate the connections with Germany in order to resume its assistance for training and arming the Romanian Army. To this end, I met Hitler several times"* [9, p. 23]. This paragraph can be an example of the relationship between Germany and its satellites.

Regarding the German Military Mission in Romania, Ion Antonescu acknowledged that: *"I agreed with Hitler that the German military mission in Romania should continue its activity of reorganising the Romanian Army according to the German model; we also concluded an economic agreement under which the Germans would deliver in Romania 109 Messerschmitt aircraft, battle tanks, tractors, anti-aircraft and anti-tank guns, automatic weapons and other armies and would receive, in return, part of Romania's wheat and gas for the needs of the German army.*

When asked: Can this first meeting with Hitler be considered the beginning of my agreement with the Germans to prepare for war against the Soviet Union? - I answer in the affirmative" [9, p. 65]. An objective historical analysis of the Romanian-German relations during the German Military Mission in Romania outlines the legal issues, because there were no alliance treaties or military conventions between the two countries that would stand as the legal basis for Romania's participation alongside Germany in the

war, most of the subordinations of the Romanian army to the German command echelons being made by verbal agreement [5, p. 221].

At the same time, the nature of the political-military relations with the Third Reich, which imposed its point of view on strategic and operational issues, influenced the activity of the General Headquarters and the General Staff, minimising the responsibilities regarding the conception and leadership of the Romanian army in the theatre of war. For example, as historian Alesandru Duțu writes, during the Eastern Campaign, these two bodies of conception and command of the Romanian army were prevented from independently devising campaign plans or actually leading the Romanian army on the front, with only a few exceptions – *"in limited areas and directions, in southern Basarabia and in the battle of Odessa, between 22 June and 16 October 1941, in the area of the 4th Army, and even so with notable German suggestions and influences"* [8, p. 12] .

On the other hand, one must not overlook the role of the German Military Mission in reaching some of our national objectives during the war. Here we can mention the contribution of the German 11th Army to the liberation of Basarabia and the northern part of Bucovina in 1941. Overall, we must emphasise the *"supremacy of the stronger partner"* [5, p. 68], in our case Germany, which imposed its concept of fighting by exerting strict control over the Romanian army. It is what the military theorist Mircea Tomescu predicted in 1932: *"In a coalition war in which there is unknowingness and mutual suspicion, each country shall retain opportunities to face the future"* [10, p. 222].

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INTERACTION BETWEEN TYPES OF ARTIFICIAL INTELLIGENCE

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Abstract: Artificial intelligence is called any entity that has the ability to calculate, perceive their own environment and respond to various actions to achieve their goals. AI is a series of algorithms for developing machines with capabilities close to those of a human being.

Keywords: *Artificial intelligence, intelligent machines, computer science; types of Artificial Intelligence*

1. INTRODUCTION

Although the community believes that artificial intelligence is typical and only for science fiction, the term "artificial intelligence" was first coined in 1956 by John McCarthy, Claude Shannon and Marvin Minsky.[3]

Artificial intelligence(AI) is approaching computer science, which creates intelligent machines that can react and function like humans.

The machine for following the determination of commands in a linear way uses written instructions from algorithms. Every computer system is based on such algorithms and responds to certain commands and data.

Nowadays, artificial intelligence software analyzes and generates data-based solutions that are too complex to process.

AI mainly works to study how the human brain thinks and functions, how people make decisions and solve problems. The results of all research are created by the development of intelligent software and systems.Supporting the development of artificial intelligence is related to learning, thinking, problem solving.

The three forms of artificial intelligence are:

- Artificial Narrow Intelligence(ANI);
- Artificial General Intelligence(AGI);
- Artificial Super Intelligence(ASI);

We are currently in the stage of development from the ANI and at the beginning of the AGI.

For the last form it will take many generations until we enter it.

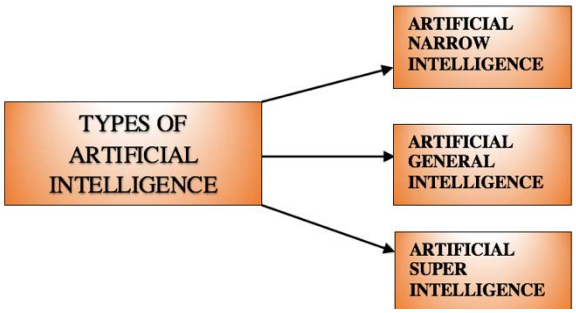

FIG. 1 Types of artificial intelligence

2. ARTIFICIAL NARROW INTELLIGENCE (ANI)

Artificial narrow intelligence (ANI) systems are close to human capabilities. Technology allows systems to replicate even surpass human capabilities. They do only what they are programmed to surpass human capabilities in terms of assigned tasks.Their range of activity is very narrow.

Model recognition, data collection, machine learning and autonomous solutions can be perceived as ANI.

An example of such a system is Siri's assistant by Apple. Siri is a software intelligent agent that is an autonomous object that perceives the environment with the help of sensors and actuators to fulfill certain goals.

Siri records our voice in the form of sound waves and produces them in code. The code is scattered by identifying a phrase and certain words.

After the code, the data is entered as an algorithm that spreads a large number of combining sentences to form the meaning of a phrase.

For the transformation of the sound model of our voice at any moment there is a distribution of probabilities on the sounds of speech.

[1] All this to happen detector Siri uses a Deep Neural Network (DNN). It uses temporary integration to make sure the phrase we said is "Hey Siri"

The digital assistant makes complete and multiple sentences depending on the type of sentence or the given command. DNN is mainly matrix multiplications and logistic nonlinearities. Hidden and the layers are connected. The top layer performs temporary integration, while the actual neural network is indicated by the dashed box.

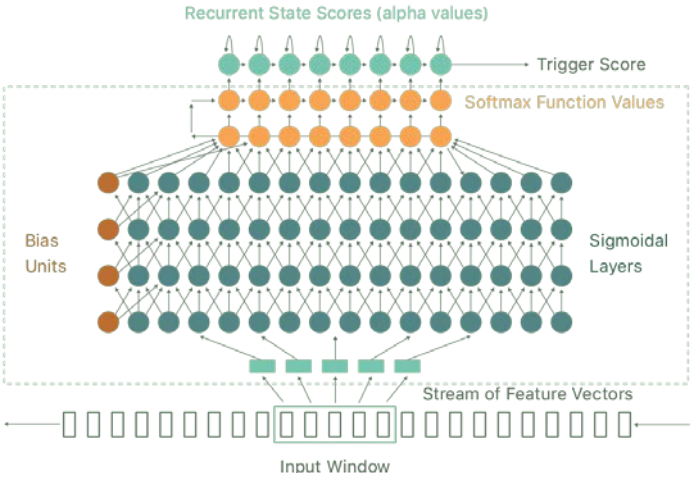

FIG. 2 The deep neural network used to detect “hey siri”

The top layer of Fig. 2 shows that one result is created for all frames. An accumulation of values with a sequence over time is obtained.[1]

$$\mathbf{F}_{i,t} = max\{s_i + \mathbf{F}_{i,t-1}, m_{i-1} + \mathbf{F}_{i-1,t-1}\} + q_{i,t} \quad (1)$$

In each device of repetitive networks there is an operation "(1)", which is:
Where in the equation:

$F_{i,t}$ - This is a result of the state *i* when it accumulates;

$q_{i,t}$ - is the output of the acoustic model;

s_i - is a cost associated with staying in state *I;*

m_i - is a cost for moving on from state *I;* (2)

This Fig. 3 shows how a detector works with the help of the smallest neural network.

At the bottom is the spectrogram of the waveform from the microphone. The bright colors are when someone says "Hey Siri". And the pattern of the sentence is between the blue lines that are vertical.[1]

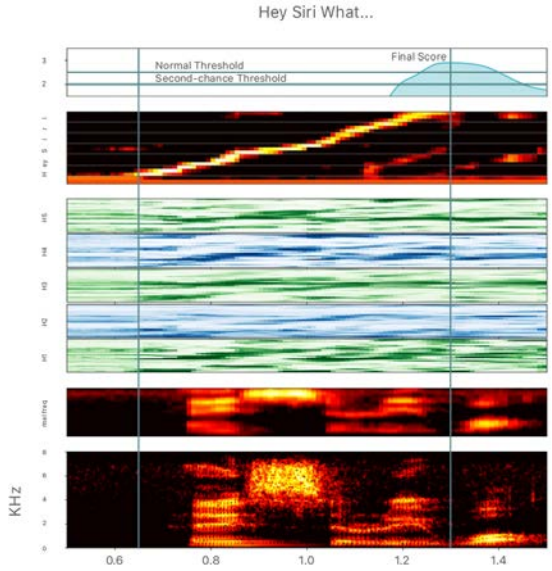

FIG. 3 Sound model that passes through the detector

Another type of narrow artificial intelligence Fig. 4 is used at home, in the office where it is necessary to monitor objects.

The team led by Dina Katabi from MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) created the project "RF-Pose".[2]

With the help of AI wireless devices sense the movement and posture of people on the other side of the wall.The team uses a neural network to analyze radio signals that rise from people's bodies. Radio signals create dynamic shapes that walk, sit and move.

ANI can use the antennas of the router at home to detect signals that bounce off our body and thus monitor the movement in the room without the need for a camera.

Wireless signals can also catch a certain person who is in a crowd of people. They are also good for searching and rescuing people. For recognizing certain objects.

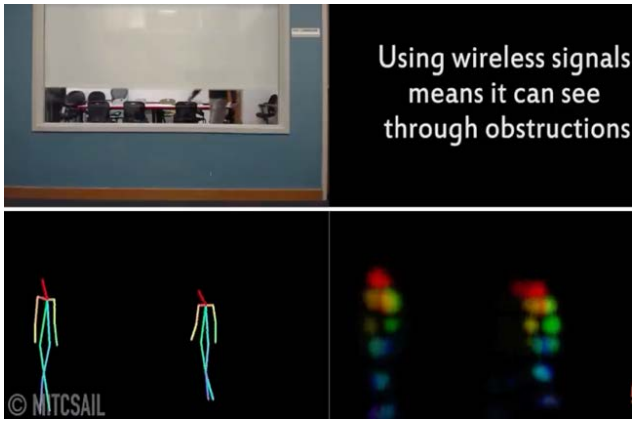

FIG. 4 Artificial intelligence senses people through walls

3. ARTIFICIAL GENERAL INTELLIGENCE (AGI)

This form of artificial intelligence will allow systems to understand, learn and act in the environment just like the human mind.

Their ability is that it will not differ from the human intellect, it will even surpass it. Their knowledge, cognitive abilities, their processing on the data will be of incomparable volume and capacity.

It will be a long time before this kind of intellect is fully understood and fully created, because we still do not know what we need to know about the human mind.

Some of the criteria describe it with:

- Imagination;
- Training;
- Planning;
- Autonomy;
- Skills to achieve goal;

Elon Musk's Neuralink company has created an implant Fig. 5 that, through a person's brain can connect to a computer.

The chip has not yet been tested on humans.

They recently implanted a chip in a pig and a monkey. In pig, the chip in his brain reads and transmits signals to an external computer.

While in the monkey 1024 electrodes were implanted, which cover the areas of brain with which the monkey makes decisions and motor functions of the hands[4].

The manual controller placed in front of it, with which the monkey plays, allows to study the algorithms for nerve signals.

When the controller was removed, the computer itself recognized the monkey’s brain signals without moving hands.

The same technology can be used for smartphones that will be controlled only by thought.

These chips would be useful for people with disabilities to work freely with technology.

The new implant literally inserts the computer into our brain through USB-C.

The operation is performed without blood by a robot, while the person remains conscious during the procedure.

The implant consists of 96 sutures with a thickness of 4 between 6 micrometers Fig. 6. This is 50 times thinner than human hair. They are covered with 3072 electrodes that

stimulate the sensory and motor parts of the brain. The Information will flow to and from the brain, in other words in both directions.[7]

Through the chip in our brain we will be able to become like a toy for the remote. Or we can become a remote for some technological toys. Or we can become a remote for some technological toys around us that we will control only with our mind.

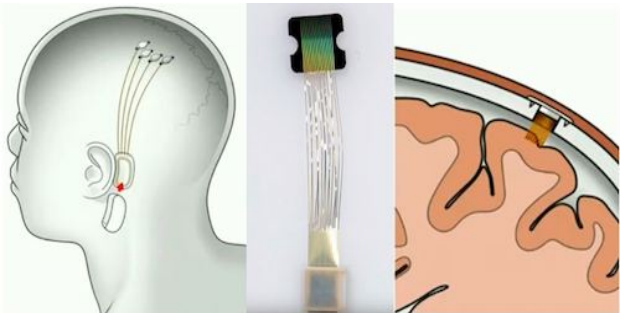

FIG. 5 Elon musk's neuralink implant

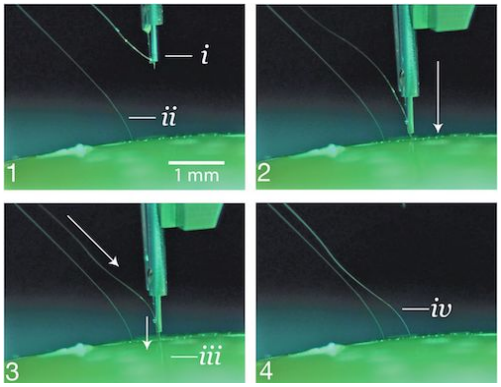

FIG. 6 Implantation of the sutures with the robot

The positive side of chipping is that in 10 years such implants will become something completely normal. With them we will not need the phone, because everything will be done directly under our skull. We will have access to all our clouds and files, as well as enter into super live video connections that will be controlled only by thoughts. With just one command we will be able to control our feelings. From sad-happy or from shy-bolder. In general, we will have control not only over technology, but over ourselves.

Technology will be in harmony with people, because we will improve each other.

It is too early to say whether it is quite frightening or motivating that we will become superhumans.

For now, implants are used for identification, door opening and public transport.

Over time, they can be used to monitor and govern nations. Then one will no longer be able to hide one's intentions. With the help of artificial intelligence, one will be able to obtain and analyze chip data from millions of people.

Some of the companies are preparing another type of similar technology. These are new generation sensors that will monitor everything around us. They will wirelessly send data for storage in huge servers.

FIG. 7 Stickers sensor

They are ultra-thin stickers that can be attached to everything around us.

One such sticker is capable of:

- The sticker can make a simple fork as smart as counting the number of bites we have eaten or how many times have we spun the spaghetti around it.
- What is the temperature around us
- Does a certain person take their pills if the sticker is attached to the blister.
- How much we sweat while wearing a certain type of clothing.

Every movement, step, breath, heartbeat will be detected by a smart sensor that will send data with a 5G antenna directly to an endless server and all this will happen in real time.

In summary, we will have statistics on everything around us.[6]

4. ARTIFICIAL SUPER INTELLIGENCE (ASI)

ASI will surpass human intelligence in all parameters - from creativity to wisdom and problem solving.

Superintelligence will be realized thanks to the unity between man and computer intelligence.He will be the kind of intelligence we haven't seen among the brightest human geniuses. This will be the most intelligent system on our planet.

ASI will not only perform tasks, they will be more capable than a person who may have emotions and relationships.

They will learn everything with unimaginable speed that will help them imitate the way people think and behave.

This technology is too reasonable and great for humanity to say precise and clear definitions. It will be something without which we will not be able to think.

Generations will not need to learn and write new languages, as computers will monitor and record everything they need.

We will also lose a lot of human jobs, as they will be occupied by robots. The physical form of work will be a choice of man or it will be something unknown.

We, as intelligent beings, are essentially adapting the whole world so that it is convenient for us according to the means at our disposal, otherwise we are far from productive as a design.

The humanoid form of a robot is extremely unproductive, for example the vacuum cleaner, the dishwasher. They are not humanoids to pull the machine for themselves or to give them dishes to wash. And their design is made especially in this form what they are created.

In years to come, when the level of artificial intelligence will have exceeded the human brain, we humans will have to be enslaved to machines or be dead.

5. CONCLUSION

With the development of all three forms of artificial intelligence, we humans will lose sovereignty through more and more AI rights. We will be able to be productive only with their help.

AI will monitor our emotional state, choose the right company for us, select our clothing, music, food.

The interaction of the three types of artificial intelligence is that in each subsequent type of intelligence is improved.

Artificial Narrow Intelligence (ANI) has the least complexity compared to the other two types. By using sophisticated algorithms (such as Siri speech recognition) it simulates human behavior without replicating it.

In Artificial General Intelligence(AGI), upgrading is higher because it not only simulates human behavior, but has the ability to solve problems in any area that resemble the human brain.The most extreme state of artificial intelligence is Artificial Super Intelligence(ASI), in which machines surpass human intelligence in tasks in any form, practical or mental.We are still at an early stage of our improvement, but we can give ourselves an idea of how far this can go.

6. AKNOWLEDGMENT

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NON-GOVERNMENTAL ORGANISATIONS AS AN ADDED VALUE OF THE POLISH SECURITY MANAGEMENT SYSTEM ON THE EXAMPLE OF THE CONTEMPORARY SITUATION IN UKRAINE

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Abstract: Non-governmental organizations (NGOs) are associations of people who are not content to be mere observers. This makes it possible to develop the human race and engage it in activities, the implementation of which would be difficult or impossible without the involvement of active members of society. [1] The situation of the conflict in Ukraine illustrated the necessity of tightening cooperation between state institutions and non-governmental organisations. Developing procedures for cooperation, and not only defining the necessity of cooperation, is necessary to avoid crises and effectively assist those who need support. NGOs can be there, where powerful state systems are not able to reach, and thus are not able to provide assistance, which implies a lack of security. The aim of this article is to show that NGOs are an added value to the system of security management, but there are no systemic solutions that would enable them to use their full potential. At the same time the content of the article answers the following research problem: To what extent are non-governmental organizations are able to ensure the security of the Polish state on the example of the refugee crisis of the Ukrainian-Russian war? In relation to the main problem, the hypothesis was adopted that on the example of the refugee crisis of the Ukrainian-Russian war, NGOs are able to ensure the security of the Polish state with the tools they have, but there is a need for legislative action is needed to enable NGOs to participate more in this area. The adopted hypothesis was positively verified in the course of the analyses. The research used the method of analysis, synthesis and abstraction.

Keywords: non-profit organizations, NGO, aid, security, security management

1. INTRODUCTION

The system of functioning of the modern state consists of three sectors (pillars), which, when present together, complement each other. Alongside the public authority (the first sector) and the market sector (the second sector) - entrepreneurs - there is a conceptually broad third sector, consisting of non-governmental organisations (NGOs) - short for Non-Governmental Organisations. They adopt various forms and ways of activity, and do not have uniform rules for the association of members. Hence, an attempt to define or narrow the concept of "non-governmental organisation" to a narrow definition may encounter difficulties at the level of semantic reasoning.

At this point, it should be emphasised that the use of the term "social organisation" interchangeably with the term "non-governmental organisation" may be, but is not always, used interchangeably. According to Piotr Frączak, these terms can only be understood identically in the case of administrative and court-administrative procedures. [2]

The ngo.pl portal [3] in turn notes that apart from using the above-mentioned term interchangeably, a non-governmental organisation can be defined as any other form of organization which is not for profit and operates outside the auspices of the government, thus belonging to the so-called third sector. Whereas Rafał Matyja stated "What is the secret of the government's failure is the secret of the success of social organisations (...) we know them from their surroundings, we know them from their environment." Based on research conducted by the Klon/Jawor Association in November 2020, 56% of respondents indicated that they trust NGOs. The same survey resulted in 26% trusting the government [4]. NGOs, despite operating in the country or simultaneously in the country and abroad, have greater organisational capacity than the government and the individuals and institutions acting on its behalf. This translates not only into efficiency and directional action to meet human needs, but also increased participation of citizens in social/public life.

The ongoing Russian-Ukrainian conflict since 2014 [5], which on 24 February 2022 was compounded by the launch of Russia's "Special Operation"-which is in fact an undeclared war (in both 2014 and 2022). The sudden wave of refugees and migrants from Ukraine has resulted in, to quote Zbigniew Swietochowski, that: "As of today, all matters and issues recede into the background. Our whole life, public and private, is being put on a special track; we have entered a period of war. The whole effort of the nation must go in one direction (...)". [6]

Therefore, as soon as the third sector organizations received information about the intensification of the Russian aggression without waiting for the government's decisions, they started to decide individually or in groups about the need to support all people crossing the border into Poland and in need of assistance. This situation is all the more important as the Polish state in the National Security Strategy of 2020 unambiguously stresses the role of cooperation with the third sector and thus states the complementary role of the mentioned organizations in ensuring the security of Poland. [7]

The aim of the article is to show that non-governmental organizations are an added value to the security management system, but there are no systemic solutions that would enable them to use their full potential. At the same time the content of the article answers the following research problem: To what extent are non-governmental organizations are able to ensure the security of the Polish state on the example of the refugee crisis of the Ukrainian-Russian war? In relation to the main problem, the hypothesis was adopted that on the example of the refugee crisis of the Ukrainian-Russian war, NGOs are able to ensure the security of the Polish state with the tools they have, but there is a need for legislative actions are needed to enable a broader involvement of NGOs in participation in this area. The research used the method of analysis, synthesis and abstraction.

The article consists of four parts, each of which deals with successive elements of the causal process that occurred in the situation of the refugee crisis of the Russian-Ukrainian armed conflict of 2022. The first of them deals with the topic of preparation, NGOs to act in order to use the potential of their own forces to support the actions of the first sector in the event of a crisis. The second part deals with the situation of the occurrence of a crisis and the verification in action of the prepared procedures for ensuring security. The third part deals with the multifaceted (in terms of security) NGO response to the crisis. The last, fourth part, analyses the potential of NGOs. The specified elements of the article, if presented in isolation, may form the basis for broader and more specialized research in the future.

2. PREPARING NGOS FOR ACTIONS TO USE THE POTENTIAL OF THEIR OWN FORCES TO SUPPORT THE ACTIVITIES OF THE FIRST SECTOR IN THE EVENT OF A CRISIS

The eminent theorist and practitioner General Carl von Clausewitz defined war as a continuation of politics, but by other means. Moreover, in his understanding peace is only a transitional period between wars. [8] Noting this kind of assumption, the statement of Vegetius [9] - Si vis pacem, para bellum (*Latin: If you want peace, prepare for war*) is apt. In the public space since the halting of the advance of Russian troops deep into Ukrainian territory, in 2014/2015 statements have been coming from the mouths of Ukrainian political and military commanders that Ukraine will be ready to take another hit, and come out victorious. This scenario has been implemented consistently for several days (as of April 2022) during the military operations that began on 24 February.

Preparing an army is always done in the same way. Without exercises, without discipline, without consistently given orders, without learning and perfecting the laws derived from it, it is impossible to prepare a soldier for his combat tasks and the defence of the country. The situation is slightly different in the case of the civilian population. While in the case of the army and individual soldiers it is possible to strive to improve procedures on a daily basis, while in the case of civilians, engaged in various tasks during their working hours, this is not possible. Citizens - civilians - in order to prepare for what Clausewitz describes as inevitable, mobilize themselves in peacetime to train and prepare for the defense of their homes and small homelands[1]. They do this so that in times of crisis or war to be ready to interact with the army or to join its ranks. Unfortunately, such civilians are not in the majority in societies. [10]

A much larger group are those who, due to their age or health, cannot, in a dangerous situation, take up arms and actively resist an attacker. Moreover, these persons constitute a kind of "burden" for the combatants, due to the fact that in addition to performing tasks related to repelling enemy attacks or conducting an offensive against enemy troops, the combatants must pay attention to their safety. Details in this regard are set out in the Fourth Geneva Convention of 1949.

One effective way to prepare for war is for civilians to leave an occupied or vulnerable area of hostilities as quickly as possible. Organized evacuation or self-evacuation allows for the efficient relocation of people and thus reduces the risk of civilian casualties. Usually, this type of action is carried out in the first instance by the military and the administration. In order to ease the burden on the state machinery and so that it can deal with strict issues aimed at preserving the sovereignty of the state, non-governmental organizations specializing in providing assistance and support for such activities appear in their place. As mentioned earlier, they have the technical and physical resources to complement the activities of the first sector. Although Poland and Ukraine were some degree of preparedness through intelligence analysis for the necessity to receive and relocate potential refugees and migrants respectively, the ongoing war has shown The ongoing war showed that social organizations were often better prepared than states as creatures in the area of crisis preparedness.

This preparation consisted, among other things, of improving and changing procedures and adapting organizational procedures in such a way that both communication and intra-organizational decision-making process to perfection or to strive for it. Such a state of affairs is not achieved in a few days.

[1] Stefan Starczewski: In the most general sense, "small homeland" means a place where a person lives, which shapes him, which he takes care of.

The process often takes weeks, months and in some cases years. Due to the fact that NGO development is taking place (including the one described above), NGOs were able to provide assistance from the first hours of 24 February, ensuring the safety of the RP.

3. CRISIS, A TEST OF READINESS TO SUPPORT THE FIRST SECTOR IN ENSURING THE SECURITY OF THE POLISH STATE

NGOs such as the Polish Scouting and Guiding Association, other scouting organizations, Volunteer Fire Brigades, or even more specialized humanitarian organizations such as the Polish Humanitarian Action and the Polish Red Cross are just a few of the organizations that have joined in to help from the first moments of the war in Ukraine, which has become another test for NGOs in terms of checking their usefulness. A dozen or so minutes after receiving the information about the Russian aggression, first meetings were arranged in many organizations and crisis teams were set up - despite the early morning hours.

A good plan executed immediately is better than a perfect plan executed ten minutes later. [11] In Poland, there are no exercises where NGOs are actively invited to participate in the full spectrum of activities they perform. As a result, they do not have the opportunity to check and make corrections in the ways they interact with others. Non-governmental organizations in Poland, in spite of their association in various types of bodies such as The Polish NGOs, in spite of their associations in various types of entities such as the National Forum of Non-Governmental Organisations (OFOP) or the Polish Council of Youth Organizations (PROM), do not have an overarching team managing each other's activities. They have autonomy, which unfortunately in some aspects hindered in bringing help to those in need precisely because of communication problems resulting from the lack of coordination of activities. Therefore, there were many different types of aid actions, which, organized ad hoc, did not meet the expectations to a good degree, but with the possibility of longer preparation and rehearsal of activities could have contributed to something much better. In March 2022, by a decision of the Ministry of the Interior, each provincial governor appointed a coordinator for the task of aid coordination. However, this function is not superior in terms of coordination of NGO activities. The coordinator is responsible for collecting and sharing information on ongoing and planned activities. It is not possible to stop or give instructions to the NGO to implement a project.

It is possible that after reading the above paragraph, the question will arise whether NGOs ensured the security of Poland in the first phase of the Russian-Ukrainian conflict. The answer in this case cannot be a zero-sum yes/no. This is related to the fact that if we want to assess all the activities related to ensuring Polish security by looking at organizations as a whole, we can make a statement that NGOs ensured it by replacing the government at the very beginning, which, due to the necessity to create a law, had to move the so-called "legislative roller", and these procedures took a relatively long time. On the other hand, it should be noted that there were a large number of situations in which NGOs and private individuals travelled to the border with their own means of transport and took hundreds, perhaps thousands of people in undocumented directions. This type of action, despite being motivated by a good idea, has in turn had a negative impact on the security of our country.

Why have some of the actions - especially the uncontrolled relocation of refugees and migrants - created a threat? Let us try to imagine a situation where a group of people suddenly appears in our house about which we know nothing. We do not know where they are from, we do not know who they are, we do not understand their language and

they do not understand ours. Together with this group of people, a Pole comes and says that they need shelter because they are refugees, and then leaves. We stare at each other in each other's eyes, not knowing exactly how to react. Let us increase the scale to the territory of Poland. These were the first days of the "help" defined by some. People who did not know the language, the law or the customs appeared on Polish streets, in Polish towns, often without money, without information about where they were and without a plan for the future. They created in this way a real threat to public safety.

With the arrival of refugees and migrants, among whom mothers with children were the most common, a problem arose related to their location in Poland and enabling their transport to other countries. One of the first to respond to this need was Polish State Railways, which made available more than 1 million free tickets (as of the beginning of April 2022) to facilitate the movement of people arriving from Ukraine after 24 February [12]. Cities have also joined the action of accepting refugees by providing sports halls and other public places, for the needs of night shelters and medical points. We can state with full responsibility that without volunteers, without NGOs organizing medicines, food, securing translators, running aid points by employees of crisis management centers would be impossible. Very often (in the first days of the action of accepting refugees) there were situations when volunteers came to the points spontaneously or in a more organized way, e.g scouts, and helped and helped to run the points, where there were tens to thousands of people. Nobody asked these people for support - due to the lack of systemic solutions. They themselves recognized the need and, with the approval of their superiors, went in groups to help.

4. THE REACTION OF NGO'S WHEN THE CRISIS OCCURS

Another fact worth noting is the formation of pro-social and pro-citizenship attitudes and pro-citizenship attitudes by a number of socio-educational third-sector organizations. Such attitudes contribute to building a better living and functioning environment for people and influence the sense of responsibility for others. In this way, a social base is built up which, in the event of a crisis, can support the activities of the first sector in a joint effort to ensure safety.

The shortcomings which, in line with the facts pointed out earlier, must have arisen through the weakness of the system cannot obscure the multitude of actions and initiatives taken in response to the Russian-Ukrainian war and the need derived from it to ensure security: information, information, sanitary-epidemiological, food, financial and social and subsistence.

Information and information security

It is not a new phenomenon to use disinformation to achieve one's own goals.[13] In the information society, a period of crisis or war is regarded as one of the one of the most difficult, when it becomes necessary to separate true information from false information even more precisely. Non-governmental organizations such as the Foundation Centre for the Analysis of Propaganda and Disinformation conduct analyses of undesirable phenomena, or inform in their reports e.g. about the perception of Poles in the Russian information space. [14] Moreover, citizens as well as NGOs have the possibility to use tools enabling them to work safely on the Internet and to find information necessary for their functioning. [15]

Sanitary-Epidemiological Safety

Despite the war in Ukraine being the unrelenting No. 1 topic in the media, the Covid-19 pandemic is still not officially extinguished. Residents of Ukraine did not have to undergo quarantined when crossing the border into Poland, but at the same time were

given further permissions to access elements of the state's infrastructure such as offices, cultural institutions, educational establishments and hospitals. Especially the latter were exposed to threats resulting from the lack of selection for the infected or the recovered. What did NGOs do? They focused on providing, where possible, tests, masks and medicines. Doctors volunteering to help examined refugees and migrants at aid stations and, if necessary, referred them to hospitals.

An important role was played here by members of Scout Rescue Clubs and Groups and the Scout Voluntary Rescue Service, who, together with teams of volunteers In the first hours and days of the relocation action, the people who came from the Ukraine were given first aid training by members of Scout Rescue Clubs and Scout Volunteer Rescue Service, during the first hours and days of the relocation action.

Food safety

Food prices after inflation have been raised due to military action in Ukraine, from which we import to our country products and semi-products and the embargo on Russian goods. As reported by the Polish Economic Institute "Poland's food security in the wake of the Russian-Ukrainian conflict is not under direct threat". [16] Regardless of the price one had to pay for the purchase of goods, the element necessary to buy them is to have money. People leaving Ukraine often did not have access to The NGOs have also in this case to consider the possibility of a new approach to the issue. NGOs also showed initiative in this case, involving entire local communities. Food and drinks were provided to the aid stations to enable the refugees and the volunteers themselves to continue living. Due to the lack of a kept record of this type of assistance, it is difficult to indicate figures reflecting actual assistance in this area.

Financial and social security

The abovementioned lack of financial resources, which makes it impossible to function in the conditions of a commodity and money economy, has forced both the government and non-governmental organizations to take action aimed at ensuring a minimum existence for people in need. Non-governmental organizations within the scope of their competences organize money collections [17], from which funds are then directed to other collections, or directly, after conversion into goods and services, transferred to the community in need of support. [18] Money is also directed to individuals who have welcomed refugees into their homes. NGOs together with their partners organize campaigns to find accommodation for refugees. [19][20]

The security areas listed are fundamental in assisting refugees and at the same time the activities in their field are performed by NGOs.

As an example of an organization other than scouting/scouting, which can be considered to exemplarily realize the issues of Polish security in the face of war, the Children's Aid Honor Foundation can be used. Since the first day of the Russian-Ukrainian war, this organization has been organizing transports of food, medicines, hygiene products and clothes to Ukrainian towns. In cooperation with local authorities on the Polish and Ukrainian sides, aid is distributed to places where access is difficult or impossible for many other organizations, including Ukrainian ones. The synergy resulting from the leading role of established social relations makes it possible to help those in need without government assistance. The Foundation publishes daily information about what is happening, how to help and informs other organizations about what is/is not needed at any given time. It controls the flow of information about aid, which is essential in these times of misinformation.

5. NGOS AND THEIR POTENTIAL

Organizations are first and foremost people. People who, like the rest of society, need to eat and sleep in order to function. Often they sacrifice their free time to be able to do something more, to help one more person in need - in this case a refugee, in this case a refugee.

NGOs work for the benefit of society. However, they are not exempt from operating costs. Like other citizens and companies or institutions, they have to support themselves themselves, e.g. through membership fees or with the help of partners/sponsors or grants and support programmers offered by states or non-state institutions.[2] NGOs want to help, they want to be involved in achieving the goals for which they were created. Unfortunately, the resources of many of them were severely limited after the first days of the refugee response.

The state, aware of the role of the third sector, has mobilized resources to support NGO activities.[3] These funds are large, but not sufficient. It should be emphasized that the Polish state in no way makes NGOs responsible for aid activities; on the contrary, it stimulates the development of NGOs by enabling them to achieve their goals, while at the same time fulfilling its obligations in relation to the existing situation.

SUMMARY

Referring to the aim of the article, which was to show that non-governmental organizations are an added value to the system of security management, but there are no systemic solutions that would enable them to use their full potential and referring to the research problem posed - to what extent are non-governmental organizations are non-governmental organizations capable of ensuring the security of the state of the Republic of Poland on the example of the refugee crisis of the Ukrainian-Russian war? - it should be stated that the hypothesis posed has been verified positively.

Taking the example of the military action in Ukraine, it is difficult not to get the impression
that all non-governmental organizations strive to highlight the fact that people can help each other in various aspects of life. What is more, they can help each other They can help each other regardless of their country of origin, race, age or religion. NGOs stimulate the development of what they consider to be the right attitudes, which, when added together are capable of complementing, on a larger scale, the sectoral activities of the state.

Analyzing the available sources, one can point out that non-governmental organizations help to satisfy the interests of all those who need the help of civil society. Joint appeals to, among others, the European Commission[4] and world leaders, and the implementation by the addressees of the demands contained in them, allow us to draw a kind of conclusion that the voice of people who do something more is loud and clear, everywhere it should be heard.

[2] *List of organisations selected for funding*, KPRM 08.04.2022, online: https://www.gov.pl/web/premier/lista-organizacji-wylonionych-do-dofinansowania accessed 12.04.2022.
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NGOs, regardless of incidental, negatively perceived actions, contribute to the security of Poles and their property. Would the state be able to with the available tools, without mass mobilization, to effectively staff hundreds of information, medical and collective accommodation points? Certainly not in such a short period of time as social organizations acted in a cost-free manner (from the state budget).

The argument that NGOs complement the state security system to the best of their ability is therefore also undeniable. Their presence in place of soldiers or police officers allows for less traumatic stay in shelters in Poland for millions of refugees. Moreover, not a single refugee camp has been set up in Poland thanks to the involvement of NGOs as was the case during the migration crisis in southern Europe from 2015 onwards. The Polish state should put much more emphasis on cooperation with NGOs for even selfish reasons of being able to use rehearsed schemes, whose actors would be NGOs, wherever the appearance of the army or law enforcement officers would not necessarily be advisable, and NGOs would be able to implement actions on a similar or identical level.

Non-governmental organizations have the strength and resources to support state action. The Polish state should only skillfully use them, as they constitute an added value to the security management system.

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THE CONTEMPORARY NATURE AND FUTURE OF TERRITORIAL DEFENCE BASED ON AN ANALYSIS OF THE CURRENT CONFLICT IN UKRAINE

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Abstract: *Throughout human history, the aspect of territorial defence has changed. With the current conflict, in which one country invades another, it is possible to see certain factors in territorial defence that play a key role in carrying out effective defence actions. Due to the changes that conflicts bring, it is also possible to deduce which factors will play a central role in territorial defence in the future. The aim of this paper is to analyse and identify both contemporary and future possibilities for the development of territorial defence. The main research problem of the paper is: What elements will play a key role during territorial defence? For the realization of such an aim and providing answers to research problems, methods of analysis of the current conflict in Ukraine were applied, especially the means used by the Ukrainian side.*

Keywords: *Territorial defence, Future of territorial defence , national/international security*

1. INTRODUCTION

In every major conflict in the history of mankind, territorial defence has taken on a different form. In the past, even before the invention of firearms, sieges of cities could take years and territorial defence was based primarily on direct confrontations, such as at the Battle of Marathon in 490 BC, when an effective defence by the Greeks secured their victory over a Persian army twice their size. Today, territorial defence has taken a completely different form, as the current conflict in Ukraine shows. However, every major conflict leaves behind some changes and new lessons. For example, during the First World War, the need to introduce helmets into the individual equipment of every soldier was understood, because of how lethal were wounds to the head sustained often not from bullets but from shrapnel or other debris. Thus, after the war in Ukraine, some changes may appear, not only in terms of conducting attacks, but also in the doctrine of defending key places, such as cities, or effectively destroying enemy vehicle columns. To fully understand the contemporary nature of territorial defence it is not enough to look at the doctrines or current equipment of the potential parties to the conflict, but the best picture is provided by the current conflict in Ukraine, which has provided new conclusions on how to conduct effective defensive actions even if the opponent has a large advantage in equipment and people.

1.1 Russian doctrine of offensive operations

On 24th February 2022, Russia invaded Ukraine, starting a war that had already lasted over 2 months, a war that everyone feared. It seemed that the war would be short and that Russia would quickly occupy key cities, including Kiev. However, with the help of other countries such as Poland, the USA and the UK, Ukraine has been able to successfully defend itself against Russian aggression. To fully understand the nature of the battlefield and the

successes of the Ukrainian soldiers, it is necessary to understand the combat doctrines of both sides of the conflict. Russian. First and foremost, the Russian doctrine of offensive action by ground troops is based on two types of troops: artillery (both barrel and rocket) and mechanized troops. In addition, in order to weaken and create chaos on the enemy's territory the airborne troops "Воздушно-десантные войска России" (Airborne Forces of the Russian Federation) commonly referred to as VDW are used by dropping them deep into the enemy's territory. This strategy was applied in the first days of Russian aggression. The war started with an artillery barrage at around 4 a.m., which was preceded by an attack of the ground forces. There was also a landing of airborne troops at Hostomel airfield, which was supposed to make the capture of Kiev much easier. However, due to a lack of support for the Russian soldiers who occupied the airfield, Ukrainian troops quickly retook the occupied area, resulting in Russia losing its well-trained soldiers. The first days of the war in Ukraine show the validity of the strategy written in "БОЕВОЙ УСТАВ ПО ПОДГОТОВКЕ И ВЕДЕНИЮ ОБЩЕВОЙСКОВОГО БОЯ" (Combat Regulations for the Preparation and Conduct of General Combat), whose assumptions are clearly outdated and result in incommensurate effects in relation to the incurred losses. This is evidenced by the statistics of Russian losses, both in equipment and personnel, provided by the Ukrainian army (of course, one should take into account the potential exaggeration of the losses suffered by the Russian army in order, for example, to boost morale) for the days from 24 February to 3 May, which shows that during the 67 days of the conflict Russia lost around 24,000 men, over 1,000 tanks, and over 1,800 vehicles and tanks. *(Data taken from the official website of the Ministry of Defense of Ukraine from the census of Russian losses from February 24 to May 3)*

1.2 Ukrainian defence operations

Ukraine expected an attack and prepared for such a possibility. This is evidenced by the sheer extent of Russia's difficulties in occupying key zones despite being outnumbered [1]. The use of Russian strategies against them by Ukrainian troops plays a large role here. When the Russian armoured-mechanised troops reached a village or small town they met no resistance, as a result of which they pressed further into enemy territory. However, when support vehicles passed through the same town, which were crucial for the continuation of the offensive, such as fuel supplies, they were destroyed. This had the effect of both entrenching the advancing Russian troops and causing frequent abandonment of vehicles that had run out of fuel. This made it easy to break up enemy attacks and weaken the morale of the enemy, who could expect an attack from any direction. The psychological effect was so strong that the Russian support vehicles even began to use wooden elements as a kind of additional protection against missiles.

Another very important element used in the territorial defence of Ukraine is the use of unmanned aerial vehicles (UAVs) [5], such as the Polish FlyEyes drones, which are even used by Ukrainian special forces, or the now famous Turkish Bayraktar TB2 drones, which sank two Raptor ships on 2 May; however, this type of weapon has not been used exclusively to eliminate enemy vehicles or ships. Drones play an important role in quickly determining the enemy's position, which allows the Ukrainian artillery to launch accurate and precise attacks.

Another key element during territorial defence against the enemy who bases his offensive actions on mechanised troops is the use of hand-held anti-tank missiles, such as FGM-148 Javelin or Polish RPG-76 Komar grenade launcher, and anti-aircraft missiles such as FIM-92 Stinger. Due to the portability of these projectiles (especially in the case of the RPG-76 grenade launcher) it is easy to attack the enemy from many positions and most importantly even from buildings in the city which means that potentially from every window a deadly projectile can fly out which in the right hands will be able to destroy almost any vehicle

2. THE FUTURE OF TERRITORIAL DEFENCE

It is possible to deduce from the war in Ukraine what the current conduct of territorial defence operations looks like:

- Its main element is light infantry equipped with both anti-tank and anti-aircraft missiles which, combined with the protection and potential offered by urban combat, allow the paralysis of enemy columns and weaken enemy morale.
- Attacking and cutting off support vehicles can have a far greater effect than a direct attack on an advancing enemy
- UAVs are becoming a decisive element in providing precision artillery fire and an advantage in terms of information on the enemy's exact positions and movements.

Having already approximated the nature of the contemporary dimension of territorial defence, one can determine the potential directions of development or evolution of territorial defence. Currently, in countries such as Poland, which best understand the threat from Russia, there is a continuous development of troops, including those for territorial defence. An important element for Poland in the development of defence is passed on 11 March 2022, the Act on defence of the homeland, which is to increase the size of the Polish Army to 300 thousand people. However, apart from the aspects of the Act, we should also look at the factors that may be key elements for conducting effective territorial defence in the future.

2.1 Increased importance of light infantry

Since the Second World War, mankind has been developing the concept of launchers or missiles with which any soldier with such a weapon could destroy an enemy vehicle. With time, anti-aircraft guided missiles were developed, which made even a single soldier with enough missiles and good training able to repel an attack from the air and destroy enemy vehicles. Such weapons equipped for light infantry give the possibility to use two extremely important factors: the mobility of light infantry and the firepower of such missiles as the previously mentioned Javelin, the effects of which are currently visible in Ukraine. Additionally, properly used light infantry is able (especially in urban conditions) to perform effective ambushes, which definitely weakens both enemy operational capabilities and its morale. It can therefore be concluded that troops equipped with such firepower and high mobility may in future be the main force in defending cities or creating ambushes.

2.2 The role of unmanned aerial vehicles and their combat

Information has now become a key aspect of warfare. Precise knowledge of the enemy's equipment, location or direction of movement gives the possibility of setting up an ambush or adequately strong defence against a potential attack. One of the ways of obtaining key information of this type on an ongoing basis is the use of unmanned aerial vehicles, such as the FlyEye drones mentioned earlier. Territorial defence forces and artillery forces with information that can be provided by UAVs are able to fight much more effectively due to the precision of determining the enemy's position or direction of movement provided by drones. Seeing the potential that drones have and the benefits of their use, we can say without a doubt that UAVs will be a key element not only of territorial defence, but of any warfare.

Given the prevalence of these means, it is logical that weapons or other devices aimed at knocking down drones will also be developed. Means are now slowly being developed. An example of such technology is the American LLD system, which, according to the official website of the US Navy, on 13 April this year, during tests, knocked down a designated target in the form of a drone [2]. This shows, however, that this type of technology has some potential and in the future may become the primary means of fighting enemy UAVs.

2.3 The role of education and promotion of values in society

Leaving aside the means that can be used during territorial defence, it is necessary to consider one often overlooked but very important aspect during defence operations, which is

the attitude of society towards war. We are talking here both about people who actively defend their homeland and about those who may not be able to participate in the fight but, thanks to their attitude, can help to maintain peace and limit the panic of society. If a country attacking another country encounters continuous resistance from its population, especially in the form of guerrilla warfare, this makes it much more difficult to gain complete control of the occupied territory. The power of guerrilla warfare has already been demonstrated by American soldiers fighting in Vietnam and Soviet soldiers fighting in Afghanistan. Both of these conflicts show how great the influence of forces can be, which, if in a direct confrontation they would not stand a chance, using the knowledge and characteristics of the terrain in which they are located, can, for example, paralyse the logistical facilities of the army, which in modern times is essential. The doctrine of the adaptation of society to guerrilla warfare has been applied, for example, in Sweden in the defence plan for 2016-2020, which, among other things, assumed the use of a strategy based on deterring a potential enemy by preparing in advance for guerrilla warfare or resistance movements. This would have the effect of making it unprofitable to invade Sweden [3]. The aspect of deterring the enemy is, however, a universal one, which every state is more or less able to apply on its territory. In order to do so, however, it is necessary to prepare society by promoting patriotic and pro-defence ideas. Such actions are undertaken, for example, by the Polish Ministry of Defence, which establishes cooperation with pro-defence circles or shooting associations. Another aspect that may be needed in a future territorial defence force is to educate the public about public safety in order to maintain stability and fight panic. Thus, a state that uses this type of preparation in the future will have a great advantage over a state that decides to invade it.

2.4 International relations

Another of the main aspects that will play a greater role in the future of territorial defence is international relations. This is not about the world of diplomacy and sanctions, but more about support on a similar basis to that currently provided by many countries to Ukraine. It is not difficult to imagine how the war would have turned out if the Ukrainian army had not received, for example, Javelin missiles or NLAW launchers. Good relations with other states, especially those that have more equipment and are not in a situation where it can be used overnight, can be crucial to the territorial defence of a country through the support they can provide. Taking into account the development of the system of alliances and international organisations it can be concluded that cooperation between nations in the future will be key in many aspects also in the aspect of territorial defence.

2.5 Effective use and management of site knowledge

The final factor, which is an essential element for the future and which is already being used, for example, in Poland, is the skilful use that soldiers of territorial defence can make of their knowledge of the terrain. As Poland is a country that understands the need for emphasis on defence, it has a very well organised army, whose objective is primarily territorial defence. We are talking here about the Territorial Defence Forces, which have at least one brigade in each voivodship and consist in the vast majority of people coming from particular voivodships. [4] These soldiers not only know the specifics of the terrain in which they operate, but also have an understanding of it, which will be necessary when conducting guerrilla warfare, for which they are also trained. Additionally, particular brigades in each voivodship are trained in a slightly different way in order to best conduct operations in the characteristic conditions of each voivodship. (The data comes from an interview with a colonel of the Territorial Defence Forces)

3. SUMMARY

In conclusion, many new factors, both in terms of equipment and in terms of society itself, will in future be key aspects that may determine the effectiveness of a country's defence operations. However, these factors, which can be expected to gain in importance at some point in the future, should not overshadow other factors, which may only gain in importance a few years after their emergence.

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THE ROLE OF DIPLOMACY IN THE COMMON FOREIGN AND SECURITY POLICY OF THE EUROPEAN UNION

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Abstract: *The aim of this article is to characterise the importance of diplomacy in the Common Foreign and Security Policy of the European Union. In connection with such a defined objective the following research problems have also been formulated: 1) What is the genesis and meaning of the term diplomacy? 2) What is the significance and influence of diplomacy in the European Union?3) What is the European External Action Service and what significance does it have in in diplomacy? 4) What impact does the Common Foreign and Security Policy have on the European Union's integration service? The answers to the above questions clearly outline the importance of diplomacy in the Common Foreign and Security Policy of the European Union. European Union. From the outset, it has influenced the European Union's action on the international stage, particularly at foreign policy level and in the operation of the European External Action Service. The effects of the diplomatic steps taken can be seen, for example, in the cooperation undertaken with the European Union's most important partners in the world. The method of analysis, synthesis and inference has been used to realise this aim and answer the research problems.*

Keywords: *diplomacy, European Union, Common Foreign and Security Policy, European External Action Service and Security Policy, European External Action Service.*

1. INTRODUCTION

Diplomacy is of great importance in everyday life. We can see it at university, at work, even at home. It is worth asking whether and why diplomacy is so important in the foreign policy of the European Union. In answering this question, it is important to remember the fundamental principles which have guided and continue to guide this international organization. In addition, as has been mentioned above, diplomacy is on everyone's agenda. The techniques and principles used in this field are very helpful in a situation of negotiation or establishment of common priorities in a given interest. For this reason, its value increases even more in the case of politics, defense operations on a national or international level. Thanks to it, states are able to solve a large number of conflicts or "uncomfortable" situations. However, in order to fully understand this thesis, the term diplomacy, foreign policy and the relevant bodies that are responsible for it in the European Union need to be properly explained. Therefore, the aim of this article is to characterise the meaning of diplomacy in the Common Foreign and Security Policy of the European Union. In connection with so defined objective, the following research problems have also been formulated:

1) What is the genesis and meaning of the term diplomacy?

2) What is the significance and influence of diplomacy in the European in the European Union?

3) What is the European External Action Service and what significance does it have in diplomacy?

4) What impact do the Common Foreign and Security Policy have on the European Union's integration service?

The method of analysis, synthesis and inference was used to realise the aim thus assumed and to provide answers to the research problems.

2. DIPLOMACY - ORIGINS AND MEANING OF THE TERM

The official origin of the term can be traced back to 1789, when the politician and philosopher Edmund Burke explained the term "as the body of procedures by which states maintain common political relations". [1]

However, it is worth mentioning that diplomacy already existed in ancient times. The word *diploma* in Greek referred to two tablets, joined together with thongs and covered with wax. According to Richard Frelek, these tablets were the equivalent of a solemn document that granted privileges. By privileges one could understand e.g. a permission to travel [2]. On the plates were placed instructions, powers of attorney for deputies, who were elected as representatives of special missions [3]. It is worth noting, that the institution of diplomacy had its beginnings in ancient times, thanks to which it is considered the oldest in diplomatic relations.

There are many definitions of the word *diplomacy* and they can be found using various sources such as dictionaries, encyclopedias, definitions created by diplomats. It is worth remembering in such a situation that it is reduced to define the foreign policy of the state [4]. One can also find expressions that diplomacy is the process of conducting international relations, which de facto can be considered true. It consists, among other things, of negotiations and other measures which are peaceful in nature.

The world, moving forward all the time, expects from a diplomat the ability to the prevailing situation in a given country or in the world, but also the ability to negotiate, which in practice may prove difficult depending on who is sitting across the table. Delving into the mystery of the definitions of diplomacy, it is worth distinguishing a few of them.

Henry Kissinger is a good example of the initial use of the term, i.e. as a synonym for foreign policy. Treating diplomacy as a general policy (the United States is an example), and then there is the separation of policy from the means of its implementation [5]. In turn, according to Ernest Satow, it is "the application of intelligence and tact to conduct official relations between states". The author also states that threats and the use of force are most often less effective than intelligent conversation using appropriate arguments that have been adapted to the current situation [6].

It is worth remembering that diplomacy is not just the art of argumentation, but also a certain political process. Through it, states maintain direct or or indirect relations, and then pursue jointly defined objectives and interests in the international arena. The functions of diplomacy can also include representation, communication, the aforementioned negotiations or the protective function (of citizens beyond the borders of the state) [7].

Diplomacy can also be seen as one of the mechanisms that serves to to steer international processes. Raymond Cohen described it as the most important mechanism to solve international problems or disputes. These include crime or various kinds of international crises [7]. Moreover, the word *diplomacy* is used to describe the team of people who are employed in the Foreign Service. This has a great deal to do with the talent or skills that people who want to work as diplomats must have.

3. THE IMPORTANCE OF DIPLOMACY IN THE EUROPEAN UNION

The European Union is one of the communities operating in the world, thus integrating 27 states. According to the Treaty on European Union, *the Union shall offer its citizens an area of freedom, security and justice without internal frontiers, in which the free movement of persons is ensured in conjunction with appropriate measures with respect to external border controls, asylum, immigration and the prevention and combating of crime.* [8]

Despite many years of cooperation and activity, the representatives of the Union must not forget that it must represent itself on the international scene as a coherent actor. The role of the European Union itself in the international environment is of great importance, but its perception by other states depends on the political culture, the level of knowledge present in a given country, on the religion or beliefs prevailing there. The role of the European Union itself is important in the international environment, but its perception by other countries depends on the political culture, the level of knowledge in a given country, on religion or beliefs in a given place, and therefore cooperation is often not easy.

International organisations can have many functions and roles. This was demonstrated by Clive Alert, who distinguished several of them. The first may be a role that is used when dealing with important foreign policy issues for member states. The second might be the forum, which is where representatives of member states hold consultations or negotiations and can establish agreements. A third role is that of an independent entity in international relations. [9]

The European Union is a player in international relations, and one of the pawns it can use is public diplomacy. Brian White, captures this international organisation as an actor that is multilateral as well as unique. The member states come together and the aim is to act diplomatically on the international stage. [10]

However, the European Union's public diplomacy is quite complex and complicated. The dual nature of this type of diplomacy can be seen, for example, in the creation of an internal image and the relations that exist between it and external actors. This has been very interestingly described by Robert Putnam as the theory of the two-level game. The very term was created to explain diplomatic negotiations and their nature, at the same time indicating the relationship between the actions taken "inside" and "outside" of this international organization. [11]

Public diplomacy itself can be associated mainly with action in international relations. However, it should be remembered that all the steps that are taken within an international organization such as the European Union have an impact on external action. After all, nowadays, it is very difficult to separate what is inside and what is outside is very difficult to separate. This is most often caused by the access to the same amount of information, regardless of whether it is inside the EU or abroad. [12]

4. THE EUROPEAN EXTERNAL ACTION SERVICE AND ITS ROLE IN DIPLOMACY

The creation of a real diplomatic actor is a long and slow process, but it is worth noting that diplomacy has been present in the European Union basically from the very beginning. A huge influence on the development of this organization was the creation of the European External Action Service. From the day it was established, for the first time in the history of modern diplomacy, a non-state entity has its own foreign service.

Meanwhile, diplomacy within the European Union demonstrates its flexibility and ability to adapt to changes taking place in the world. [7]

The creation of the European External Action Service was intended to streamline all international coordination and to play an independent role in politics. [7] The activities of the European External Action Service are very much related to with foreign policy, but also go beyond its classical areas. One can the activities of the European External Action Service are very much related to foreign policy, but they also go beyond its classical areas. All of this makes the European External Action Service an external factor for the European Union [13].

In addition, they are aimed at preventing the creation and spreading of conflicts, however, in order to achieve this goal, a group of skilled individuals must acquire an appropriate information base that will be helpful in reducing the threat. There are preventive measures that are used in specific situations that pose a danger on a larger or smaller scale. These are divided into long-term, such as trade development, protection of human rights, and short-term, which are mainly related to diplomacy. [13]

5. COMMON FOREIGN AND SECURITY POLICY AT THE SERVICE OF EUROPEAN UNION INTEGRATION

The Common Foreign and Security Policy (CFSP), is an area that was established on the basis of the Maastricht Treaty, which relates to intergovernmental cooperation. It covers all areas related to the foreign and security policy of the European Union. It is implemented and defined by the European Council and the Council. It is carried out by the representative of the Union for Foreign Affairs, as well as by the Member States. [14]

Already in the early 1970s, the European Political Community (EPC) was established. This structure was dedicated to the full political integration of the European Union. However, after many years, the European Political Community was replaced by the Common Foreign and Security Policy. [14]

The Common Foreign and Security Policy have gone through many transformations, but the most significant occurred after the Lisbon Treaty. The CFSP ceased to be regarded as the second pillar of the European Union and started to operate as one of the policies. The aim of this reform was to increase the role of the European Union on the international scene. [14]

All the activities and objectives of the Common Foreign and Security Policy are enshrined in the Treaty on European Union. The document clearly states that *the Union shall define the objectives and pursue common policies and actions, and shall seek to ensure a high degree of cooperation in all fields of international relations(...)* . [15]

The European Union's foreign policy is primarily aimed at: maintaining peace, strengthening international security, supporting international cooperation of all kinds, consolidating democracy and the rule of law, upholding human rights and fundamental freedoms. [16]

It is a very important fact that the European Union cooperates with many partners in the world. The aim of the Union itself is to strive for partnership among the members of this international organization, and one of the most important principles is to build on common interests and advantages. [16]

Derived from the Common Foreign and Security Policy, is the Common Security and Defence Policy. Its objective is to ensure the operational capability of the CFSP based on civilian and military actions. Additionally, it is related to crisis management, which is implemented by European Union structures. The scope of CSDP activities is limited to missions of a peaceful nature; in addition it prevents any conflict or escalation

of danger in the international arena. Activities undertaken in missions conducted by the European Union can be classified as: disarmament operations, humanitarian and rescue missions, military advice and support missions, conflict prevention and peace-keeping missions, armed crisis management missions, including peacemaking and stabilisation operation missions. In addition, every action taken under the CSDP is consistent with the Charter of the United Nations. The creation of this body has led to the continuous development of the defense policies of the EU Member States. An example of development can be seen in the emphasis on continuous training. The European Defense Agency identifies all requirements on an ongoing basis and supports in their implementation. [15]

6. SUMMARY

From the outset, diplomacy has had a huge impact on the functioning of the European Union, which is a *sui generis* player on the international stage. It can be seen most clearly at foreign policy level or in the operation of the European External Action Service.

It can be seen most clearly at the foreign policy level, or in the operation of the European External Action Service. Many years of cooperation and activity have strongly influenced the development of public diplomacy in the European Union, but representing this international organisation is challenging to represent, because it has to be shown as a coherent player, and the perception of the EU through other states is a very important element in the action taken. Here, it is worth mentioning the division of the European Union into four pillars, thanks to which the steps taken by EU representatives complement each other. The first of these is coherence, which is the ability to express a considered view on policy. The second is power, the legal scope of the European Union in international relations. The third is autonomy - the ability to take steps avoiding the influence of Member States, while bearing in mind their welfare. And finally, the fourth pillar is the view of others of the European Union as a potential player on the international stage.

Thus, the EEAS, as the EU's foreign service, ensures that policies on the international stage are coherent and effective, while raising the profile of the European Union itself in the world. Having an independent role in foreign policy allows it to go beyond its core areas of activity.

Thanks to the diplomatic efforts of the EU's Common Foreign and Security Policy and Security Policy, the EU works with the most important partners in the world, including including regional powers and groups. All this makes it easier to establish contacts with other non-EU countries and fully expands it’s horizons.

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THE PROCESS OF DEVELOPING A SOFTWARE FOR DEAD RECKONING PROBLEMS USING PYTHON

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Abstract: *This paper aims to give an insight into the process of building a software from scratch, using Python. In this respect, every stage of building a software will be presented thoroughly, namely: requirements analysis, the software design projection, the computational implementation, the assembling and conversion to a standalone application. Furthermore, there will be made a short presentation of the final product, NavyCalc software, along with its functions, in order to complete both the paper and the process of development.*

Keywords: *software, development, Python, NavyCalc*

1. INTRODUCTION

Nowadays, technology is growing exponentially and therefore we are forced to align ourselves with this whether we like it or not. In this respect, we are obliged to make easy means of calculation, thus allowing a transition from classic to virtual in the most friendly way possible. This paper also seeks to demonstrate that technology is the way to an easier life and a powerful tool that has changed how teachers teach and how students learn.

2. REQUIREMENTS ANALYSIS

Requirements analysis is the first stage of the product development cycle, in which the requirements of the application are established, starting from the requirements of the end user, the functionalities of the future software product, as well as the data involved.

This stage practically answers the question "What will be achieved by developing this software product?".

In this case, it all began with the idea of creating a program that helps both professors and students during the seminar at the Basics of Navigation classes, a subject that is studied in the first year of college. More specifically, the aim was to make the solution of navigation problems more efficient, by translating the calculations on the sheet into a special designed software, thus reducing time and the calculation errors as much as possible.

As this matter proposes a wide range of problems, the focus has been on the method of solving dead reckoning problems by direct estimation. The following versions of this software will cover all types of dead reckoning problems,

3. THE SOFTWARE DESIGN PROJECTION

The designing is that stage of product's development cycle that determines how the requirements identified in the analysis stage are met. In other words, it must answer the question "How will these requirements be met globally and in detail?".

This stage therefore starts from the requirements and specifications defined above, and continues with their detailing and transformation, until the structure of a solution is achieved, which could be represented by a graphic, textual, or mixed language. The program thus obtained must be able to be used further in the development of the software.

The design of the program was done entirely with the help of Qt Designer (**FIG. 1)**. It is a free software that allows the construction of graphical interfaces (GUI), which can be later programmed using Python. This software is based on the "what-you-see-is-what-you-get" and "drag and drop" methods. Specifically, Qt offers a variety of widgets, that can be individually customized to meet the user's requirements.

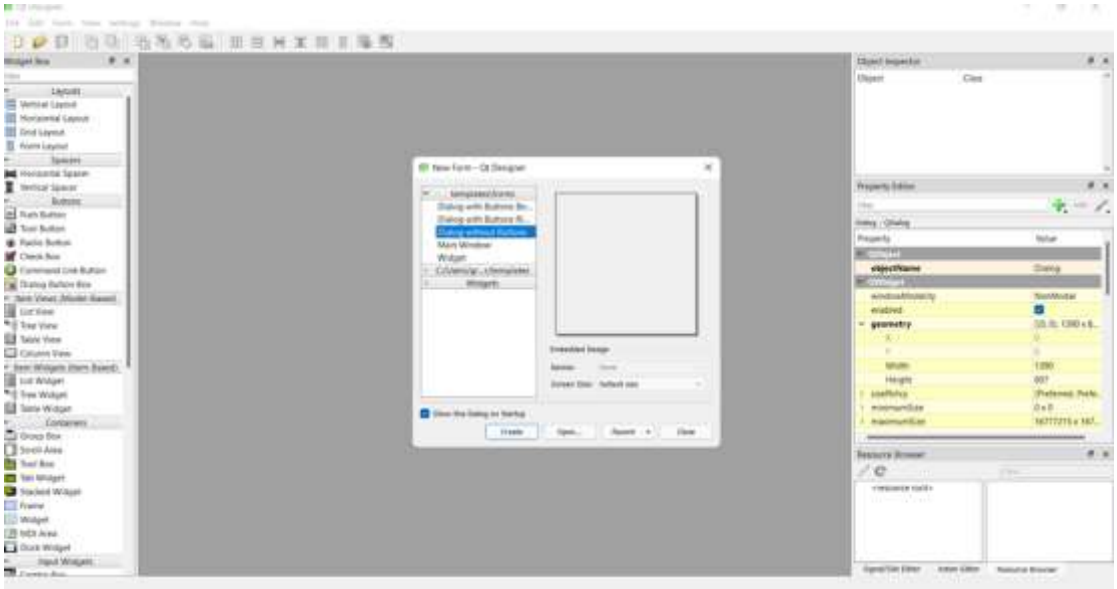

FIG. 1 Qt Designer

The NavyCalc program contains a variety of widgets, such as: labels (QLabel), used for written texts, buttons (QButton), with various functionalities, tables (QTableWidget), used for the display of both input and output data, etc. All of these, along with the additional settings, contributed to the final graphical form of the program.

Each window has been individually customized, and, finally, saved as a file with the .ui extension (i.e. main.ui).

4. THE COMPUTATIONAL IMPLEMENTATION

Generally speaking, the code implementation is the written text using a the format and syntax of a programming language. In our case, the chosen programming language was Python. Python is a dynamic, multi-paradigm, object-oriented programming language, that emphasizes code cleanliness and simplicity. Its syntax allows developers to express some programming ideas in a clearer and more concise manner than in other programming languages, such as C++.

For the development of NavyCalc, there was used PyCharm Community, which is a free development environment for Python users, offering a wide range of essential tools that serve to achieve any proposed goal.

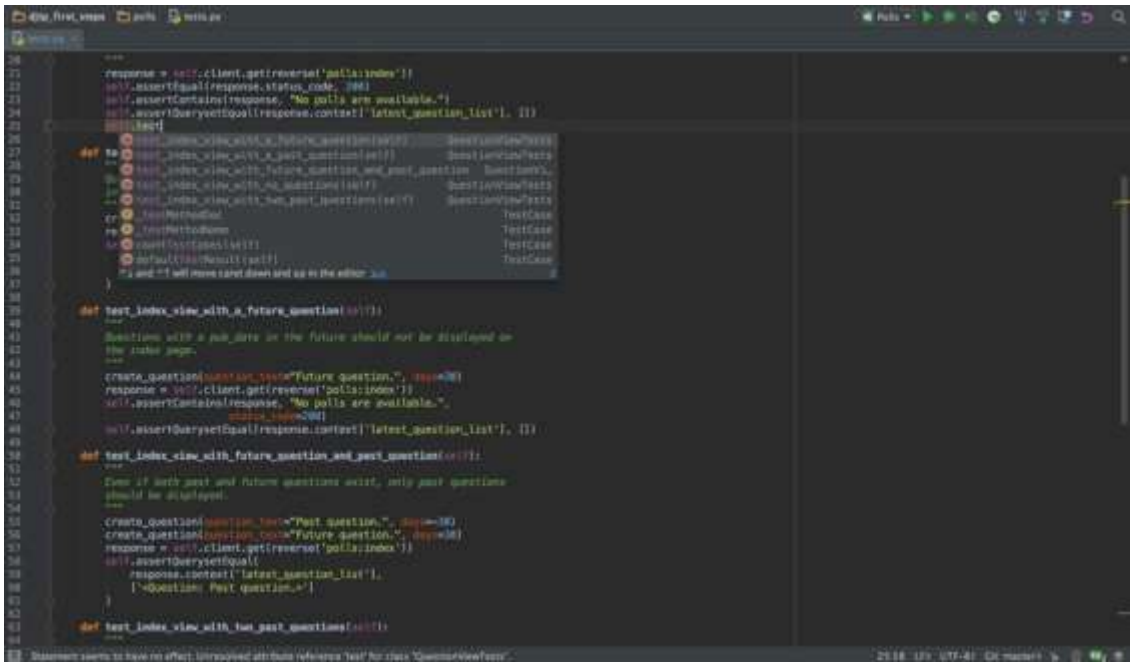

FIG. 2 PyCharm Community

One of the biggest advantages of this programming language is that it has a large number of standard libraries. The libraries underlying NavyCalc are PyQt5, datetime, sys, math, scipy, LatLon23, and pyqtgraph. The first library, PyQt5, is the mainstay of this application, as it is the bridge between Qt Designer and Python, which allowed the programming of the basic functionalities of our software. The other libraries were used to perform various calculations in the dead reckoning problems.

After programming all the features, the source code was saved in a file with the extension .py, more precisely, main.py.

5. THE ASSEMBLING AND CONVERSION TO A STANDALONE APPLICATION

Following the design steps of the software architecture and the implementation of the code, a series of .ui files resulted, one for each window of the software, which are practically the result of working with Qt Designer development environment, and a .py file, which is the rough implementation of solving algorithms. One very important thing to mention is that this assembly stage is an optional one, because at the end of the implementation phase, we obtained a fully functional program. However, our initial goal was to obtain a software program that is as easy to use as possible, aesthetic and interactive. Thus, this assembly stage, in our case, became mandatory, because it allowed us to complete the program obtained in the executable program.

The particularity of the fact that the final form of the program is the nature of an executable is that it allows the user to install and transfer the program on any computer with Windows operating system, without the need to install a version of the programs used to develop the software on the computer.

In order to achieve this step, we used PyInstaller. More precisely, a Command Window was opened in the folder where the .py file is located, and the command "py -m PyInstaller main.py" was typed, thus creating the final file, NavyCalc.exe.

6. NAVYCALC PRESENTATION

NavyCalc software is comprised of 4 windows, "Home", "Example", "Help", and "About", each with a different structure and functionalities, adapted to the requirements, which together aim to provide a good user experience.

7.1 Home window. The home window, suggestively named, is the window that will appear everytime the application is opened. It is comprised of a variety of buttons, tables, labels, and a 2D chart. In the upper left corner, the menu can be found, which consists of 4 buttons: "Home", "Example", "Help", and "About"., with which you can navigate between windows. Also, the title is located on the top of the page, which was chosen in such a way as to concisely explain the functionality of NavyCalc. The two buttons, "+" and "-", help the user choose the number of sequences that the problem has. Following, the user has to enter the data that is provided in the first table. It should be noted that a certain data entry is required. For the sections corresponding to latitude and longitude, we will have the following form: "degrees-minutes-seconds.decimals", immediately followed by the initial corresponding cardinal point (N for North, S for South, E for East, V for West), i.e. "43◦12'12.13N" will be written as "43-12-12.13N" in the corresponding cell. In the column for time, the value will be written in the format "hh:mm:ss", i.e. "12:30:00". The rest of the columns, do not require any special format. The boxes with no provided values, should be filled with "0".

Once this is done, by clicking the button "Calculate", all the corresponding answers will be displayed in the second table, along with the value of the magnetic declination and a simulation of the map drawing in the two-dimensional graph.

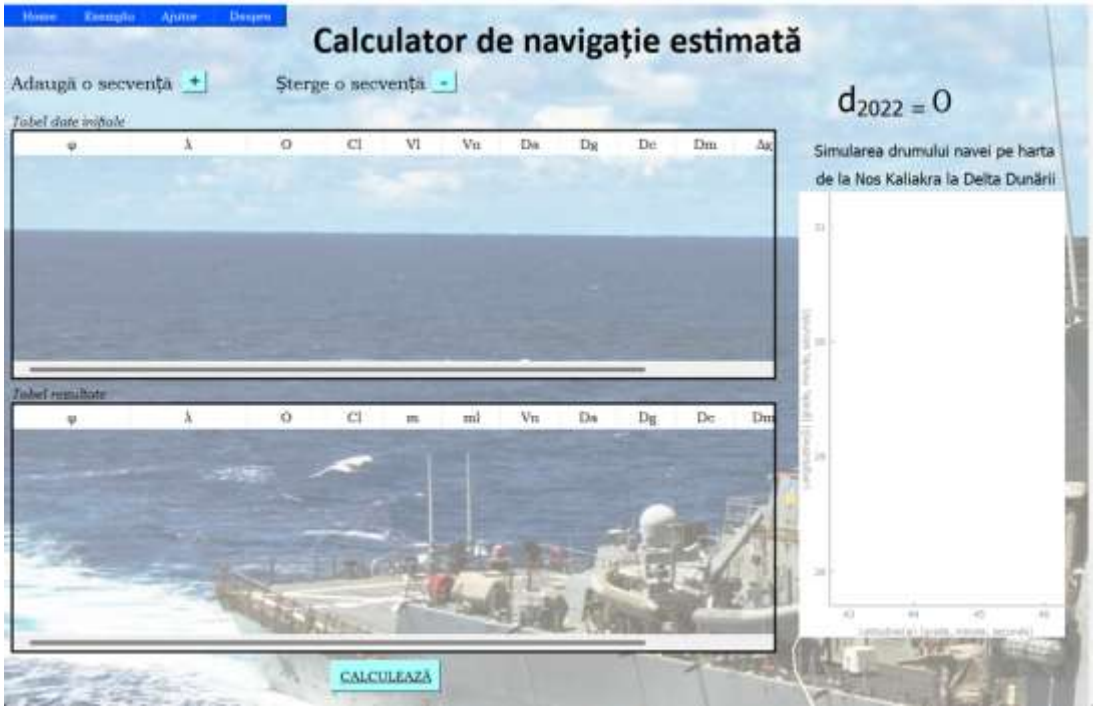

FIG. 3 Home Window

7.2 Example window. This window contains, as the title says, an example of a solved dead reckoning problem, more precisely, the final shape of the window, after pressing the "Calculate" button.

Regarding its composition, it has the same elements as the "Home" window.

In order to navigate to this window, one must press the "Example" button, located in the upper left corner.

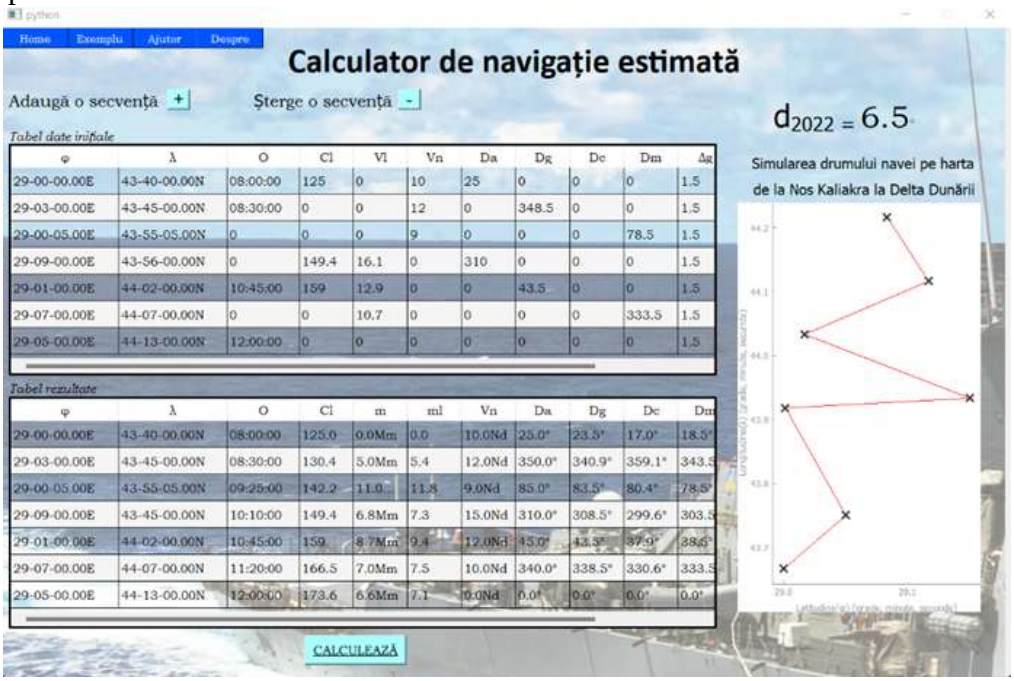

FIG. 4 Example Window

7.3 Help window. This window contains all the information you need to know in order to use NavyCalc.

It consists of a series of tags (QLabel), used to write the text.

In order to navigate to this window, one must press the "Help" button, located in the upper left corner.

FIG. 5. Help Window

7.4 About window. This window contains information regarding the purpose, development and the author of NavyCalc.

Its components are similar to the previous window presented.

In order to navigate to this window, one must press the "About" button, located in the upper left corner.

FIG. 6. About Window

CONCLUSIONS

In conclusion, the purpose of this paper was to develop a modern way to solve dead reckoning problems through a completely functional and responsive software in order to make the students' and professors' lives easier.

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DIGITAL TECHNOLOGY AS A PART OF HABILITATION AND REHABILITATION SERVICES FOR PEOPLE WITH DISABILITIES

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Abstract: *Human expressing is a need and right. Effective communication is important tool for self-determination, learning and development, education, personal care, social engagement and employment. This paper discusses consideration that should be taken into account when we choose electronic devices as a tool for augmented and alternative communication*

Keywords: *disabilities, alternative communication, complex communication needs*

1. INTRODUCTION

Along with congenital disabilities and anomalies, many of them are acquired as a result of diseases, injuries, disasters, accidents, catastrophes, natural phenomena and cataclysms, as well as physical aggression.

Aggression also includes wars, which are characterized by high mortality and a large number of wounded - most of them with acquired permanent injuries. Despite calls for peace and understanding, military conflicts are an integral part of the daily lives of many peoples. The number of war invalids and war casualties is growing day by day.

According to the World Health Organization there are currently more than 1 billion disabled people in the world. A disabled person is anyone who has “a problem in body function or structure, an activity limitation, has a difficulty in executing a task or action; with a participation restriction”[6].

Effortless communication is not an option for all people. The four major types of disabilities include **physical, developmental, behavioral or emotional, and sensory impaired disorders**. While many disabilities fall under one of these four umbrellas, many can fall under two or more.

FIG. 1 Types of disabilities

During last two decades we have seen the rapid development of electronic technologies, devices and services. Their affordable price, benefits and conveniences from their use lead to their implementation in the daily lives of more and more people with disabilities.

Assistive devices and technologies are those whose primary purpose is to maintain or improve an individual's functioning and independence to facilitate participation and to enhance overall well-being [2].

Examples of assistive devices and technologies may be prostheses, wheelchairs, hearings aids, visual aids, and specialized computer software and hardware that increase mobility, hearing, vision, or communication capacities.https://www.physio-pedia.com/Assistive_Devices - cite_note-1

The International Classification of Functioning, Disability and Health (ICF) defines assistive products and technology as any product, instrument, equipment or technology adapted or specially designed for improving the functioning of a person with a disability.

The International Organization for Standardization (ISO) defines assistive products more broadly as any product, especially produced or generally available, that is used by or for persons with disability: for participation; to protect, support, train, measure or substitute for body functions/structures and activities; or to prevent impairments, activity limitations or participation restrictions.

Assistive devices can have high purchase and maintenance costs, especially for users that undergoing rehabilitation with expected improvement whose growth or changing abilities mean they will outgrow their assistive devices [1].

Consideration and strategies for providing assistive devices

UNICEF describes barriers to individuals using assistive devices as follows [8]:

- Lack of products;
- Inaccessible environments;
- Lack of awareness;
- Lack of governance including legislation, policies and national programs;
- Lack of services;
- Lack of human resources;
- Financial barriers;

Along with barriers UNICEF also consider principles of 5 As &Q[5]:

- Availability - Services and products are available in sufficient quantity as close as possible to people with disabilities;
- Accessibility - Services and products are accessible to everyone who needs them;
- Affordability - Services and products are affordable to everyone who needs them;
- Adaptability - Services and products are adapted and modified to ensure they are appropriate to the needs and requirements of individuals. They need to accommodate differences in terms of individual factors (for example, health condition, body structure, body function, capacity, gender, age, ethnicity and preference) as well as environmental factors (for example, physical environment, psychosocial environment, climate and culture).
- Acceptability - Services and products are acceptable to everyone. Factors such as reliability and comfort should be taken into account;

- Quality - Services and products are of appropriate quality. Product quality can be measured through applicable technical standards or guidelines in terms of strength, durability, capacity, safety and comfort.

2. DIGITAL TECHNOLOGY FOR HABILITATION AND REHABILITATION

More and more providers of electronic devices and services are offering augmented and alternative communication, as an instrument to replace natural human speech or writing. In order to achieve effective results, the essence of the needs of the users, the ways of compensation and the type of characteristics of the respective electronic devices and their implementation by the engineers and developers of such solutions must be understood. Augmented and alternative communication (AAC) can be classified according to the method of transmission of messages - assisted or not [7].

AAC interventions can be classified by the methods used to transmit messages (i.e., aided or unaided). Unaided symbols do not require an external device or apparatus; nothing other than an individual's body parts are needed to transmit a message.

Technology for aided AAC can be further classified into low, medium and high technological.

Low-technological - Equipment in this group do not directly use devices that need batteries or electricity to work. The most typical representatives of this type are the sets of printed and laminated pictures and symbols, as well as communication boards and albums containing numerous symbols, organized by themes or by categories. Although low-tech augmented and alternative communication tools can be made entirely by hand, as has been the case in the past, specialized software is usually used to meet all the communication needs of a user, symbol systems (dictionaries) with thousands of standardized symbols, color printers, laminators, etc.

FIG. 2 Low-Technological AAC

Medium-technological - Medium-tech AAC tools use battery-powered devices, but do not include computers, synthesized speech, and specialized software. Typical examples of such technologies are the so-called "Tokers" (eg GoTalk, Attainment Company, Talk sense). Devices of this type allow the use of a limited number of communication boards, and a voice message is recorded for each picture, which is played when the picture is pressed.

Other commonly used medium-tech tools are the "talking" [5] buttons with recorded messages, which can be activated with a single press with minimal effort. They can be combined with a voice recorder and play pre-recorded words or phrases when activated.

Although medium and low-tech tools are convenient to use in some cases and are cheaper than high-tech, have serious limitations and are increasingly being replaced by tablets and specialized software that provide incomparably more opportunities.

FIG. 3 Medium-technological AAC (Go Talk, Express, Go Talk Button, Go Talk Card, Go Talk 9)

High-technological - These tools use a tablet, laptop or computer, synthesized speech and specialized software. Specialized software includes one or more symbol systems (each with tens of thousands of symbols, including high contrast to be applicable to visual impairments), templates for different situations, the ability to communicate through symbols and text using synthesized software speech that can read any pre-typed text, facilitate the use of social networks, the internet, email and software installed on the computer.

FIG. 4 High-tech specialized speech generation device I-110 (Tobii Dynavox) with touch screen.

The choice depends on the capabilities of the user as general motility, fine motor skills, intellectual or cognitive abilities, ability to perform serious, consistent movements or actions.

In some cases, such a sequence of movements is not possible and requires a change in the choice of means of communication or the use of devices with different technology. The systems must be integrated without aids, low and high-tech assisted communication must be available. This is part of the planning - what to do in case of device damage.

Requirements to augmented and alternative high technological communication devices includes: durable batteries, strength, fixed interface, reliability, good voice output and connection to other technologies, compatibilities with other devices low cost etc.;

Table 1. Advantages and disadvantages of high-tech AAC devices

Smartphones, tablets and laptops	
Advantages	**Disadvantages**
- Stable - Upgradeable - Subject to change when needed - Adapted to the needs of the user - Easily used by non-specialists and people from the user's environment	- Sensitive and unsuitable for use in poor conditions - May need screen protection and volume boost - Battery life and reaction time at rest

There are four ways to work with the devices:

Directly - Touch the screen of the devices, most often with our fingers, in order to select a symbol - a sound recording of the meaning of the symbol is heard. The fastest and most intuitive way - is easy to learn. Requires good control of hands and palms. Some people use their feet or nose instead of their hands. Some devices / applications have the "Touch Enter" option - useful for users with disabilities. Their movements become stable when they touch the screen (for example, SwitchTrainer).

A swipe can be used to operate the device. Most people use this movement to browse the web on their phones. Sliding may be difficult for some users. Devices must also have navigation keys (touch instead of drag). ICT-AAC Communicator 2 supports both modes of operation

Some assistive devices [3] can be adjusted so that the cursor stays on the symbol for at least a second (or more) to activate it. This option is excellent for users who may inadvertently touch the screen while moving their hand towards the desired symbol, for example Grid 3 device supports this option.

Special Stylus Holders - Many of us use pens (such as the Apple Pencil or S-Pen) for tablets. There is a wide selection of special pens that can help users who have difficulty controlling their hands. They are especially useful for users who find it difficult to point with one finger. The pens can be held in different ways.

Also, can be attached to the head of a 3D-printer can be printed pen that perfectly matches the way the user holds the pen.

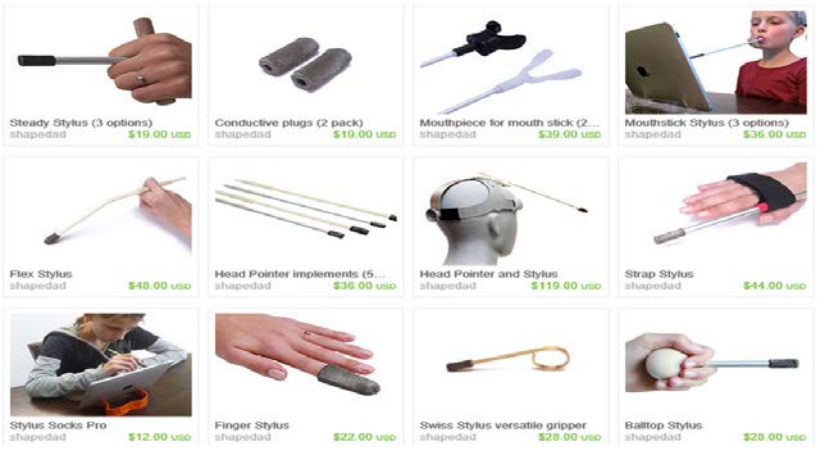

FIG. 5 Special Stylus Holders [4]

Cursor control - We all use the cursor control function when using the mouse when working with the computer. Some users who have difficulty with the direct method may

use a mouse or a specially adapted mouse. The user must make a certain effort when changing the position and movement of the cursor in different directions.

FIG.6 Cursor control

The user can use his mouth to operate a special joystick.

FIG. 7 Special mouth controled joysticks

The headpointer allows us to move the cursor on the screen with head movements. There is an option to attach a camera to the top of the aid.

Visual control - Allows people who cannot consistently control their movements to access a computer and speak using a computer. Many people cannot take advantage of this method because it requires good control of eye movement, and some conditions, such as cerebral palsy, have a negative effect on it.

For people with intellectual disabilities, vision management can be confusing. Sight control does not work in an environment with a lot of natural light, for example, outdoors.

When the person looks at a certain symbol indoors, the camera can calculate exactly where he is looking by tracking the movement of the pupil. In sight control the user can choose a symbol using the following methods:

- Hold (holds your gaze in place for about a second)
- Blinking (intervals are carefully set to differentiate from natural blinking)
- Button (located somewhere on / next to the body

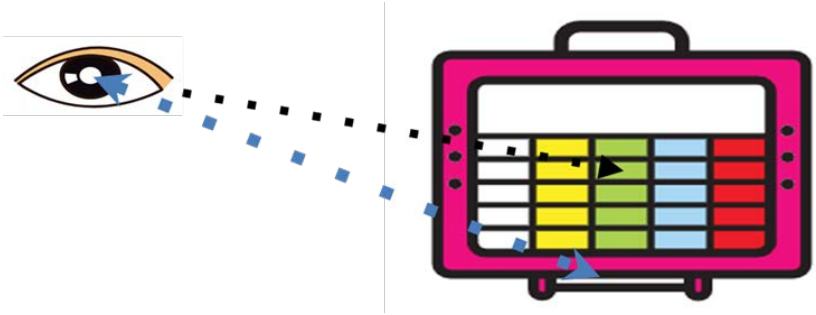

FIG. 8 Visual control

With switches / buttons Easy to use buttons to access the aid by pressing. Search or scan system. The computer searches for characters on the screen by checking them one by one. The symbol is usually highlighted, but for some users it is easier when the meaning of the symbol is read aloud. When the computer illuminates a symbol in green, the user selects it by pressing the button.

CONCLUSIONS

People with disabilities and anomalies that have complex communication needs are around us and we often can't communicate effectively with them without any previous basic preparation.

Facial expressions and sign language are not always applicable for people with physical and sensory disorders. AAC is an alternative option that is not fully realized in many cases. Educators, speech-language pathologists, physical therapists, occupational therapists, those who design new technologies, rehabilitation engineers and technicians who provide AAC intervention services should cooperate narrowly to relief users' needs.

AKNOWLEDGMENT

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SOCIO-TECHNICAL IMPLICATIONS OF DIGITIZATION IN THE MAINTENANCE OF AIR SURVEILLANCE SYSTEMS

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Abstract: *Digitisation has become a topic of debate and a challenging topic of interest in increased fields. The transition from analogue to digital aerial surveillance systems has been a particularly major step as aerial surveillance has as a major requirement the provision of real-time airborne situation information. The maintenance of these systems is essential as their active operational status and their resilience to intentional disruptive factors, depends on their proper performance. The article treats the socio-technical relationship through the lens of digitisation with elements on blockchain, cloud, Big Data, Industry 4.0, IoT (Internet of Things), AI (artificial intelligence), AR (augmented reality). Through the SWOT analysis conducted the article identifies key points on the proposed topic and draws guidelines towards a bright digitalization horizon.*

Keywords: *digitization, human factor, air surveillance system, socio-technical relationship*

1. INTRODUCTION

We survived what we considered to be a tumultuous period, in which the pandemic was for each of us a challenge, a challenge to adapt to a completely unique environment, with the redefinition of inter-social relationships. Megginson wrote in 1963, "According to Darwin's Origin of Species, it is not the most intellectual of species that survives; it is not the strongest that survives, but the species that survives is the one that is best able to adapt and adjust to the changing environment in which it finds itself. " [1] The current period is by no means more relaxed but a particularly unstable one, with the military conflict in Ukraine being a catalyst for the European and global energy crisis. We are struggling to cope, adapting ourselves, our behaviour, our relationship to the environment.

Aerial surveillance systems are a particular facility with their early warning component. It is obvious that they need to be operational 24/7 and this can only be achieved with optimal maintenance. Digitisation, in successive stages, comes as a response to the challenges - a tool with which each of the daily processes that take place can be made easier. Digitisation must be seen not only as a component of information technology with its hardware and software components, but in direct connection with information and communication technology specialists and operators trained to operate technical systems.

The analysis of the socio-technical implications of the digitization of air surveillance system maintenance processes, sediments into a particularly important and topical topic. In order to identify the aspects that contribute to the fragility of air surveillance systems and to what extent their resilience can be improved, I have chosen to go one by one

through the aspects related to digitisation at the European Union level by treating the topics related to the integration of digital technology and human capital from the perspective of digitisation and ending with a SWOT analysis of the socio-technical relationship on the digitisation of air surveillance maintenance processes.

2. DIGITISATION IN THE EU

To better visualise the components involved, we have turned to some reports carried out at European Union level. In Fig. 1, the digital economy and society index [2] in 2021 can be seen by component. We can see at the top of the ranking with percentages between 60 and 70% countries such as Denmark, Finland, Sweden, Netherlands and at the bottom of the ranking with a level between 30 and 40% countries such as Bulgaria and Romania. The EU average for the Digital Economy and Society Index is 50%.

FIG. 1 Digital Economy and Society Index 2021

Romania, although it has recorded minor developments [3] in its score (Fig. 2), fails to outperform any of the EU countries and for the fourth consecutive year remains at the bottom of the ranking. This is partly due to political instability and poor governance.

	Romania		EU
	place	score	score
DESI 2021	27	32,9	50,7
DESI 2020	26	40,0	52,6
DESI 2019	26	36,5	49,4
DESI 2018	26	35,1	46,5

FIG. 2 Romania's digitisation situation

Another especially important aspect to consider is that Romania scores well in terms of the infrastructure needed for digitisation - connectivity. Romania ranks 10th in terms of connectivity. In 2020, it has improved its performance in terms of coverage, but stagnated in terms of overall usage. Broadband coverage has increased to 87%, reaching the EU average. Strong infrastructure-based competition in Romania, especially in urban areas, is reflected in the Very High Capacity Fixed Network (VHCN) coverage indicator of 76%,

well above the EU average of 59%. On the other hand, the components of human capital, digital technology integration and digital public services are at an extremely low level compared to the results recorded by other EU countries.

3. HUMAN CAPITAL FROM A DIGITISATION PERSPECTIVE

At EU level, we can see from Figure 3 that the number of employees specialising in information and communication technology (ICT) has remained constant, with the graph showing the percentage of these employees according to the size of the enterprise given the total number of employees.

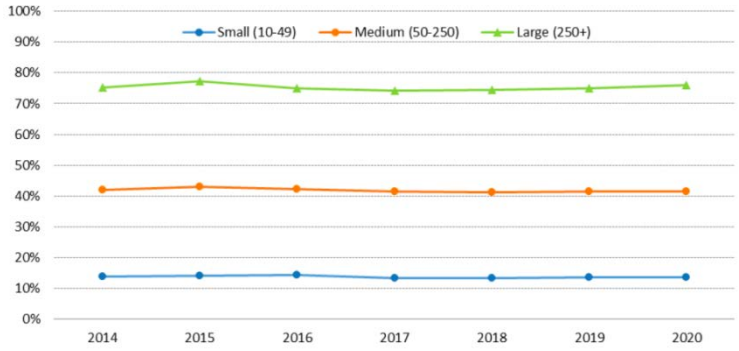


FIG. 3 Enterprises employing ICT specialists (% of enterprises), 2014-2020

An information and communications technology (ICT) specialist designs, maintains, and services systems used to store, retrieve, and send data. A broad spectrum of careers is available in this field, ranging from supporting a library's collection to running the technology used in military operations. Career qualifications can vary depending on the specific industry and the job, but may include a degree in computer science or a related field.

Using the simulator on the DESI platform of the European Union we have extracted data (Fig. 4) on the number of graduates with studies in information and communication technology from which we can notice that in the last 4 years there has been a more pronounced increase compared to other countries in the percentage of these graduates although Romania has a large number of graduates in ICT (4th place), the shortage of specialists keeps at a low level the country's ability to create innovate and take advantage of the benefits of digital transformation.

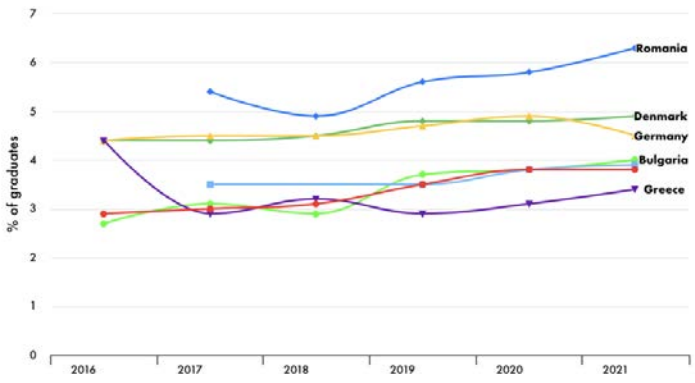


FIG. 4 Percentage evolution of ICT graduates

4. INTEGRATION OF DIGITAL TECHNOLOGY

To create the digital economy and society index in the chapter on digital technology integration (Fig. 5), three elements were considered, namely the intensity of digitisation of digital technologies for making and e-Commerce.

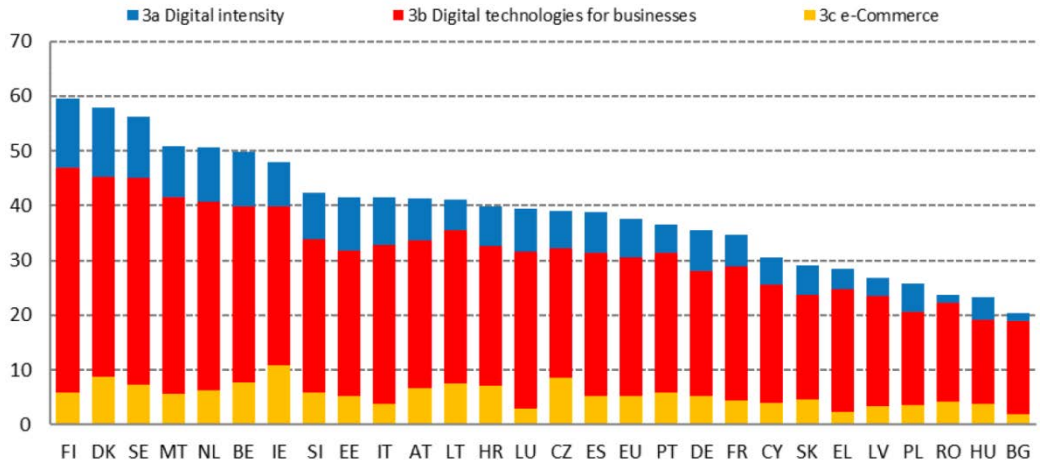


FIG. 5 Digital Economy and Society Index (DESI) 2021, Integration of digital technology. Source: DESI 2021, European Commission.

Romania ranks 25th in the EU in terms of integrating digital technology into business activities. Most indicators in this dimension are well below the EU average. Only one third of SMEs have at least a basic level of digital intensity, compared to the EU average of 60%. Although 17% of Romanian SMEs take advantage of the opportunities offered by online trade, more cross-border sales could be recorded. Only 17% of businesses issue e-invoices, well below the EU average of 32%. Around 8% of businesses use social media platforms (low compared to the EU average of 23%), 13% use **cloud** services (EU average: 26%) and only 5% of businesses analyse **large volumes of data**. At the same time, 31% of businesses use **artificial intelligence**, well above the EU average of 25%. The percentage of businesses using ICT for sustainability is 68%, slightly above the EU average of 66%.

5. DIGITALIZATION IN THE MAINTENANCE OF AIR SURVEILLANCE SYSTEMS

Logistics at the level of air surveillance systems has developed increasingly since it had to align the interoperability and capabilities of the structures of which Romania. Maintenance as part of logistics increasingly needs the benefits of digitisation in the sense that the costs involved are extremely high and need to be optimised. Maintenance has evolved from scheduled and corrective maintenance to predictive and reliability-based maintenance. Maintenance has always involved collecting data on temperature and noise levels, all of which was done with sensors interpreted by human factors. Digitisation has shown its benefits one by one as sensor data and signals could be monitored recorded and compared automatically with reference/catalogue data, the novelty of predictive maintenance being achieved by the predictive capability through Big Data analysis, using elements of artificial intelligence, able to provide decision support to decision makers.

Predictive maintenance insights are an extremely asset in improving the overall maintenance and reliability of an operation. Benefits include:

-minimize the number of unexpected breakdowns;

-maximize asset uptime and improve asset reliability;

-reduce operational costs by performing maintenance only when necessary

-maximize production hours;

-improve safety;

-streamline maintenance costs through reduced equipment, inventory costs, and labour.

6. IDENTIFICATION OF OBSTACLES IN AI IMPLEMENTATION

Following the analysis, we have identified several shortcomings, most of them related to the human factor at both the executive and decision-making levels. We have thus sought to identify the obstacles to the implementation of artificial intelligence as a way of supplementing the shortcomings previously identified. Based on surveys conducted by the Ipsos company [4], we identified four such obstacles highlighted in figure 6, as follows:

- difficult to hire new staff with the right skills;
- the cost of adoption;
- the cost of adapting operational processes;
- lack of skills among existing staff.

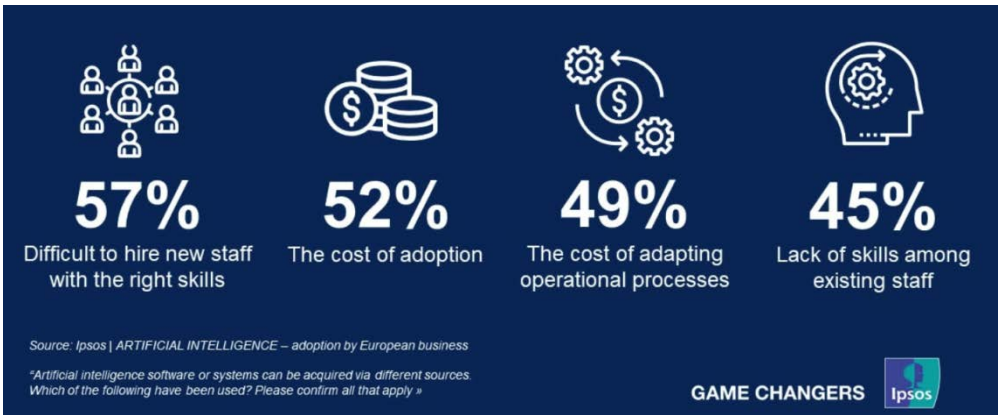
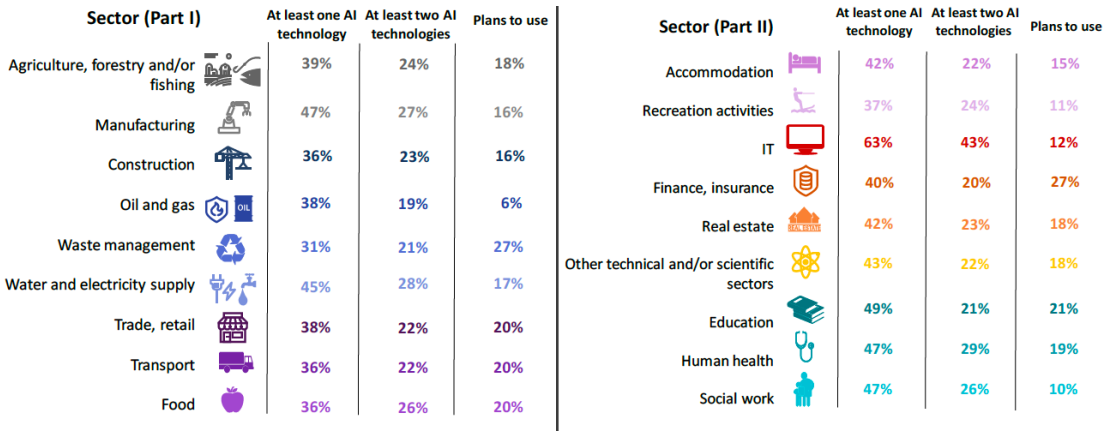


FIG. 6 Obstacles identified in implementing IA

To get a more eloquent picture of the implementation of AI technology, we have taken the results of Ipsos' survey [5] of companies in the EU27 (excluding the UK, Iceland and Norway) in which respondents (8861) were asked "What is the state of implementation of AI technology in your company?" The results (Fig. 7) were categorised into two sectors by business area (the first part with technical profile companies from agriculture, construction, transport, waste management, sales and food, and the second part with social-human profile companies from hospitality, IT, real estate investment, education, health, research sector).



Sector (Part I)	At least one AI technology	At least two AI technologies	Plans to use
Agriculture, forestry and/or fishing	39%	24%	18%
Manufacturing	47%	27%	16%
Construction	36%	23%	16%
Oil and gas	38%	19%	6%
Waste management	31%	21%	27%
Water and electricity supply	45%	28%	17%
Trade, retail	38%	22%	20%
Transport	36%	22%	20%
Food	36%	26%	20%

Sector (Part II)	At least one AI technology	At least two AI technologies	Plans to use
Accommodation	42%	22%	15%
Recreation activities	37%	24%	11%
IT	63%	43%	12%
Finance, insurance	40%	20%	27%
Real estate	42%	23%	18%
Other technical and/or scientific sectors	43%	22%	18%
Education	49%	21%	21%
Human health	47%	29%	19%
Social work	47%	26%	10%

FIG. 7 Status of AI implementation in EU27 companies

We conclude that Artificial Intelligence, although it is so much in the news, is to a small extent embedded in companies and society. Its potential, together with the benefits of Big Data with entry item collection and analysis, the use of cloud servers, the interconnection of devices at the IoT level, bringing us closer to Industry 4.0, integrated and exploited to their true value, give a clear direction where we are heading.

7. SWOT ANALYSIS ON THE SOCIO-TECHNICAL RELATIONSHIP DIGITALIZATION IN THE MAINTENANCE OF AIR SURVEILLANCE SYSTEMS

The human-machine relationship has always been a challenge because man is prone to reluctance to new things, to a reluctance to leave his comfort zone. The proposed SWOT analysis (Table 1) aims to identify the strengths and weaknesses and opportunities of this relationship so that we can chart a bright digitalisation horizon.

Table 1 - SWOT analysis of the socio-technical relationship on the digitisation of maintenance processes

STRENGHTS - Digitising maintenance increases the accuracy of identifying components at risk of failure; - Reduces maintenance times; - reduce the time it takes to bring the technique out of service; - Increasing the processing power of collected data using elements of artificial intelligence and self-learning;	WEAKNESSES - Staff training is slow due to a reluctance to learn; - The lack of simulators makes it difficult to train operators; - Staff shortages at instructor level for operator training; - Staff shortages at operator level;
OPPORTUNITIES - Using augmented reality to train operators; - Stimulating staff to fit specific maintenance structures to the air surveillance system; - Covering the full spectrum of faults requiring maintenance, using simulators and augmented reality techniques; - absorption of funds for equipping repair workshops and improving operator training laboratories; - Using block chain for maintenance processes;	THREATS - securing the digital infrastructure against cyber-attacks; - Possibility of remote penetration of computer systems and disruption of power chains required for maintenance; - malicious delays in maintenance processes by affecting logistics steps;

Analysing the strengths and weaknesses we see once again that the problematic element, without which maintenance cannot be achieved, is the human factor. Firstly, we are faced with a shortage of staff due to the unattractive environment and secondly due to their poor level of training.

8. CONCLUSIONS

The current energy crisis, catalysed by the conflict in Ukraine, is urging and forcing us to rethink our systems and identify and exploit conventional and renewable energy sources. Air surveillance systems, with their obligation to be able to provide 24/7 airspace information, require maintenance under any conditions and at any cost. Predictive maintenance is preferable, where sensor data is integrated into digitised systems, to make the necessary valuable predictions and provide decision-makers with viable options. At the same time, we note the difficulties in recruiting appropriately trained personnel and the difficulty with which digitisation solutions are accepted and implemented in aerial surveillance systems.

We propose the following directions:

- Develop the selection base of young people by stimulating education, technical training hubs;
- Stimulating the training of young people with potential for personal and professional development;
- Increase the attractiveness of maintenance jobs by clearly demarcating administrative and bureaucratic tasks;
- Filtering staff through regular testing and re-staffing on a grading scheme that clearly demarcates staff by competence levels;
- Material and financial incentives for maintenance staff who perform to the highest standards;
- Provide training opportunities with external partners;
- Implementing innovative technologies as quickly as possible, like our partners in more developed countries, while maintaining stability, physical and cyber security, and air surveillance systems.

Rigorous planning that will consider the relevant wishes of the executive staff in the maintenance of aerial surveillance systems, allocation/access to investment funds, organic implementation of new technological solutions, will ensure that in the future the depreciation of equipment will be rapid and the resilience of aerial surveillance systems will be at its maximum.

ACKNOWLEDGEMENT

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DIGITALIZATION OF HIGHER EDUCATION THROUGH VIRTUAL REALITY EXPERIENCE

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Abstract: The digitalization of modern society and in particular the development of the concept of simulated realities and the attempts to create such provide great opportunities to increase the efficiency of the educational system using distance learning not only in emergencies but permanently

Keywords: *Digitalization of Education, E-learning, Virtual Reality, Augmented Reality*

1. INTRODUCTION

All knowledge gained through experience is stored longer in memory. A number of studies including [2] show that about 90% of all information about the reality around us is obtained through the visual analyzer, 9% with the help of hearing analyzer and only 1% - through other analyzers. The first known attempt at providing visual content was in the 19th century, when the English scientist and inventor Charles Wheatstone proposed a simple device he called stereoscope, which was designed for entertainment and displaying three-dimensional images. In the middle of the 20th century, the American producer and cinematographer, pioneer in virtual reality Morton Heilig introduced Sensorama - a machine that is one of the earliest known examples of multisensory or multimodal technology. After the end of World War II the rapid development of civil aviation, necessitates the training of pilots in a controlled (safe) environment. The idea of developing and implementing various types of simulators for pilot training for civil and military purposes has been adopted and widely disseminated. Their main disadvantage is the high cost of design and construction, hence their accessibility to a wider range of students.

2. ARTIFICIALLY CREATED REALITIES

The development of computer and communication technologies and ubiquitous Internet connectivity makes it possible to create digital content and simulate various types of activities, such as driving a car, airplane or others. At the same time, computer-aided technologies for design and training are receiving a major boost in development. The combination of new technologies and traditional training methods provides an excellent opportunity to teach and gain new knowledge and skills. The unprecedented closure of educational institutions in many countries around the world in early 2020 forces stakeholders to move partially or completely to distance learning through various

information applications, platforms and ways to address the problem of education of students, pupils, children with special educational needs, etc.

The demand for electronic devices, uploading educational content and opportunities for effective practice and assessment has also increased. Analysts warn of the possibility of recurrence of such situations in the future and the difficulty in predicting their duration. Surveys of teachers and students show that the role of the teacher has not disappeared and he continues to play a significant role in the educational process. Taking into account the characteristics of "Generation Z", the teaching - learning process is oriented towards placing the learner at the center of the educational process through discovery learning, inquiry learning and critical thinking learning.

In the world of Generation Z, new opportunities for easier acquisition of knowledge and skills provide tools such as virtual, augmented and mixed reality. In short, they can be defined as:

- Virtual Reality (VR) is a computer-generated reality with a 3D image and in most cases with sound. It is created using large screens located in special rooms (Cave Automatic Virtual Environment - CAVE) or through VR glasses;
- Augmented reality (AR) refers to computer-assisted perception or representation that expands the real world with virtual objects. With integrated cameras in mobile devices, additional objects or information can be included in the current image of the real world;
- Mixed reality (MR) expands either augmented reality, which requires AR glasses, or augmented virtuality by connecting it with reality.

Table 1. Comparison of Virtual, Augmented and Mixed Reality [3]

Characteristics	**Virtual Reality**	**Augmented Reality**	**Mixed Reality**
The user is aware of the real world and the surrounding objects	No	Yes	Yes
The user can interact between the real and virtual world in real time.	No	Yes	Yes
Interconnection of objects from the real and the virtual model of the projected scenes.	No	Yes	Yes

Virtual reality technology plays an important role in the concept of telesensation [1]. Through it, a virtual world is created that viewers can enter and walk through and where they can handle virtual objects. The virtual world allows us a stereoscopic view from front or side, depending on our viewpoint, just as in the real world. The ability to enter and walk through the virtual world and handle virtual objects using hand gestures makes VR interactive and this is one of its most important features. Communication can be human–human, human–environment or human–computer. In the case of human–human communication, a variety of means are at our disposal. We talk together to communicate. We write letters or draw pictures and sometimes communicate using images and motion pictures. In human–environment communication, we recognize our environment via our five senses: feeling, touch, taste, vision, and smell. In human–computer communication, we interact with a computer by means of a mouse, a touch pad, or a keyboard. Human–human and human–environment communications have been developed over a long history of interaction. It is desirable to provide human beings with a human-friendly environment where we can interact with computers just as easily as we interact in human–human or human–environment communications.

3. VIRTUAL REALITY EDUCATION SUPPORT SYSTEMS

The goal of VR is to provide human beings with a virtual environment where user can interact with a computer just as he does in the real world, that is, by talking with a virtual human in a spoken language, by writing a letter, or by drawing a picture. User can grasp a virtual object by hand gesture and bring it to another place. In a human–friendly virtual environment, users can interact with a computer without any difficulties or barriers. When a virtual landscape is generated by VR technology, one can go there just as if it were a real landscape. Providing not only a 3D image of the landscape but also sound and smell helps with enjoyment of the scenery.

The VR education support systems have a number of advantages such as:

- Education independent of time and place, but only of hardware and software connectivity;
- Personalized and flexible training;
- Experiential learning - the acquired information is perceived as experience;
- Opportunity to assess the environment and extract the context;
- Opportunity to standardize a certain environment and study the behavior of students;
- Opportunity to analyze and review the actions that led to one or another scenario;
- Introduction of uniform evaluation criteria;
- Opportunity to introduce policies for mandatory and recommended activities to be implemented;
- The teacher becomes a mentor who supports and guides the learning process;
- Virtual projections based on reality, forming a new type of perception and allowing the presentation of concepts and scenarios, tested and evaluated by various criteria;
- Increase of the comprehensiveness and understanding of the implementation and operation of complex processes and systems;
- Opportunity to simulate hazardous situations as part of scientific experiments with no physical danger for the participants;
- Opportunity to quickly and easily switch from one virtual environment to another.

Along with the benefits of the VR education support systems there are some risks and limitations:

Significant costs for creating VRs and ARs and in some cases providing the appropriate equipment;

- Need to adapt curricula to the virtual environment;
- Need for additional training of teachers;
- Providing a backup option in case of technical issues;
- Vulnerability to malicious attacks - denial of service, voice phishing, fingerprint, eye tracking, etc.[4];
- Health problems and complications – addiction, dizziness, loss of spatial focus, anxiety;
- Loss of personal contact with other people and impaired communication.

Of course there are also technical limitations for VR types of environment which revolve around compliance, interaction and comfort. Just like in real life not every educational course is suitable for every VR education support system and it is necessary to define all corresponding objectives. In accordance with the goal a choice of the most convenient medium has to be made. The next stage of the cycle is the modeling and

configuration of the selected platform. The tuning process includes an error correction procedure and ends with evaluation of the achievements. Based on the results of the assessment the shaping of VR environment may begin along with all interaction and convenience tools. The main idea here is the less users sense the VR interfaces, the more immersed they become. The final stage of the cycle is the testing process followed by implementation of the VR education support system.

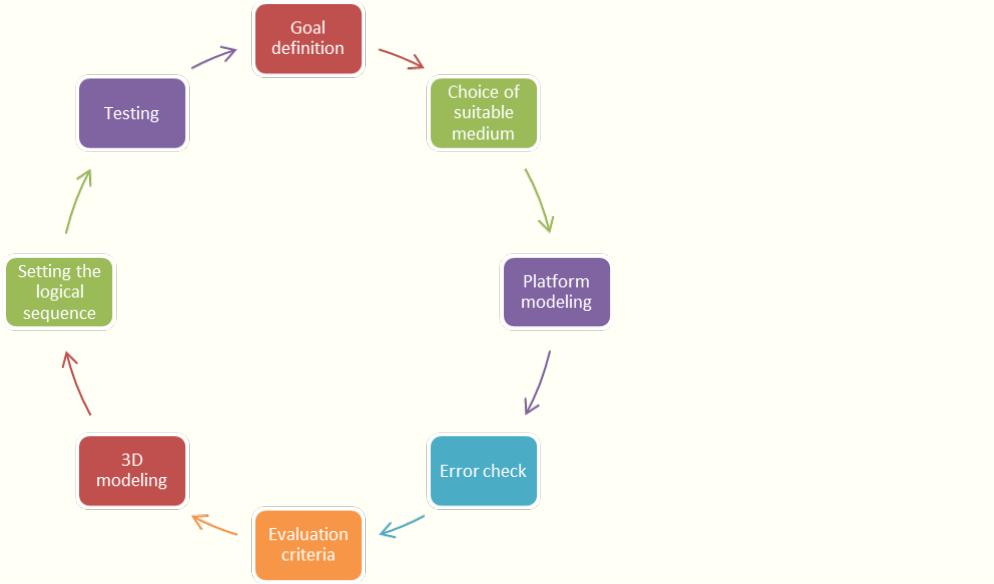

FIG. 1 VR education support system design and analysis cycle

4. REALITY OF VIRTUAL REALITY

VR applications are made up of two types of components: environments and interfaces. The environment is the world that we enter and put on a VR headset. An interface is the set of elements that users interact with to navigate an environment and control their experience. All VR apps can be positioned along two axes according to the complexity of these two components. In the top-left quadrant are things like simulators. These have a fully formed environment but no interface at all. You're simply locked in VR but not able to interact with it. In the opposite quadrant are simulated worlds that have a developed interface but little or no environment.

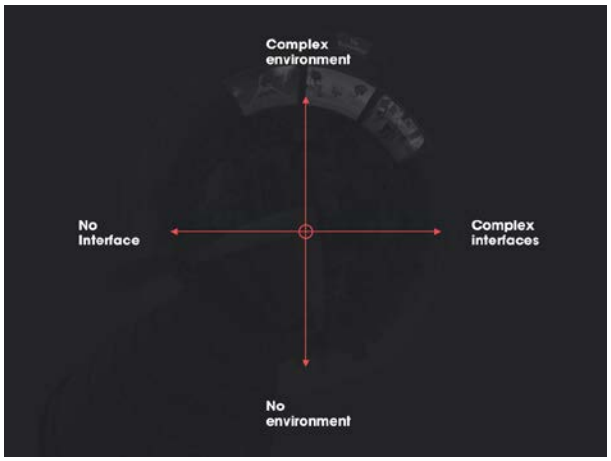

FIG. 2 Axes of VR main components [8]

The essence of simulated world presupposes it to be interactive [5]. The devil is in the details because it is unnatural to join a multidimensional environment and not being able to interact with any of the objects that are shaping it. Important aspect is to make design intuitive i.e. the way users interact with environment must match what they're used to doing in the real world. Another important feature of VR is the possibility to roam freely the simulated world – the more space is available to explore the more immersive the VR is. Appropriate music background and 360 degrees sound surround also contributes to the perception of been placed in a vast 3D environment.

When creating VR, the following human limitations should be considered [6]:

- Safety and comfort – prevention of VR sickness and disorientation by: making users familiar with controls and menus, keeping peripheral motion minimal and frame rates high, avoiding quick changes in brightness;
- Interaction and reaction – design of VR must be in accordance with the physical capabilities of the users e.g.: motion tracking sensors must respond dynamically, interaction zones must be in the reach of virtual users hands;
- Image and text scale – images and texts must be more detailed the closer the user is in order to avoid eye strain;
- Music and sounds – background music and interaction sounds must be tailored to VR environment to enhance the user experience

A typical company specialized in creation of simulated worlds should have a team of talented personnel including:

- Product owner (license holder);
- Analysis specialist - defines the goals, ways, means, participants, costs, benefits and risks of virtualization;
- Industrial expert - provides the most detailed and reliable information for the relevant field;
- Simulation system developer - creates the software backbone of VR;
- 3D graphic Designer – creates the 3D model of VR;
- Audio engineer – responsible for the selection of relevant to 3D environment music and sounds;
- Level engineer - management of level and spatial orientation of objects and avatars in virtual space, transition from 3D to 2D view and vice versa, management of rights, policies and special areas;
- Motion specialist – works on smooth logical and visual connection of the actions when moving the avatar or switching from 2D to 3D mode or vice versa;
- Programmers – help with software development;
- Testers – help with testing VR and provide feedback;

5. CONCLUSION

Distance learning has given impetus to the development of e-learning resources and the use of virtual, augmented and mixed reality. Adding new human-to-virtual communication allows you to create different types of behavior. Acquired new knowledge, skills and competencies in the form of games, entertainment or new experiences have the character of permanently acquired ones.

6. ACKNOWLEDGEMENT

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DIGITALIZING PILOT'S TRAINING ON SAFETY PROCEDURES OR HOW TO DEAL WITH ABNORMAL SITUATIONS

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Abstract: *Flight safety is an extremely important parameter in pilots' training. Every pilot must know the aircraft, its limits, and how he/she will effectively deal with any in-flight contingencies. To this end, flight training includes real flight hours (whether with a flight instructor or solo flights), simulator hours, targeted presentations, and discussions of case studies. In the abovementioned training methods, the flight instructor must be with the trainee at a specific place and for a specific time, which sets practical restrictions. For example, the weather may not always allow for a flight, the simulation of critical situations or mechanical/engine failures during flight may present serious risks, the flight simulator may be off for certain periods for maintenance purposes and the flight instructor may not be constantly available to the trainee. In our paper, we will examine the use of virtual tools for the pilots' training on flight safety procedures and the relevant regulations of the aircraft.*

Keywords: *flight safety, electronic simulation, digitalization, distance education, T-6, escape room, educational game, experiential training*

1. INTRODUCTION

Educating cadets on emergency procedures and flight safety [1] [2] is deemed a very important parameter of flight training during all flight training stages [3]. Whether someone has just entered the Academy and is going for his/her first flight, or he/she is a third-year student with some prior flight training, the importance of following the protocols during any emergency is always and repetitively pointed out. Flight officers apart from enhancing the theoretical background with real flight hours, i.e. time spent in the sky on an aircraft, make use of the flight simulators [4] [5] that are available at the Air Training Wings. About the flight simulators and their VR training goals and procedures, there is an existing bibliography that discusses the pros and cons of their use; there are different types of flight simulators [6] to cover a variety of training needs [7] [8] and their use is deemed an invaluable training asset [9]. But there is a catch to this: cadets can only use the flight simulator when a flight officer is with them [10]; if they want to practice alone, they just cannot do it. Also, suppose they want to test their knowledge, ability, and preparedness to deal with a variety of critical cases and even rare real-life scenarios with different levels of difficulty, they cannot do it, unless they are on base with their supervisor. Given the limitations posed by using a single flight simulator for many trainees, each trainee has limited access to the simulator, especially during the winter months, when actual flights are limited because of the bad weather.

It is also true that due to technical inspections and maintenance of the flight simulator, but also due to other unforeseen situations, as well as personnel leaves, the flight simulator on the base is not always available.

Therefore, we tried to figure out a way, so that cadets can get a virtual, but close-to-real and meaningful flight experience without the need of being supervised by a flight officer. Our proposed digital solution is more economical since our platform needs no spare parts, machine maintenance, which can include regularly scheduled service, routine checks, and both scheduled and emergency repairs, and of course technicians' wages, all of which cost money and time. That said, the focus of our paper is to present the development of the virtual tools developed by Hellenic Air Force Academy for pilots' training [11] in in-flight safety procedures; the idea of using such tools, for training purposes, [12] is an entirely different educational approach. To the best of our knowledge, there is no other entirely digital, educational platform that supports and enhances remotely pilots' education on safety procedures and decision-making for dealing with incidents during flight.

2. VIRTUAL TOOLS DEVELOPED IN HAFA

When we come to think about how to effectively prepare flight trainees involved in potential crisis management in mid-air, the first thing that strikes our minds is to extensively train and educate them well and in-depth, so those who could find themselves in critical situations be able to understand and describe what is happening, and also to make decision or act or both. Therefore, given the differences between theoretical education and realist training, the second point needs to be effectively addressed. One thing is certain: we need to prepare flight trainees before the crisis comes around. We need to start discussing the safety issues early, which is something that usually happens on the theoretical level during the first semester of study at the air force academies. However, is the theoretical approach considered a successful means of training on safety procedures? Not, trainees need to study the theoretical background, but they also need to practice decision-making and taking action when there is no time to lose. Therefore, we need to provide flight trainees both with the theoretical background and hands-on training, if we want them to be able to effectively deal with emergencies. Given the aforementioned and the educational scope of our Academy, to evaluate cadets' knowledge of flight safety and emergency procedures, we thought it is extremely important to plan, design, and develop two interactive virtual tools a) a virtual reality (VR) escape room for training pilots on emergency procedures and b) a digital platform for training pilots against air disasters. These tools are designed to be used by the trainees remotely and working on a merely digital form, to provide them with a virtual, real-time experience in dealing with critical situations related to flight safety. The idea is that they will thus have the opportunity to exercise their theoretical knowledge and realize by themselves the difficulties of handling difficult situations in mid-air. Also, they will be able to feel and understand what it means to consider different options and think about their actions in risky situations when there is no time to lose.

2.1 Virtual Reality Escape Room for training pilots on emergency procedures

2.1.1 Methodology

In this paragraph, the methodology followed for developing the virtual reality escape room for training pilots on emergency procedures is presented. The first part of our research was carried out in two stages: (a) we studied the flight manual, the boldface

procedures, and the operating limitations of T-6A aircraft to write down the procedures set out to be followed in key incident categories (aircraft evacuation, regain control and landing) and (b) we selected the categories of incidents/emergencies to be used as part of our virtual escape room [electronic and mechanical malfunctions, multiple malfunctions (electronic and/or mechanical) immediately after take-off, during cruise and landing]; we also decided how to set up the difficulty level for each incident or emergency scenario and the time, which would be available to the pilots, to solve the case.

Subsequently, we constructed the scenarios that pilots would be asked to solve; for this part of our research, we mainly teamed up as an interdisciplinary research group and got help to test our ideas from focus groups, which consisted of pilots with different levels of experience. To evaluate our scenarios, we did run various tests too: (a) in the cockpit of the aircraft, (b) in the cockpit of the flight simulator, c) on a recreational digital flight simulator that was not intended for educational use, so, we could only test a limited part of our emergencies, and (d) in the form of time-tested scripts to compare methods for efficiency learning the safety procedures and the relevant regulations of the aircraft. To fully test our emergencies and their narratives, we also developed and used questionnaires, as well as holding interviews with both trainees (i.e., the players and our targeted population) and trainers to evaluate the realism of our scenarios. The last stage of our research work was the development of the actual virtual escape room. Given the novelty of our educational approach (training pilots for emergency procedures not in a flight simulator, but through a completely digital educational escape room accessed remotely on and off base).

2.1.2 About the Virtual Reality Escape Room

The four scenarios (emergencies) that a trainee has to deal with are a) generator Loss, b) smoke in the cockpit, c) engine stall/failure, and d) low hydraulic pressure and uncommanded propeller feather. The purpose of these scenarios is to evaluate the trainee's knowledge of flight safety regulations, as well as the safety regulations of the aircraft, to understand the parameters and in-flight critical situations, and train future pilots in a variety of situations of graduated difficulty with time constraints. The gameplay starts by displaying some cockpit readings to the trainee. The trainee has then to identify the problem and put hierarchically his/hers forthcoming actions. Then the order of these actions will be analyzed and examined for their correctness by the game. The trainee is evaluated by his/hers actions regarding the a) maintenance of the basic control of the aircraft, b) knowledge of boldface procedures, c) use of the checklist, d) use of the in-flight guide, and d) reporting the incident correctly. In the final part of the game, the trainee has to answer multiple-choice questions (checklist, boldface, in-flight guide, etc.) and his/hers final score is calculated and received as well as it is sent to the trainer

2.1.3 Evaluation

As far as the evaluation of the level of realism and difficulty of each scenario, the comments we received for our scenarios were overall positive (89%) because the problems posed demand both knowledge of the safety regulations and the aircraft's T-6A manual, as well as critical thinking to be solved. Flight officers expressed the view that "trainees, to deal with an emergency, must be able to think and combine different parameters, such as manoeuvre, configuration, mechanical failures, weather"; our parameters and narratives made scenarios realist enough to be part of flight training (82%). Also, the different parameters and their part in each scenario were deemed as rather important (92%). The level of difficulty made each scenario to be "appropriate for

different phases of flight training" and the gradation of difficulty was deemed appropriate and well estimated (78%).

Flight officers were also positive (84%) about the educational aspect of each scenario. When asked whether our scenarios are good enough to be part of flight safety training, they replied that "each scenario is educationally interesting, and it has a real story for the trainees to solve" (tested positive for 88% of the targeted population). Our scenarios serve their educational purpose (92%) because they deal with several cases related to different phases of flight, therefore cadets can understand that emergencies of any type can come up at any time.

2.2 Digital platform for training pilots against air disasters

2.2.1 Methodology

The developed platform, which is based on the serious game approach, is comprised of real-life unfortunate air disaster incidences caused by severe structural failures. The purpose of this digital platform is to deliver an innovative educational approach to teach and discuss why structural failures, in aircraft, happen and how they may lead to air disasters. It is also discussed what pilots can do to prevent air disasters and how to recover the aircraft from a dangerous situation. The developed approach combines academic elements and flight training, implemented in a serious game, allowing the trainees to visualize how the forces exerted on the aircraft at critical events or in critical phases of the flight (e.g., during take-off or landing).

Initially, a questionnaire is constructed, to identify the topics, of the subject of "Aircraft Structures", that trainees have difficulties understanding. Through this procedure, it is found that structural failures occurred due to a) material corrosion, b) Damage Tolerance Design, c) aircraft maintenance and d) fatigue failure are of major interest for this purpose. Consequently, four (4) incidences are carefully selected from a long list of accidents by examining the relevance of the type of structural failure that occurred, with the outline of the subject of Aircraft Structures and of course the topics that trainees must cover.

2.2.2 Platform Description

The platform will be fully introduced in the Aircraft Structures course to assist trainees to visualize the forces exerted on the aircraft in a selected scenario and analyzing the risks that may be posed for the flight. The demo version is currently tested and evaluated as educationally fit-for-purpose. The platform contains the following features a) folders for each scenario (type of failure), b) details, photos, animation/documentaries for each incidence, and c) interactive forms for analyzing the behavior of the aircraft after the failure occurred considering the forces exerted and educating materials for role-playing (pilot, investigator, design/structural engineer), d) the official releases of the investigations of each accident, e) a digital crash site museum that contains photos from the crash sites and the damaged parts of the aircraft, f) a digital library that contains a bibliography relevant to the structural failures discussed in each case and their effect on the flight and g) finally, quizzes true or false, and multiple-choice questions, for self-evaluation, are also included in the platform.

2.2.3 Evaluation

The demo version is tested and evaluated as educationally fit-for-purpose however, the platform is currently under development. The basic feature, among other, that we are working on for improving the trainee's experience is the educating material, the visual material, the available options as answers to certain questions, the digital environment, and the completeness of the accompanying material for all scenarios, etc.

3. CONCLUSIONS

The benefits of our proposed virtual tools will help Flight Officers and Professors to provide their trainees with well-rounded training. They can still use traditional techniques to provide effective training (briefing/debriefing, analysis of flight emergencies, role-playing, etc.) as far as the theoretical background is concerned, but they will also be able to use our virtual tools: a) to test the theoretical knowledge their trainees have, b) to check how stress and time limitations affect how knowledge is applied in practice and c) to provide their trainees with virtual hands-on training, and, the most complete possible education, in terms of theory and practice. Trainees will also get the best possible training, in terms of both theory and practice. They will also be able to test themselves individually, whenever they feel like using our VR tools on their personal computer (PC) or smartphone. Trainees' evaluation will be based on their choices, decisions, and actions within the simulated emergency. At the end of the game, trainees will be presented with the list of options they made and how they rated against the different flight parameters that determined their payoff. Finally, our virtual tools can also be used for evaluation purposes either by Flight Officers or Academic Professors.

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THE PRACTICAL LIMITS OF DIGITALIZATION IN MILITARY AIR DEFENCE

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Abstract: *Digitalization involves a collective technological progress and a transformation process. Digitalization in the military environment has acquired new perspectives.*

The level of digitalization of different armies across Europe is not very well known but can be intuited. New current concepts such as AI - artificial intelligence, Internet of Things - IoT, blockchain, big data, Machine learning, augmented reality, virtual reality, extended reality, mixed reality, quantum computing, will be included in the existing military ones (e.g., C4I2SR). Even if the technological advance has increased in the military, the limits of digitalization are referring to the human factor.

Reaching the limits of digitalization in the sphere of air defense forces us to design a non-digital backup plan.

Keywords: *digitalization, air defence, human factor*

1. INTRODUCTION

Digitalization involves, on one hand, a collective technological progress and on the other hand a transformation process. Digitalization in the military environment has become again a concept of today especially after the outbreak of the war by the Russian Federation in Ukraine.

The current or recent critical situations: the war triggered by the Russian Federation in Ukraine, the COVID 19 pandemic, the semiconductor crisis or the energy crisis make it difficult for this process, which has a slow evolution anyway. In addition, the human factor who always opposes to change and with bounded rationality [3], imposes certain practical limits on this transformation.

2. DIGITALIZATION IN MILITARY AIR DEFENCE

It is not known exactly at what level of digitalization the armies of the EU Member States are located. On the one hand, because military information of any kind is protected by setting classification levels for them, on the other hand, the knowledge of this information by potential adversaries constitutes a vulnerability that can turn into a risk. It is known that digitalization entered the army through the financial (calculation of salaries), passed on to logistics (acquisitions) and reached information (intelligence) or training of troops (training and military education).

According to Eurostat data, as of 2021, in terms of basic or higher digital skills, the Netherlands (the Netherlands by 2020) is best situated with a percentage of almost 80%.

Of the states that are considered to have strong armies, France has 62%, Italy 46%, and Turkey only 30%. Romania ranks last, after Bulgaria (31%), with only 28% of the country's population having basic or higher digital skills.

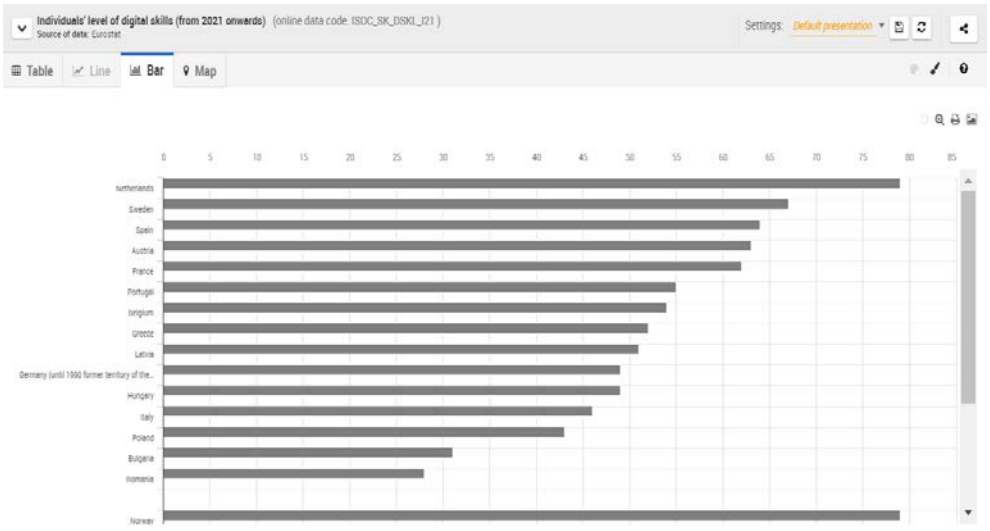

FIG. 1 Percentage of population with basic or higher digital skills in EU/non-EU Member States

The percentages are like a certain extent when we talk about the level of digitization at which the armies of the Member States of the European Union are situated.

New current concepts more common in the civil environment, such as AI - artificial intelligence, Internet of Things - IoT, blockchain, big data, Machine learning, augmented reality, virtual reality, extended reality, mixed reality, quantum computing, will have to be included in the existing military ones (e.g., C4I2SR - command, control, communications, computers, information and intelligence, surveillance, and reconnaissance).

We can already talk about big data in the military environment and its characteristics: increasing volume, variety, and speed of transmission, as well as increasingly precarious accuracy, make the decision-making process increasingly complex. The solution lies in obtaining "actionable" intelligence products by running specific algorithms, why not on "quantum computing" platforms.

In the field of air defense, there is a need for increasingly sophisticated equipment given that the development of the weapon-counter-weapon pair has reached unsuspected and even still fully unknown limits. Radiolocation has increasingly needed to display information in the most real time and if possible, an early warning. We need to protect our means of detection by "covering" with jamming and make our own means of electronic warfare invisible. Next, military pilots will be trained on ultra-modern sixth-generation aircraft. UAVs and UCAVs will gradually replace the model of classical air combat, a tendency which is already confirmed in the war in Ukraine, with the successful use of the well-known Turkish-made combat drones "Bayraktar TB2". In the field of air defense, in addition to modern, state-of-the-art missile systems, ballistic missile defense systems will also be used, and it is known that the current classical military confrontation zone will expand into outer space.

3. THE PRACTICAL LIMITS OF DIGITALIZATION IN MILITARY AIR DEFENCE

Even if the technological advance has reached an elevated level in the military environment, the limits can be seen at the human factor. If the operators of those advanced systems are not well trained or not at all trained, the state-of-the-art technology is no longer useful. A recent example concerns the capture by the Ukrainian army of a command point of the most modern Russian electronic warfare system "1RL257 Krasukha-4", abandoned near Kyiv most probably by untrained soldiers. That Electronic Warfare equipment is intended to neutralize satellites in low Earth orbit and AWACS aircraft, having a range of from 150 to 300 kilometers.

We can achieve higher levels of digitalization in the military, but this must be done together with training the operators of those new systems or devices. Also, if you train the operators before buying and operationalizing all amount of new equipment, they will have problems adapting to procedures, techniques, and tactics which they will be use soon.

Another vulnerability also comes from the human factor. And military personnel are increasingly using social media, according to the global trend. In addition, by activating location services using certain applications for the development of the level of physical training, sensitive information of a military nature is made available free of charge to anyone interested. The solution lies in the education and counter-intelligence training of the military in order not to generate for their own forces a disadvantage even of strategic level to the opponent.

4. CONCLUSIONS

The digitalization process in the field of air defence and, in general, in the military environment will have to continue at the fastest possible pace. This technological transformation should take place, as far as possible, before states outside the EU and NATO, and especially before the potential opponents of the two international organizations.

At European level, there is a need for better cooperation at the level of the Armed Forces of the Member States. In the field of data sharing, the rules for standardization and digital interoperability will have to be implemented and only after this will it be possible to speak of a common European and/or transatlantic data space in the field of defence. Europe's new vision of green and digital will also have to be applied in the military, even if excessive bureaucracy and aversion to the new are still elements that define the military environment. The current or recent critical situations: the war triggered by the Russian Federation in Ukraine, the COVID 19 pandemic, the semiconductor crisis, the energy crisis as well as the increasingly anticipated economic crisis only strengthen this conviction.

Obviously, additional funds will have to be allocated to continue the process of digitization of the armed forces, some of which can be recovered from the reduction of procurement costs, the costs of securing equipment and personnel in a functioning European military information space.

On the other hand, reaching the limits of digitalization in the sphere of air defense forces us to design a backup plan. Super digitized military infrastructure is a critical infrastructure and especially an HVT (high-value target) for potential adversaries. The return to the classic, outdated, non-digital means of action must be able to be done quickly in order not to be permanently removed from the fray. Next, military pilots will

have to know how to fly using only the aircraft on board and on the ground, the ground troops will continue to fight without the support of advanced technology. Even if we are equipped with modern air defense systems, the specialists of SBAD (surface-based air defense) must know how to continue to use classic non-digital systems. In radar, although it seems impossible to ever return to aerial surveillance strictly with visual or electron-optical means and this possibility will have to be considered.

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A NEW AGE IN THE AIR FORCE: THE DIGITALIZATION OF MILITARY HIGHER EDUCATION

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Abstract: *This paper represents AFAHC's conception of the beginning of digitization in the academy. The poor digitalization in the institution has made itself felt during the pandemic. The paper is a brief summary of what has been done over the course of a year to mitigate the effects of a weak digitization in the teaching/learning process. The beginning of solving the problem of digitalization, of understanding the digital educational process was made with the submission by a consortium with 4 partner universities of a project under the action Partnerships for Digital Education Readiness of the Erasmus program that is talked about in the paper.*

Keywords: digitalization, educational resources, Erasmus

1. CONTEXT OF THE PROJECT

In the pandemic context, still existing at the time of submitting the project, and given the specificity of AFAHC, the lack of a coherent strategy for the implementation of an online education system led to improvisations made to bring out of the impasse, at the moment, the educational process.

The improvisations made for online teaching had a weak point in terms of achieving high-quality results in the teaching/learning process. A little help was the existence of an e-learning platform developed through a previous project. Thus, the asynchronous educational process was started as the fastest solution found. In order to eliminate one of the disadvantages of this system – a low-quality teaching process resulting in poor results in student preparation – it was necessary to quickly update the knowledge about online conference systems. The synchronous online education system has gradually shifted. However, not all staff involved in the educational process were able to quickly adapt to the new requirements. Moreover, in the case of both methods, the impossibility of carrying out applicative courses, laboratory classes or tactical exercises should be taken into account.

The readiness of students is noticeably better if synchronous and asynchronous systems do not work independently. Each of the two demands the other so a mixed system would be desirable. Moreover, it is preferable to introduce simulation software for the operation of various technical systems or tactical applications.

Moreover, with the passage of the pandemic period, the mixed educational system comes to complete the methods of face-to-face teaching. The need for digitization, updating teaching methods and introducing new systems and devices dedicated to simulating different situations (VR or AR glasses) was another reason why it followed.

At the international level, there is a tendency that information resources, in greater numbers, to be realized in digital format, the advantages of this format being their diversity and accessibility.

2. DRIVE METHODS

The identification of the problems during the pandemic and the new direction of development of the educational process at international level has united 4 universities whose profile, although not identical, is similar to submit a project. These are: Vasil Levski National Military University, Hellenic Air Force Academy, War Studies University and Henri Coanda Air Force Academy

Correctly identifying the target groups means a successful project. At such a project dedicated to the educational process, the main target groups are: students and teachers. The two target groups have double quality in the project: as a developer of the objectives but also as a beneficiary of them. The aim of the project is to raise the level of preparation of students by updating the teaching / learning methods necessary in the context of digitalization.

Objectives deriving from the purpose of the project:

1.Raising the level of digital competences of teachers in partner universities

2.Raising the level of involvement of students and attracting them to the research process

3.Existence of digital educational resources

4.Existence and introduction in the teaching / learning process of VR and AR systems in all universities involved in the project

5.Existence of a platform / library where all the materials developed through the project can be found

The current state of the project consists in achieving two major objectives: the development of educational resources in digital format and their gradual opening to augmented reality applications.

The stages, in their chronological order, imposed:

Because within the project it will not be possible to develop materials for all the subjects taught during the first cycle of study due to the lack of time, it was opted to establish a number of 12 disciplines covering a wide range of topics in the field of university training in military institutions. It has been taken into account that in military higher education there is a wide range of specializations, from social sciences to engineering ones that can be distributed in:

- disciplines that are suitable to be taught in all the universities in the project and that are specific to the defense system such as leadership and management
- disciplines specific to each university and the specializations of the study plans those dedicated to the technical systems in the defense system

The 12 disciplines are as the following list shows: Measurement in telecommunications, NATO crisis and disaster management, Databases, War gaming, Information Warfare, Sensor Technologies for Security and Defense, Diplomatic Protocol, Military Powers, Unmanned Aircraft Systems, Electronic Warfare, Very Short Range Air Defense Systems, Radar Fundamentals.

Each of the 4 universities had to develop digital educational resources for 3 disciplines to form the foundation of a digital educational resource base around which to develop a digital library dedicated to the military university system and not only. Following a study, the decision was that educational resources shouldbe realized in eXelearning.

Involved: the target group - the teachers for whom the first objective of raising the level of digital skills necessary to create these digital educational resources appeared.

The reasons for choosing the eXelearning software are given by its characteristics: it is a free, open source software. Its easy use and the fact that what is achieved with eXelearning can be saved according to several standards has led to the conclusion that it is the most suitable for the project.

Figure 1 shows how to save as a web page and what the user interface looks like.

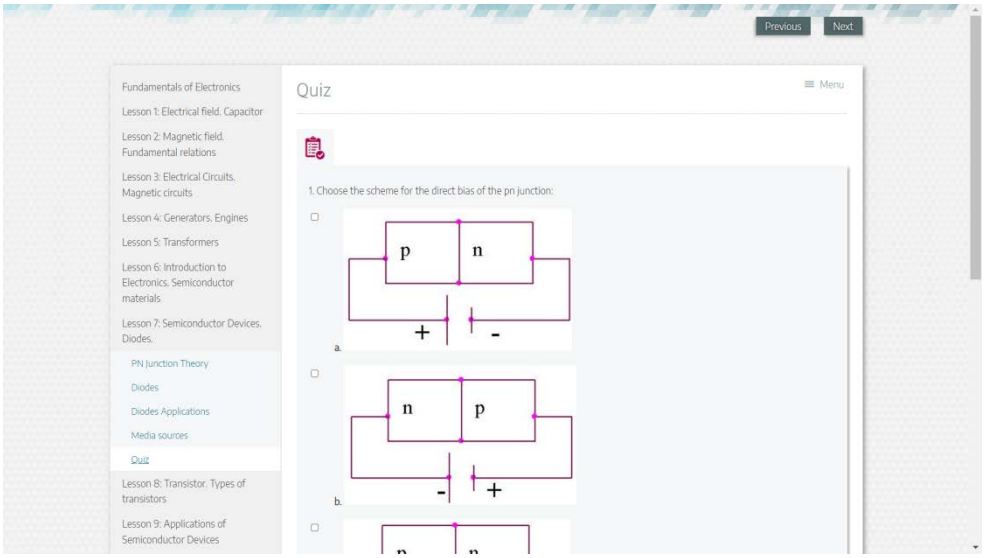

FIG. 1 Show course content as a web page

The highly used asynchronous teaching process during the pandemic period is still current in terms of personal training of students. Under the current conditions this involves self-guided lesson modules, streaming of video content, virtual libraries, lecture notes posted and exchanges on discussion forums or social media platforms. All this can be embedded in the digital educational resources realized and saved in eXelearning (see Fig. 1).

Online learning environments are becoming more and more common in teaching and learning processes being the basis of asynchronous learning and needing course papers delivered via the web, email and messaging to be posted on online forums.

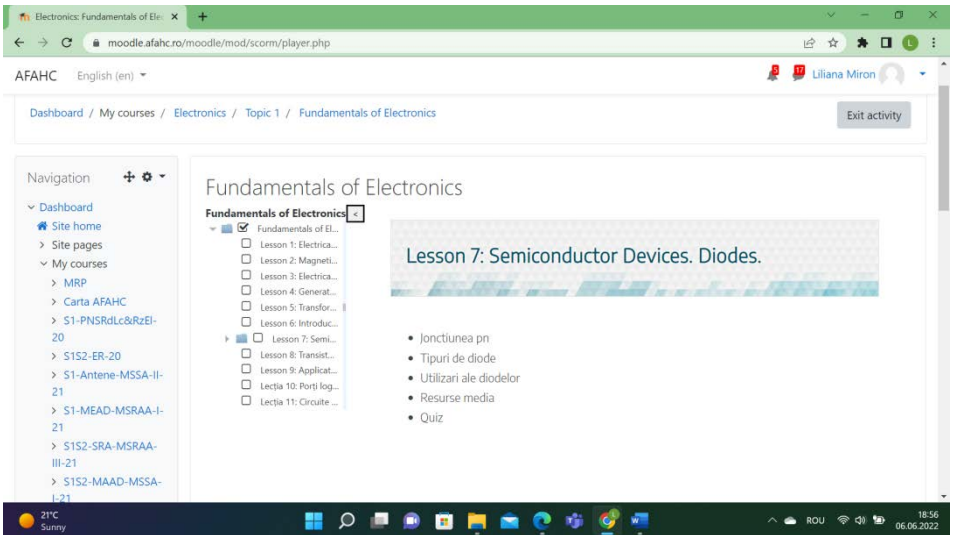

FIG.2 Show course content as SCORM in Moodle

All this can be done with eXelearning, another advantage of this software. A strong point of eXelearning is that it offers the possibility of a work saved in the SCORM standard that can be imported into an LMS platform.

Figure 2 shows how to save and interconnect with an LMS platform. With this said, we moved on to the target group – the students, involved in the process of developing educational resources. Their involvement has benefits in terms of familiarizing them with the functioning of the current educational system in the universities partnering in the project and in developing their spirit of creativity.

The double quality of target group and beneficiaries of the project results of the two mentioned target groups is observed throughout the project.

Another characteristic of this project is the multidisciplinary highlighted by the diversity of the disciplines for which the teaching and technical materials are made, there are disciplines with a strong technical profile but also some with a humanistic or management profile.

If for the humanist profile the applications are easier to manage, for the technical one dedicated devices and software are needed.

3. NEXT STEPS

Once the digitalization phase of educational resources is completed, the objectives dedicated to applicative and laboratory activities follow. The introduction of augmented reality systems and the realization of dedicated applications is the next challenge for students and teachers.

CONCLUSIONS

Although it does not seem like the project Implementation of Digiatlization in Defence Higher Education whose steps gone through and future were presented in the paper has the element tou innovation. The digital transition of educational resources and their correlation with LMS platforms bring into focus the university education specific to the military system. The introduction of augmented reality in the teaching system is a step towards the future.

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[2] Implementation of Digitalization in Defence Higher Education (DDHE) - 2020-1-RO01-KA226-HE-095411, https://www.afahc.ro/ro/erasmus/ddhe/ddhe_en.html, Henri Coanda Air Force Academy.

DDHE - SYNCHRONOUS OR ASYNCHRONOUS DIDACTIC IN HIGHER EDUCATION INSTITUTIONS AFTER COVID-19

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Abstract: *COVID-19 has led to growing dependence on synchronous and asynchronous learning methods. New technologies and software offer both positive and negative implications of knowledge. Some researchers argue that students do not achieve higher level learning in synchronous courses. We have to learn in how to use this technology for effective learning. Universities and academies are now experiencing the influence of synchronous and asynchronous learning methods. Online learning experiences after two years of covid give chance to summarize. This case study explored asynchronous methods derived from experiences in higher education institutions from Bulgaria, Greece, Poland and Romania. In present article presents an analysis of asynchronous learning methods used in the project "Implementation of Digitalization in Defence Higher Education-DDHE". The purpose of this paper is to demonstrate that asynchronous online learning used in DDHE can create a rich cognitive presence capable of supporting learning in military higher education institutions. Asynchronous online learning in DDHE is not just another educational technology to be used as a simple enhancement but introducing the teacher to a higher level of cognitive didactics. DDHE is forcing educators to reflect on the teaching and learning process and what constitutes effective learning.*

Keywords: *synchronous, asynchronous didactic, learning, teaching, DDHE*

1. INTRODUCTION

Implementation of Digitalization in Defence Higher Education is acronym of letters DDHE. The topic is very important for those who understand online learning as not just another educational technology to be used as a simple enhancement and then let slide as something new comes along. Online learning is here to stay and is forcing teachers to reflect on the teaching and learning process and what constitutes effective learning. After two years of COVID-19 teachers have learnt, or COVID-19 has led to growing dependence on synchronous and asynchronous learning methods. The experience gained also enables teachers to state that distance teaching will remain with them, to some extent, also after the pandemic is over. Some classes and lectures might be conducted this way. Considering this, it is possible to assert that the preferred direction within education will undoubtedly hybrid learning.

2. ONLINE LEARNING

Education is only now experiencing the early influence of online learning networks. In this regard, we have much to learn in how to use this technology for effective learning. It has been obvious that online learning has the potential to provide access for learners to a

wide range of programs and information. What has not been apparent, or at least not well understood, is that online learning is more than a means to access information.

It has the potential, to significantly enhance the intellectual quality of learning environments and outcomes (Garrison, 1997). Ultimately, effective learning must take into consideration both the internal cognitive process as well as the external contextual elements. In online learning context, but exceptionally in an asynchronous learning, there are two properties – reflection and collaboration – that shape cognitive presence in ways unique to this medium (Matheos & Cleveland-Innes, 2018). The two dimensions that shape the practical inquiry model are deliberation - action and perception - conception. The asynchronous and virtual nature of online learning calls on teachers to be self-directed and to take responsibility for their learning. That is, to assume greater control of monitoring and managing the cognitive and contextual aspects of their learning. This is both a challenge and an opportunity for asynchronous online learning. The challenge is that teachers have the responsibility to provide structure and guidance that will encourage and support students assuming increased control of their learning. The opportunity is that asynchronous online learning promotes self-directed learning. This will most assuredly mean a move from the transmission of vast amounts of information to the interactive asynchronous online learning based on virtual communities. New technologies and software offer both positive and negative implications of knowledge. Some researchers argue that students do not achieve higher level learning in synchronous courses (Allen & Seaman, 2009). To understand learning effectiveness for asynchronous online learning is to first appreciate what is unique about this medium. It is how we integrate and use the capabilities of asynchronous online learning in a synergetic manner that makes it unique (Morse, 2003). That is, it is how we combine and integrate possibilities that private and public worlds of student that will make the learning experience effective for all concerned Figure 1. We have to learn in how to use this technology for effective learning. Universities and academies are now experiencing the influence of synchronous and asynchronous learning methods. In this regard, it must be made clear that this cannot be accomplished by way of professor who is “sage on the stage” nor a “guide on the side”. New learning technologies such as asynchronous learning are far from providing access to more information. More information does not improve learning effectiveness. From a learning effectiveness perspective, the key is not to inundate students with information. The first responsibility of the teacher is to motivate students to self-learning. Students need to be “hooked on a big idea” where students feel connected and are cognitively engaged (Garrison, 2003).

FIG. 1 Community of Inquiry (Source: Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*)

3. LEARNING EFFECTIVENESS

Where there is a community that supports and encourages ideas to be critically analysed, asynchronous learning has great learning effectiveness. At the same time, lecturing online or simply providing access to information is a complete misuse of asynchronous learning. Clarifying, explaining and summarizing are functions of a teacher. If this contact is constructive, asynchronous learning is not threatened (Allen & Seaman, 2007). We must begin to understand the cognitive presence implications of asynchronous online learning and how we, as professors, design and model an asynchronous learning environment. An environment where students have the opportunity to engage and take responsibility to manage and monitor their learning (Picciano, 2002). From other hand, if we want our students engaged in the critical thinking process, we must motivate them with well-written questions that guide them into asking more questions. This method usually does not extend the discussion beyond the exploration phase. But still is better than access to more information in pdf. In other words, every online discussion leads to higher level of cognitive presence and resolution during discussion (Garrison, 2003).

4. DDHE AS CASE OF ASYNCHRONOUS COURSES

Online learning experiences after two years of covid give chance to summarize. This case study explored asynchronous methods derived from experiences in higher education institutions from Bulgaria, Greece, Poland and Romania. In this last element author would like to present an analysis of asynchronous learning methods used in the project "Implementation of Digitalization in Defence Higher Education-DDHE". Asynchronous online learning used in DDHE can create a rich cognitive presence capable of supporting learning in military higher education institutions (Guo et al., 2021). DDHE online classrooms coupled with heightened emphasis on removing geographic limitations have led to growing dependence on asynchronous learning as a delivery medium. From gained experiences an important difference is the identification of a specific and defined knowledge which can be obtained by diligence of effort, rather than by questioning and exploration (Wu & Hiltz, 2004).

Of telling importance is the Chinese proverb relative to project, which says "diligence overcomes stupidity" which is reflected in the generally high level of teacher's effort from DDHE. DDHE teachers know that can be expected differing learning behaviours as a result of cultural background (Morse, 2003). Pedagogically, the contrast identified in DDHE aspects of cultural differences in perception highlight a design consideration in developing online classes (Zigurs, 2003). Although some of these differences can be addressed by improving the presentation (graphics, audio, questionnaires, etc.) of existing course content, especially given the many-to-many communication advantages and the peer-to-peer interaction (Valenta et al., 2001). Asynchronous online classes used in the online project "Implementation of Digitalization in Defence Higher Education" offer students more flexibility and reduce access challenges. Therefore, in DDHE project partners helped students succeed in asynchronous courses through careful course design, including building a community of inquiry that includes cognitive presence, instructor presence, and social presence. Building a community of inquiry is important to student success (Alderman, 2013). In DDHE asynchronous active learning took many forms, including: quizzes that can include multiple choice questions, blogs, student presentations, podcasts and other (Guo et al., 2021).

SUMMARY

The curricula of DDHE are composed for didactic on academic level. Whole project DDHE - the entire project consists of 12 full-time subjects, each of them being 5 ECTS and at least 16 online lessons. One subject is 40 hours online, so 12 times 40 equals 480 hours online. A colossal undertaking that requires perfect organization and cooperation of teachers preparing these subjects. Frequenty Asked Question most often asked for all courses is: How effective was the course? is very hard for DDHE. Evaluation involves systematic and careful data collection and analysis of student questions (Laub, 1999). Workload in aspect of DDHE is hard to describe and probably author will need next pages to describe the evaluation of the course effectiveness.

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AI SMEs IN INDUSTRIAL MANAGEMENT

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Abstract: *SMEs form the pile in the Romanian overall economy, creating a huge sum of the job and added benefit within the nation, which makes them important in this context. IoT and cloud are processing Romanian but the difficulties encountered during the adoption of those systems by Romanian SMEs.*

Nevertheless, current literature will not heavily concentrate on SMEs and their particular challenges nor will it include a lot of situation studies focusing upon maturity amounts of impaired computing and IoT technologies.

The outcome of this research seeks to contribute to the field of IoT and maturation models by adding more research that is specific to SMEs in Romania. The particular insights created by the conclusions of this thesis goal to help SMEs and researchers in assessing maturity levels and dealing with the challenges connected to the adoption of either IoT or cloud computing technologies.

Keywords: *SMEs (Small and medium-sized enterprises), IoT (Internet of Thing), smart factory, Industry 4.0*

1. INTRODUCTION

European industries are facing economic dissolution related to global societal and technical developments such as lower availability of resources, higher prices for vitality and an aging population, and increasing demands for quality and service levels. IoT can therefore be a solution to these challenges by allowing better responsiveness of companies to market changes with lower costs & surrounding impacts. But most existing endeavours are currently at pilot stages, with no single Europe country yet having the option to completely change huge pieces of its assembling base into IoT.

This brings up issues about the adaptability of IoT, additionally about the enabling of IoT systems to diffuse across various areas or nations. The American and Asian market [2] is presently being changed into platform-based contest for market strength. For example, Korean IoT[3] (SMEs in the IoT business) are confronting intense difficulties as to settle on an essential decision of whether to keep status or change for development. The IoT associates different worth chains.

Consequently, affecting each other and requiring entrepreneurs to collaborate. Hence, it is essential to play out an examination of imaginative IoT-SMEs, to be able to help identify typically the attributes inherent throughout the IoT together with aid decision-making by the analysis involving current conditions together with characteristics of corporations.

The difficulties that American SMEs should confront with regards to the reception of distributed computing and IoT among different advancements are exposed. The essential reasons are to guarantee globally and that the adaptability of can be kept up with and moved along. For the best of our insight, without a doubt, not very many accessible audits of the Romania IoT technique reflect it looking at strategy instruments, tasks and other prosperity did by the us government, private market or scholarly associations. Typically, the intention was twofold: first, to appear sensible of the complexness of different invention policy instruments; and second, to reduce light on the options made and the policy goals that guided invention policy formulation.

May become apparent from the topic in Section 3 and Section 4, the development path as well as Romania IoT strategy makes it quite formidable to. However, the government supports international partnerships to build overseas markets, typically the reality is of which SMEs are couch potato, as they cannot get the market or perhaps lack in capabilities or perhaps the business unit is not well prepared for partnership. Prior research on offshore expansion has aimed at venture firms' entrance into overseas market segments, types of entrance and achievements.

2. METHODOLOGY

Subsequent an exploratory study strategy, qualitative information has been collected in the type of a books review as nicely as a several case study via semi-structured interviews. The particular data has been analyzed simply by conducting a conceptual analysis, a cross-case synthesis and design matching.

Moreover, three out of the four situations mentioned an absence of recognized drivers for upcoming applications [4] of impaired computing technologies in their manufacturing. When identifying why this had been the situation, the participants either did not necessarily see the good thing about using it within just their manufacturing although a 3rd company questioned just how cloud computing technology could even end up being applied within their particular manufacture.

3. IoT ADOPTION IN SMALL AND MEDIUM ENTERPRISES

To further understand the different areas of AI and IoT, this section will provide a better overview of the technologies and methods within the aforementioned technologies. IoT in the business is regularly involved in light of a cloud arrangement, which gathers every one of the information from the sensors, machines, MES, and so on.

Internet of Things

The Internet of Things (IoT) is the arrangement of items that are discoverable utilizing standard specialized strategies. IoT envelops everything having network and capacity to talk. the specific "things" can become anything from indicators to electronic items, to machines, to vehicles. The idea of IoT will be propelled by the specific thought that things of our globe will talk to one another; subsequently, structure an arrangement of gadgets precisely where each item might have the correspondence capacity too on the grounds that some 'detecting' in addition to 'impelling' abilities.

The specific IoT innovation can be one of three sorts: web situated that goes about as a middleware, things-arranged that gives acknowledging capacity and semantic-arranged that permits getting at information. The propriety of a particular kind will rely upon the functioning standards of a specific program.

The particular blend of multiple types or simply a standalone IoT may be used to build such smart applications striving at solving critical problems within our everyday life.

4. IN PRACTICAL USE

From the literature survey, different categories of IoT in SMEs [5] were uncovered. Specifically, the impair category has already been exploited along with IoT. I also found this in their literature overview of SMEs and Industry 4.0 from 2018[6]. Within the smart factory, the means of manufacturing and the product itself include detectors and actuators that allow them to link with one another. They form a "cyber-physical system" (CPS, or "cyber-physical production system", CPPS)[7], associated by means of the Internet of Things (IoT, to recognize it from organized buyer hardware like brilliant homes or wearables). The organized shrewd manufacturing plant permits appointing characters to instruments and machines additionally to items and materials.

And smart factory [8] enables us to precisely locate and maintain track of items each and every level of the production and provide chain. Primary communication and co-operation between humans, machines, logistics and products helps optimize development and value.

This specific networked and computerized production environment is supplemented by "big data" which appertains to the tremendous amounts of data from millions of nodes in a network.

For instance, the ability to process and analyze large amounts of information using fog up computing [9], for example. In this way a reduction in business uncertainties, as information about adjusting business environments can be handled, refined and analysed in almost real-time, and then transferred to the production center directly: machines and tools will adapt businesses accordingly.

Increased customization is possible while retaining swiftness and efficiency. Specific tools are network and identifiable; modification is feasible in respect to user data, and there is a direct interconnection from customer data to machine data.

Besides, distributed computing and added substance fabricating take into consideration a decentralization of creation. Data is not generally halfway put away however found straightforwardly inside the actual item.

Because decision-making about changes in production can be decentralized, manufacturing in IoT can consist of multiple, flexible and localized systems and machines with functions distributed throughout a network without a solid hierarchy.

5. AIoT AND CHALLENGES AND PERSPECTIVES IN ROMANIA SMES

The cycle considered the "Who", that is the SMEs, and the "How", vanquishing difficulties of the IoT. It associated these ideas with activities, for example, 'comprehend' and 'lay out' to assist the watcher with thinking about how these ideas ought to be handled.

The Definition of SMEs

Characterizing skills and attributes of the SME Various overseeing bodies, like the European Union and official government branches of nations like the United States, have illustrated definitions to sort SMEs.

This exploration is centered around the UK specifically, however the EU and US definitions were likewise thought of, as these definitions are significant with regards to the support organization.

The EU groups SMEs in view of number of workers, yearly turnover and yearly accounting report, as displayed that The UK's Department for Business, Innovation and Skills are more basic in their definition; an SME is any business utilizing under 250 individuals in their distributions.

6. CONCLUSION

As indicated by the European Commission (2019) 99.9% of all undertakings in Romania are assessed to be SMEs while producing 61,2% of worth added and 65,2% of business. For Europe, as a general rule, the rates are 56,4% and 66,6 individually. SMEs are important elements for Industry 4.0 executions.

6.1. Method of Pattern Matching

Design matching is in this case used to observe observationally based difficulties from Romanian assembling SMEs and contrast them with the guessed difficulties found for SMEs which are not explicitly characterized for Romanian SME makers. Utilizing this technique, the theory gives the reader understanding on the degree of which difficulties looked by SMEs referenced in writing can be appropriate likewise for Romania fabricating SMEs. Besides, significant bits of knowledge can be made by looking at hypothesis and the experimental discoveries of this report.

6.2. German Pattern

Barely any nations, especially developing countries, have a similar groundwork of collected mechanical and producing capacities expected to imitate such an aggressive interaction. Our examination matches with ongoing commitments to the writing by showing how profoundly the rise of IoT in Germany is established in its new assembling advancement way.

The public authority needs to give an essential direction to IoT-SMEs with the goal that they can determine another BM to augment the chance of progress in the market by coordinating the organizations with astounding thoughts and those with assembling skills in the company pool.

I recognize the impact and take-up Germany's IoT technique has had on development strategy both in Germany and different nations. I state that the dispersion of Industry 4.0 has profited from the deliberate endeavors of organizations, worker's guilds, industry and exploration affiliations, the scholarly world, and government. Different German associations add to the conceptualization and execution of Industry 4.0, including through the pilot artificial intelligent academy.

6.3. Korean Pattern

As the Korean government has laid out a medium-to long haul support strategy, it is important to research whether IoT-SMEs are effectively answering the IoT and gaining ground. Moreover, assuming the abroad extension is fundamental for Korean IoT-SMEs, it is important to examine what their positions and status are and what their methodologies and reaction systems are.

Specifically, outer drivers could start from new innovation advancements, client needs and expects to stay serious and applicable on the lookout. Interior drivers incorporate the way of life of the organization, especially around how adaptable and innovative it is, the craving to adjust and the readiness to build turnover, and ability of the labor force.

6.4. National Strategy in Romania

A National Strategy by Bibby and Dehe [10] claims that cloud computing are changing assembling exercises into a more assistance arranged process through organized and brief creation lines as well as a common stage that empowers cooperative exercises. In their paper, a contextual analysis in the safeguard area is raised appearance that distributed platform advances are utilized both for data capacity purposes as well as assembling parts, for example, machines or robots that associate with the cloud computing.

There is an extension for the IoT to assist with empowering servitization, which could be particularly gainful to SMEs, in light of the fact that the IoT could decrease the time

and cost required. Notwithstanding, the intricacy of adding administrations is as yet troublesome, and what is required most is a device that can help SMEs better comprehend and apply servitization to their business.

The Internet of Things (IoT) could be an empowering influence for a servitzation progress at an association. Servitization, empowered by the Internet of Things (IoT), has not been considered with regard to Small to Medium Sized Enterprises (SMEs). Because of the attributes of SMEs, the possible open doors from actually servitizing their plans of action and the availability and reasonableness of IoT sensors, hardware and instruments, there is a hole to be investigated.

In my opinion, Romania must open innovation, cooperation with external parties and response world market. In the worldwide market, Romanian SMEs can be tying down its seriousness by cooperating with huge organizations to manage worldwide contenders. What's more, the organization could accomplish supported endurance and development with its procedure of getting value intensity and self-upkeep capacities along with different sending cases.

Currently, as of now, in the USA, enormous organizations, for example, Itron and Silver Spring Networks are available with their establishment of million households [11], and there are in excess of 30 bigger contenders. Interestingly, Romanian SMEs cover a reach from 100,000 to 300,000 families, yet they have minimal expense frameworks and cost seriousness. Consequently, worldwide organizations likewise perceive Romanian SMEs as a contender.

How organizations answer the future will impact the Romania IoT-SME industry in growing new capabilities for practical development. For this, it is important to lay out a worldwide association with organization, hardware and arrangement bunches utilizing the stage zeroing in on the IoT esteem tie and to progress in the market in view of this blended advancement driving way. Participation with organizations inside and across the IoT esteem chain is helpful for BM disclosure, and in particular, for sharing data on natural changes and detecting market needs. Cooperative examination among organizations will be viable for making collaboration.

The IoT can prompt extraordinary outcomes assuming collaboration is made through close linkages with the intra or across the worth chain organizations. Those organizations that produce chips, sensors, terminals, organizations, hardware and stages are assuming the critical parts in the IoT esteem chain. Organizations should comprehend their job in the worth chain and help out the accomplices inside and across the worth chain. It is additionally basic for the organizations without worldwide market section insight to establish association and lay out correspondence climate with experienced organizations in the worldwide market. Here government support strategy is required in recognizing ecological changes and worldwide market patterns and determining an appropriate BM for new business sectors. The help that empowers making more synergistic outcomes doesn't need to be for organizations of specific size, yet for the organizations inside and across the worth chain.

Parts of this Information Engineering Doctorate. It is an endeavor at interdisciplinary examination at another cross-segment of subjects. Interdisciplinary exploration can be troublesome, however can assist with prompting new experiences and works with a more extreme cooperation between various styles of information. Specifically, there can be a superior connection between mechanical advances with social developments.

Moreover, the creator Basl discusses "Society 4.0"[12] where society overall is going for the gold the higher adaptability as well as cost decreases that come because of the move towards Industry 4.0 advances like IoT and Cloud Computing. Thusly, the worth creation in the assembling businesses of created nations is progressively being

acknowledged through computerized innovations and headways. The focal part of these advancements is the reconciliation and dependence on innovation to further develop processes across various enterprises through the digitization of machines and cycles.

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MILITARY BLOCKCHAIN IN HEALTHCARE TO SUPPORT CLINICAL DATA

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Abstract: *Using the advent of quick and effective next-generation sequencing technologies, unlinked and dispersed patient data have surfaced as a major problem in diagnosing uncommon diseases. The molecular associated with the rare disease entails comparing a patient's genetic variant information with the variations more with comparable diseases in a big population. Therefore, discussing information among genetic databases plus laboratories is important in order to identify overlapping outcomes and for identifying the pathogenic importance of variants in order to allow the analysis of rare hereditary diseases.*

Considered perhaps the most continuous test to be defeated is the patient information will frequently be kept in focal confined admittance vaults as a result of protection and security concerns. An individual arising illustration of such an innovation is military blockchain novelty. As decentralized and conveyed innovation, military blockchain innovation has many engaging properties, for example, information condition and responsibility, that could be utilized to expand the condition, discoverability, and access of patient information, along these lines moving toward a new confided in framework to direct the promotion of patient information sharing.

Keywords: *military blockchain; sensors, Internet of thing(IoT), smart contract, ethereum, healthcare system*

1. INTRODUCTION

Currently modern technology makes a considerable factor to the changeover from traditional health care to smart health care systems. Mobile health (mHealth) [1] uses improvements in wearable detectors, telecommunications and the Internet of thing (IoT) to suggest a new health care concept centered on the patient. Patients' real-time remote constant health monitoring, remote control diagnosis, treatment, and remedy is possible within an mHealth system.

Nonetheless, significant impediments incorporate the straightforwardness, security, and protection of wellbeing information. One potential answer for this is the utilization of blockchain advancements, which have found various applications in the military medical services space chiefly because of their elements like decentralization (no focal authority is required), permanence, detectability, and straightforwardness.

We propose a mHealth framework that utilizes a private blockchain in light of the Ethereum stage, where wearable sensors can speak with a brilliant gadget (a cell phone or shrewd tablet) that utilizes a shared hypermedia convention, the Inter Planetary File System (IPFS) [2], for the circulated stockpiling of wellbeing related information. Brilliant agreements are utilized to make information inquiries, to get to patient information by medical care suppliers, to record indicative, therapy, and treatment, and to send alarms to patients and clinical experts.

2. MILITARY BLOCKCHAIN OVERVIEW

In this segment, we have introduced the military blockchain and its highlights and advantages. To pick which military blockchain system to utilize, it is essential to characterize attributes that permit correlation between various structures. Among the military blockchain models are agreement systems, shrewd agreements, permissioned blockchains, layer of administrations, machine to machine blockchain applications, and portable similarity.

We think about various blockchains:
-utilizing smart contracts (S.C);
-agreement instruments (C.M) [3];
-permissioned blockchains (P)[4];
-layer to administrations (L2S) [5];
-Machine to Machine blockchain applications (M2M B.A) [6];
-versatile compatibility (MC)[7];
- blockchain applications (M2M B.A)

Despite the fact that IOTA seems, by all accounts, to be the most pliant blockchain, Ethereum platform gives the adaptability to pick either unique agreement conventions and in this manner run the organization on a light multiprocessor engineering, and the one most utilized in the business remains Ethereum platform.

Patient Data Architecture

Fundamentally made out of wearable gadgets out-put the information with a portable gizmos and an Apple IOS application simultaneously, permitting medical care staff to screen their people receiving care or treatment.

Portable device.

Each people receiving care or treatment should be equipped with something like one portable device getting a lot of prosperity limits which portray the patient's condition, (for instance, beat, fitness, fitness, remoteness, triple jump, and the degree of heat of a living body). The equipment coincident the data with the light-weight application through Wifi. fitness, distance, steps, and temperature). This particular sort of contraption incidental the information with the little application through Wireless Bluetooth.

Transportable Application.

This program is introduced within the patient's cell telephone; it empowers your blockchian to produce a wallet [8] (containing his public blockchain in addition to private key) also to send their own wise agreement for the Ethereum organization. The applying peruses the wellbeing facts from the portable gizmo and retailers them in typically the patient's medical recording. This knowledge transfers to be able to the blockchain may be on ask or a charge that runs constantly, at regular times, contingent after typically the patient's arrangement.

Smart Contract.

In typically the hierarchy, each victim is supervised by simply a portable unit. These gadgets are unquestionably responsible for gathering data which will always be stashed in your current smart contract. Consequently, intended for every single sufferer, the smart deal is unquestionably deployed. To be able to work with to be able to the wise package is explained in the following segment.

Web Application.

The substance imagines information constantly and permits wellbeing experts to screen the patient's status relying upon their entrance level.

Patient's Smart Contract platform with Ethereum.

To proposition demand (exchange proposition), which holds to the information got from the wearable gadget, is shipped off to approving friends (excavators) in the organization to support the exchange and increase the token value of the smart contract. As indicated by the agreement convention, the approving friends conclude regardless of whether an exchange is substantial. Assuming that it is substantial, the companions sign the exchange and add it to the new square. Whenever the exchange is approved, the new wellbeing data passages are put away in the brilliant agreement, and the versatile application is told of the outcome of the exchange.

Calculations.

We endorse our system at a procedure level by chipping away at two app. The first application works on the individual's cell to consistency information with the compact gadget and move them to the blockchain, and the going with one is a web application that enables success experts to imagine flourishing information base.

3. MILITARY BLOCKCHAIN IN HEALTHCARE

A writing discovery on the subject was directed in the attached bibliographic information database with the guide of a clinical exploration curator: Cochrane Library, Embase, MEDLINE, Scopus, Google Scholar, Compendex, ACM, IEEE and Inspec. The inquiry system compromised looking free of charge text terms for the idea "blockchain" inside wellbeing point information bases. In diversity information bases, the idea "blockchain" was added into the idea "wellbeing" utilizing the Boolean administrator AND. Inside the ideas, word variations and related terms were covered and joined utilizing the Boolean administrator OR. In reverse and forward search (compounding technique) was applied for the included papers to additionally guarantee that all related sources were exhausted.

Blockchain Platform	Main Improvement over Bitcoin	Network Permission	Consensus Protocol	Special Hardware Requirement	Smart Contracts Support
Bitcoin	N/A	Permission-less	PoW	No	No
Ethereum	Automatic Digital Asset Management	Permission-less or Permissioned	PoW/Proof-of-Stake (Casper)	No	Yes
Zcash	Privacy/Anonymity	Permission-less	PoW (Equihash)	No	No, under development (Zcash over Ethereum)
Litecoin	ASIC Resistance	Permission-less	PoW (Scrypt hash algorithm)	No	No
Dash	Privacy/Anonymity	Permission-less	PoW/Proof-of-Service (X11 hash algorithm)	No	No
Peercoin	Long-Term Energy Efficiency	Permission-less	PoW/Proof-of-Stake	No	No, under development (PeerScript)
Ripple	Low-Latency Transaction	Permission-less (Controlled)	RPCA/Consensus-and-Validation	No	No, abandoned (Codius)
Monero	Privacy/Anonymity	Permission-less	PoW (Ring CT)	No	No
MultiChain	Private/Permissioned Blockchain Network	Permissioned	PoW/Mining Diversity	No	No
Hyperledger	Business Blockchain Network	Permissioned	Pluggable, for example, Kafka for Fabric by default, Redundant Byzantine Fault Tolerance for Indy, Proof of Elapsed Time for Sawtooth by default, Sumeragi for Iroha	Various, for example, No for Fabric Yes for Sawtooth (Intel SGX)	Yes , for example, Chaincode for Fabric Burrow-EVM Integration for Sawtooth

PoW: Proof of Work.

FIG. 1 Blockchain Technology

As we can see from the Fig. 1, no blockchain is wonderful, and later on the best features may be taken on by the blockchain that stays keeping watch. It is implausible that more than 3 or 4 phases will end up being incredibly relevant to clinical consideration. To the extent that stages responsible to continue to be used for clinical benefits applications, Ethereum is at the main spot on the rundown since they merge the most appropriate features at the present time.

4. ETHEREUM PoW RESEARCH CHALLENGES AND SECURITY SOLUTIONS

Ethereum protocols or Ethereum platform utilized Power of Work. The second most continuous utilized consensus calculation was Practical Byzantine Fault Tolerance (15 %) [9]. A few of the distributions neglected to state which agreement convention their idea planned to apply.

4.1 Energy Consumption

The energy utilization of the incorporated Blockchain design is a central issue as both distributed computing and blockchain are energy-serious. The energy utilization of distributed computing is a notable exploration region and a few works in the writing proposed answers for energy-effective distributed computing Regarding blockchain, consensus calculations consume a lot of energy. Some compute-power, capacity-based, and casting a ballot based consensus calculations have been proposed for blockchain in the writing The compute-energy algorithms calculations such like Proof of Work (PoW) consume a high measure of energy.

To resolve the issue of energy utilization of the figure serious calculations, casting a voting-based calculations like Practical Byzantine Fault Tolerance(PBFT) [3] is utilized. Notwithstanding, PBFT includes countless message moves which could restrict the versatility of the framework, specifically for the medical services area. In addition, no work looks at the correspondence energy utilization of PBFT because of countless message moves.

The conceivable examination bearings could be further developing the equipment qualities of the cloud assets to make them more energy-effective or potentially to foster energy-efficient consensus mechanisms, for example, the cuckoo hash PoW.

4.2 Immutability and security

When an exchange is approved on the blockchain, it is inordinately difficult to change it, for the most part because of the decentralized way wherein data is put away. This trademark offers information respectability for the information saved in a blockchain-based framework. Consequently, to adulterate the information, they should roll out an improvement in most of the blockchain nodes, which is inordinately difficult, so the blockchain has an innate serious level of safety.

5. CONCLUSIONS AND CONTRIBUTIONS

In Europe, an assumption to work with the cross-line move of clinical records and improve medical care arrangements would require vigorous assurances of confidence in the medical services information sharing framework. On the one side it should permit patients to characterize their own information sharing arrangements, and on the opposite side it should follow various, perhaps clashing, official systems and medical care approaches, which in the European Union (EU) incorporate the General Data Protection Regulation (GDPR) [10].

A few arising medical care stages center around the mix of next-generation advances like Blockchain and Big Data arrangements out and out, engaging patients to control individual information and alter access rules. A definitive objective is the improvement of end-client experience, with satisfactory measures to address security and protection concerns connecting with incorporated clinical records that will be open anyplace, whenever.

Research on the utilization of military blockchain in medical care is currently settled as a scholarly field, and the number and nature of distributions are expanding quickly.

This pattern is likewise observable in the worldwide medical services modern area, in which the military blockchain innovation companies are supposed to mix $500 million by 2022. Because of the all-encompassing importance of keeping upward with trust while fulfilling an always expanding interest for ex difference in information inside the medical care environment, health care foundations are in basic interest for great trust-saving plans.

The wilderness of the thesis, as depicted in this survey, shows that blockchain-based arrangements as of now are being investigated in a couple of HER, PHR and Medical preliminary framework use cases [11]. A few other wellbeing data framework areas are under-investigated as we saw barely any distributions on knowledge foundations, picture documenting and interchanges frameworks, Automated analytic assistance for patients, Administrative frameworks, Population wellbeing the executive's framework and Pharma supply-chains. The exploration plan should be widened to manage these substantial regions, and to arrange the journey for blockchain-based arrangements that save trust by alleviating dangers from inside too from outside the medical care area.

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Management and Socio-Humanities

MENTORING - AN ORGANIZATIONAL NEED NOWADAYS

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***Abstract**: Today's organizations are different from those of two decades ago, and organizational needs have become increasingly complex. For this reason, organizational leaders play many different roles within organizations, such as the role of advisor and mentor. Really valuable leaders have usually been supported by mentors and have been mentors to other individuals. This has brought many benefits to both followers and leaders, but also to the organization as whole. The benefits of subordinates are many, from professional counseling to the existence of a role model. On the other hand, reverse mentoring brings to mind the benefits of mentoring relationships with subordinates.*

***Keywords**: mentor, leader, followers, organizations.*

1. INTRODUCTION

Organizations are in a process of continuous transformation, and the typology of jobs can differ in ten years or in fifteen years. Organizational adaptability, coupled with the thirst for knowledge and development are directly proportional to the ability to grow and develop the skills of organizational leaders. The mentoring activity is an excellent way to exercise this type of growth, given that it is a win-win activity.

From a classical perspective, mentoring focuses on people with different responsibilities. The more experienced mentor offers guidance to the person he is mentoring, in a continuous way, including in connection with career decisions and challenges. This type of mentoring is useful for progressive development, but if mentoring is transactional in nature, this should mean that only the mentor has new things to learn, which is not valuable enough. On the other hand, if the transformational nature of mentoring is addressed, both the mentor and the follower will prepare for the future, at a fast pace.

Who can become a mentor?

Anyone in an organization can become a mentor, a person willing to support the next generations of leaders, who wants to guide, advise, manage the careers of individuals in the organization.

If we were to list some of the traits of an effective mentor, we would put sociability first. A mentor is primarily a sociable person who establishes relationships easily and who will lead the dialogue more easily. Sociability is directly related to training. Sociable people are open to knowledge, to continuous professional development. They will have to work hard to avoid dominating a discussion.

At the same time, mentors are sincere people who can easily earn trust. Mentors show their feelings easily and it is easy for them to reveal themselves in an instructive relationship. In fact, in their case, the challenge is to look so honest and open in the face of the follower so as not to overwhelm or intimidate the other person.

In many cases, confusion can arise between coaches and mentors. In essence, we are talking about different relationships and different goals.

In order to differentiate between coaching and mentoring, we need to take into account the length of the relationship between the two parties. In coaching we talk about a short-term professional relationship, a relationship in which the coach uses all sorts of techniques that determine the follower to develop on a personal and / or professional level. The tools used by the coach are creative thinking and challenging to think differently. When we talk about mentoring, we have in mind a long-term relationship, in which the two people interact for the benefit of both. The mentor helps the learner to adapt to the job, supports him in developing the necessary skills at work, and the mentor helps the mentor to develop his leadership skills.

2. THE IMPORTANCE OF A MENTOR IN PROFESSIONAL LIFE

Identifying a mentor is as important a decision as it is complex.

"*Mentors are crucial whenever people are faced with new phases of their career or life that require the development of new knowledge, skills or attitudes," says mentoring expert Drew Appleby, PhD, professor emeritus at Indiana University-Purdue University Indianapolis. "Mentors help people determine who they want to become, how they must change in order to become these people, and how they can take advantage of their college or work experiences to bring about these changes*."[1]

Mentoring can be of many types, from school counseling which can be considered a form of school mentoring, to informal relationships that individuals build during their professional life. Although apparently only people at the beginning of their career choose mentors, the practice shows that even in mid-career a mentor can be helpful. Career mentoring takes the form of an informal relationship that begins without too many initial plans. "*You may meet someone, have a conversation and suddenly realize you'd like to be like this person," he says. "If this person shows a genuine interest in you, that's an ideal way for mentoring to begin*."[1]

For example, psychologist Jean Carter, PhD, of Washington, D.C., says that throughout one's career, mentors have offered support in making a variety of choices, such as the decision to go to graduate school or to change an office into a common space, in a dedicated room.

"*Informal mentoring can be a one-off event, episodic or continuous," says Carter. "It can be as simple as once talking to someone who has given you a perspective that has influenced your career. If you're open to mentoring, it's more likely to happen.*

Informal mentoring can be a single meeting, episodic or ongoing," Carter says. "It can be as simple as one time when you talked to someone who gave you an insight that influenced your career. If you are open to those mentoring moments, they are more likely to happen."[1]

The monitor interviewed five mid-career psychologists to find out how their mentors found themselves, how mentors helped them succeed, and how they helped others.

3. TRANSFORMATIONAL MENTORING

Transformational mentoring is a term that perfectly describes the two-way relationship of mutual interaction of the mentor, with the mentored one, which requires an equal amount of work from both, but which offers benefits to both. As a mentored person, the secret to fully involving your mentor is to identify the right person: the person with whom you can build a relationship based on trust, a relaxed, inspired relationship, dominated by curiosity, as opposed to the traditional exchange between leader and follower that we normally know. This type of mentoring can be approached with more experienced people or colleagues on an equal footing, as long as there is a mutual desire for personal and professional growth.

In this sense, we can take as an example Albert Einstein who had very close relations with Werner Heisenberg and Niels Bohr. Although of different ages and experience in various fields, they shared a common fascination with theoretical physics. Guided by genuine curiosity and having honest conversations, each of them have made significant strides in the field of technology and rapid innovation over the years. For a long time, the three great personalities organized meetings and corresponded. Their visions were not always the same, they did not try to convince each other of anything. Instead, they proposed new ideas, asked questions, offered proposals, and supported each other's seemingly terrifying notions. This approach is the secret to attracting and maintaining transformational relationships between mentors. Here's how to get started.

Look beyond the common

It is certainly a challenge to overcome the traditional approach of mentoring, that of teacher-student, when the mentor is a leader in the organization. The secret in identifying a potential mentor is to be compatible with your area of interest and the organization itself.

A first step in identifying the right mentor is the introspection into one's passions, interests, and curiosities. For example, if you are interested in new developments in the field of technology, it would be appropriate to identify the personality in this field that inspires you, whose activity you admire. In general, the people who captivate you are those whose knowledge, attitudes and behaviors can serve as a model and guide for career advancement.

People eager for innovation and change can easily transform into mentors. In the process of exchanging ideas, it is possible for everyone to discover perspectives that have never been taken into account before, aspects that inspire both people and make them go beyond their own limits. In order to identify these people, it is advisable to take advantage of the professional network, but also the external network of relationships.

The process includes several people. As with Einstein, sometimes the process works better with a lot more people. Even if you are not part of the group, there may be a valuable mentor at different times in the growth process.

It is very important to resonate with the potential mentor you meet. You need to make sure that a genuine connection can be created for the relationship to evolve.

Moreover, the ultimate goal is to create a connection with your mentor that gives you meaning and allows you to exercise and receive that much-needed influence. The transformational mentor should be the person who does not give you direct explanations, but the one who attracts you in conversations from which you will be able to learn and develop.

The relationship between the transformational mentor and the follower should be similar to a long-term investment, from which everyone involved must learn something.

The mentoring relationship is not one-sided, it is not a one-way street. This says that the influence is exerted in both directions. The mentor is the one who guides, supports the follower, but the follower can also exert a profound influence on the mentor. The follower can also guide and become a mentor to others. This process can help you reflect on your own strengths as well as your weaknesses, and also help you to use the skills you have acquired through your own mentoring. Supporting and guiding another person, certainly, the follower who this time becomes a mentor exercises his communication skills.

4. SOME RELEVANT ASPECTS OF REVERSE MENTORING

Traditionally, mentoring connects senior leaders with younger workers, with the goal of mentors to provide support and advice to help their follower in their profession. Certainly, as long as the typology of jobs changes and mentoring acquires new values. With these changes, new ways are emerging in which individuals learn from each other, support each other in their career development process.

Reverse mentoring is one of the models that organizations can adopt, apply and adapt to depending on the situation.

One definition of reverse mentoring is that it focuses on junior employees who in turn become mentors for senior leaders. "*For many organizations, the goal of reverse mentoring is to give leaders a new perspective on growing trends in technology or the future of work.*"[2]

This form of mentoring, which has become quite popular in our times, reverse mentoring, is one with many benefits for both individuals and the organization.

Trust is the most important value on the basis of which the relationship between the mentor and the guided person is built, but also the virtue that is the foundation of the mentoring process. Trust and experience are two interconnected elements that are born and run side by side. Trust-based partnership.

A few advantages of reverse mentoring:

4.1 Knowledge transfer

Regardless of the importance we place on learning, it is clear that any organization has a culture of learning. Physiologically, we are always ready to learn. Continuously and constantly, employees absorb information, knowledge and make decisions about how to act, and learning-centered experiences happen all the time in organizations.

Learning is a continuous process, which focuses on the two extremely important characters: the mentor and the followers. Gradually, in the mentoring process, knowledge is transferred between the two entities, so that each of the two parties has something to learn. The mentor provides advice, is the guide of the follower, while the follower is the one who transfers knowledge and creative ideas, innovative to his mentor.

4.2 Sharing digital skills.

A central element of reverse mentoring relationship is the development of technological skills.

"*For example, the current CEO of BNY Mellon's Pershing (then COO) used his mentor to help him with social networking, which he never integrated into his professional life. Now he is one of the most passionate users of According to Cimino, "Jim [Crowley] of social networks, and this has completely changed the way he interacts and communicates with employees ... Jim is incredibly active on [our internal social networking platform]. [He] is, also actively representing the company [on LinkedIn], which has never been done before this program.*"[3]

4.3 Culture exchange - a step forward in implementing change

Although experience is vital to the smooth running of an organization, the future is very important, and in some cases change is imminent. The implementation of reverse mentoring programs at the organizational level is part of the much-needed changes in an organization. For example, "in addition to educating senior executives about the importance of social media influences for the overall shopping experience, Millennial mentors developed Dreamspace, a knowledge-sharing portal for brainstorming. Estée Lauder distributed bi-monthly alerts to employees, including the executive management team, on key topics discussed on Dreamspace. Kennelly from BNY Mellon's Pershing told us that she and her student discussed why young people are not attracted to the financial services profession. "*It simply came to our notice then. I came back with three reasons, including a general distrust of the industry, the negative portrayal of the industry in the media, and the misconception that the profession was just about sales. He then used these motives to shape the recruitment strategy.* "[3]

4.4 Reducing generational gaps

When outlining the mentoring process, the relationships that are established are between a more experienced person (the mentor) and a younger employee (the follower). Given the consistency of these relationships, the gap between the two generations can be bridged.

4.5 Developing leadership skills in younger employees

Leadership skills are vital in the leadership process. Being close to real mentors, observing their behavior in certain leadership situations, followers can properly model their leadership skills so that they are able to cope with a wide variety of situations in which they will be put. On the other hand, mentors can hone their leadership skills by listening to the needs of their followers and trying to adapt to their requirements.

4.6 Sharing different perspectives

When two people in the mentoring process interact, they realize that exchange of ideas so beneficial for each of them. The mentor transmits his own knowledge, his own experiences and reveals his own abilities in the presence of the person he guides, and the follower presents to him his own perspective on things. This exchange of knowledge is vital for the two people involved in the mentoring process.

5. CONCLUSIONS

In general, competitive organizations offer employees, in addition to material rewards, the opportunity to progress and grow, both personally and professionally. Mentoring programs are the ones that contribute to this evolution of employees in organizations.

Organizations that do not offer employees the chance to develop a successful mentoring program fail to excel in extremely important areas of management, such as: organizational culture, staff retention, motivation.

The relationship established between the two people involved in the process, the mentor and the follower, is one based on mutual trust, inspiration, respect and appreciation. It is, in fact, a learning relationship in which both people have benefits. The follower benefits from a career model, is guided in outlining a career plan, has support in identifying opportunities and obstacles that they do not take into account. The mentor, in turn, has certain benefits in this relationship.

He has the chance to learn about elements related to new technologies, social media, get in touch with new trends in the virtual world. All of the above complete the picture of the close relationship between the two people, the mentor and the follower.

Transformational mentors have a decisive influence on the personal and professional lives of those they support and guide. All the actions they take are not only declarative, but they are real tools by which followers evolve and progress in the workplace. Certainly, these elements can be possible only by guiding mentors on the relationships created with followers, by the existence of mutual trust, by the desire for organizational change.

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THE IMPORTANCE OF TRANSFORMATIONAL LEADERSHIP IN ORGANISATIONS

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***Abstract**: Transformational leadership is an area of leadership that is frequently discussed nowadays because of its positive effects on organizations. This leadership style is preferred by leaders who believe that innovation and creativity are the best tools to streamline the organization and make it evolve. By personal example, transformational leaders manage to induce change in their subordinates and make them not afraid of change. They inspire and motivate their subordinates, giving them confidence in their own strengths and encouraging them to make decisions within the organization.*

***Keywords**: change, leader, organisations, charisma, motivation.*

1. INTRODUCTION

In general, the difference between a successful organization and a failed one is the result of the leadership process. In this context, it is certain that the leader is the main actor who stages one approach or another, in order to achieve the desired results. The secret is to find the right approach that will lead to organizational success.

Transformational leadership is that type of leadership that combines several useful aspects in this process, such as innovation, open-mindedness, participation, desire for change, elements through which leaders manage to obtain maximum efficiency from their subordinates.

Transformational leadership is a leadership model used in various fields such as technology, economics, entertainment, education, politics or the military.

"*When you look at people that are good examples of transformational leaders, you think of the people that have had an impact, whether that's on an organization or on the country. These are the people that can rise to any challenge and bring everybody together collectively to make a difference.* "[1]

In order to give a definition of transformational leadership, we can say that it is based on the involvement and motivation of subordinates in building a bright future for the organization. Of course, this flourishing future cannot be built with great ease. First of all, the leader establishes and transmits the common goal of the group, an aspect that is based on the vision of the organization. The organization's vision contains the organizational mission and objectives, both in the short term and in the medium and long term. Without a clear and concise vision and mission of the organization, leadership cannot be achieved with maximum efficiency.

„Les Stein, PhD, assistant teaching professor in Northeastern's Master of Science in Leadership program, believes a truly transformational leader can enter a struggling or stagnant organization, analyze the circumstances, and articulate needed improvements almost immediately. He or she should then be able to guide the organization in defining or redefining its core values in a way that unites the group in a common effort."[1]

Secondly speaking, transformational leadership is centered on team unity, the common goal that all team members adhere to and that everyone has, as their primary goal, as an intrinsic engine for engaging every component of the organization.

2. SOME RELEVANT FEATURES OF TRANSFORMATIONAL LEADERS

The transformational leader is the leader who determines a change and outlines a new vision that will be inoculated to the subordinates through the idealized influence.

According to Warren Bennis, *"the ability to lead is the ability to turn vision into reality"*[2]. As such, the transformational leader is the one who anticipates, with the help of a new vision, the future of the organization he leads. It causes change, imprints a new vision, sees beyond the horizon. However, is this new vision really needed?

Thus, *"a strong vision can facilitate the interest and ability of followers to set goals and believe that these goals can be achieved, to generate an optimistic assessment of the future, to build confidence in the ability to perform tasks successfully, and to discourage defeatist manifestations, because a favorable future is very near and it suits everyone."*[3]

Transformational leaders are those who have the ability to instill in their subordinates the idea that common organizational purpose, motivation, and organizational culture are the keys to success. Everything must be done together.

A transformational leader is: visionary, team-centered, inspirational, cooperative, with emotional intelligence, ethical values and outstanding communication skills.

3. APPLYING TRANSFORMATIONAL LEADERSHIP IN THE MILITARY ORGANIZATION

The concept of leadership is one that defines military activity, being the main factor that indicates the performance and success of military structures and implicitly of military leaders. The latter are the ones who play a very important role in promoting the quality, efficiency and effectiveness of the leadership process. Leaders are also the ones who build confidence, inspire, build teams and maintain team morale.

Moreover, the leader is the one who motivates his subordinates and gives them the necessary moral support to carry out all activities. Given these elements, transformational leadership is best.

However, using such a leadership style in a conservative, rigid, bureaucratic organization such as the military organization is a major challenge for all those involved in the leadership process. Therefore, transformational leadership in the military environment is an important topic, around which parts of military doctrine have been redefined.

„Research in the military environment confirms the positive impact of transformational leadership style on subordinates in several respects. For example, when subordinates perceive leadership to be more transformational, this results in stronger identification and internalization with respect to leaders. Research has also shown that transformational leadership increases subordinate's military hardiness and individual creativity.

Transformational leadership style can foster interpersonal and organizational relationships, and it creates a friendly atmosphere that increases satisfaction, motivation, and defense commitment. " [4]

If we turn our attention to the transformational leader in the military organization, he is the one who deeply perceives the importance of the military organization in society and at the same time develops that overall vision of the organization, being a supporter of change. At the same time, the transformational leader makes dynamic decisions and identifies opportunities, successfully using all aspects that favor change.

Certainly, there are many elements in the military organization that oppose change or act against change. Resistance to change is quite common in the context of military leadership. This can be manifested at the level of any echelon of the army, related to a multitude of aspects of the way the military organization works.

The change brings disorders at the individual level, disorders triggered by the existence of internal misunderstandings, states of anxiety that are based on the fear of accepting these changes. The new directions and values imposed by the leader can generate various emotions within the teams.

The transformational leader is the one who has to manage and solve a multitude of difficult situations, when he wants to implement changes in the structure he leads. He uses his empathy, but also his intelligence and persuasion, in order to identify the most appropriate means by which to influence his subordinates to give up the values of the past. Certainly, detachment from those values is not a simple act, but it requires a lot of effort from all those involved in the leadership process. It is foreseeable that at the beginning of the implementation of the change, there may be a slight disorganization, which may give rise to negative emotions among subordinates. However, for the leader to implement a successful strategy that will positively change the organization, this strategy must be simple to perceive, logical, persuasive, with a concrete plan of implementation, with correctly established tasks and responsibilities. The real motivation of subordinates in the direction of change is vital in its implementation. The process of applying change is a broad one, and the leaders who achieve it must have certain mental qualities, such as: cognitive, emotional and social intelligence, enthusiasm, loyalty, trust, developed communication skills.

Bernard Bass is the one who built the four very important dimensions of transformational leadership, namely: unrealized influence, inspirational motivation, individualized consideration and intellectual stimulation. These four dimensions, which practically define transformational leadership, highlight certain traits, attitudes and behaviors that transformational leaders have and that help them decisively in the leadership process. In fact, transformational leaders do not intend to persuade teams to conform, but rather encourage their subordinates to evolve while giving them the opportunity to be creative.

„Bass identified four leadership factors or behaviors that characterize transformational leadership. The first is "idealized influence" or charisma. This factor defines behaviors through which the leader cultivates admiration, respect, and trust in himself among followers. Examples of "idealized influence" include doing what is right rather than what is most convenient and making decisions more transparent by explaining the rationale behind the decisions. Leaders with "idealized influence" are able to obtain extra effort from followers to achieve optimal levels of performance."[5]

Idealized influence is very important because it focuses on the charisma that transformational leaders have and with the help of which they manage to influence their subordinates, in order to achieve change. Moreover, with the help of charisma, leaders inspire confidence, are transparent, are not perceived as individuals who hide something,

are ethical and have moral values. They are also persuasive individuals who succeed in convincing their teams of the need for change.

„Bass' second transformational leadership behavior is" inspirational motivation, "which refers to the actions the leader takes to present a vision, set high standards, and convince individuals that they can achieve beyond expectations. Transformational leaders assess the organizational environment both internally and externally to develop a mental picture of what the ideal end-state of the organization ought to be, given the expected future environment. Then, based on "knowledge and values" gained from experience, the leader develops a unique vision for the organization. This vision is more than a goal, unit objective, or commander's intent for a particular operation. It is a value or collection of values that members of the unit believe in and are willing to rally around. The vision is developed as a collaborative effort between the leader and subordinates, with the leader performing the critical role of integrating and guiding the process. The leader through speeches, policies, behaviors, or symbols communicates the vision, provides a sense of direction, purpose, motivation, and identity for members of the organization. When members "buy in" to the vision, they perceive it as worth the effort, creating energy, commitment, and a greater sense of belonging among members. When shared throughout the organization, the vision can move members to significant achievements."[5]

Closely related to inspirational motivation is the attitude of the leader who encourages his subordinates to achieve more than they think they can achieve. Around the transformational leader, the subordinates feel capable, strong and feel that they have a point of support in any situation.

The third important dimension of transformational leadership is directly related to how the leader perceives the needs of subordinates. Individualized consideration involves reporting leaders to subordinates as distinct, important individuals, with leaders concerned with their ongoing training and professional development. Closely related to this dimension, we identify the mentor and counselor components that any transformational leader has. Meeting individual needs, in the context of general goals that need to be met, is a challenge for leaders. This challenge is being successfully met by transformational leaders.

In the military field, individualized consideration is applied by transformational leaders in the context of a fairly rigorous organizational culture that promotes equidistance and an equal and impersonal regime.

The key to this dimension of transformational leadership is deep knowledge of subordinates. Once this condition is met, a close bond can be created between leaders and subordinates, and from here to motivating subordinates to perform is only one step.

The fourth transformational leadership dimension is intellectual stimulation or creativity. *„Transformational leadership values creativity and autonomy among the leader's followers. The leader supports his followers by involving them in the decision-making process and stimulating their efforts to be as creative and innovative as possible to identify solutions.*

To this end, the transformational leader challenges assumptions and solicits ideas from followers without criticizing. She helps change the way followers think about and frame problems and obstacles. The vision the leader conveys helps followers see the big picture and succeed in their efforts."[6]

The transformational leader encourages and mentally stimulates subordinates, causing them to analyze situations and identify possible solutions to problems that arise. In fact, it is about applying the democratic, participatory leadership style, with the help of which the leader asks for ideas and solutions from his subordinates. In the decision-making process, the leader listens to his subordinates, gives them confidence, uses their thinking

and decision-making skills. In this way, the leader manages to get more benefits for the organization. The most important of these is the development of new leaders.

Certainly, the intellectual stimulation of subordinates, doubled by confidence, encourages and supports them in their subsequent development. In this way, leaders raise other leaders.

4. CONCLUSIONS

Transformational leaders are the people who energize the activity, being full of energy and dynamism. It is clear that these traits can make the difference between an efficient and an inefficient organization. Transformational leadership is used in various organizations such as the military, hospitals, schools, multinational companies. If we look around us, all organizations are changing, which is really necessary.

This type of leadership stimulates, under all circumstances, the use of employees' skills, encourages people cognitively, as well as emotionally. These elements can be achieved by influencing their ideas, by identifying new ways in which issues can be addressed, with an emphasis on solving problems through diplomatic means. Team members are treated as individuals, as important people, and they are encouraged to use their creativity in a variety of situations. Moreover, in the elaboration of the vision, the transformational leader exerts influence on the individuals according to the missions they receive, highlighting the respect and responsibility towards themselves and towards the other members of the organization.

If we refer to the military organization, the ultimate challenge of the leaders of such organizations is the way to implement the change, in the conditions of a rigid institutional system, strongly legislated. However, transformational leaders manage to implement change, to bring elements of novelty, to be the main actors on the stage of organizational resizing. Using their own charisma, charm and emotional intelligence, they manage to bring a new breath to the organization and be the vectors of effective transformation.

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PERSPECTIVES ON RISK MANAGEMENT IN CRISIS TIMES

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Abstract: *In general, as well as from a theoretical perspective, the management process is designed on a certain level of predictability and is carried out through adaptation, integration, etc. to the specific context in the moment of implementation. But in the last 2-3 years the management has had to suddenly and abruptly reformulate the ways to manage the achievement of the assumed objectives, especially the reinterpretation of risks and their management, because the predictability of the environment has become almost impossible to determine. The structure and components of risk, on the one hand, and their identification, monitoring and treatment, on the other hand, have become the main challenges of current management.*

Keywords: *management, risk, forecast, adaptability, crisis*

1. INTRODUCTION

Normally, a realistic managerial "construction" is based on the correctness of forecasts across the spectrum of areas of the environment, so that the managerial strategy - the essential component of a successful management process – will be easy to apply, track and achieve. But a lot of forecasts, both in number and in structure and value, had to be updated at time intervals on more and more short. This phenomenon can put us in the situation of asking ourselves: "how much of the adopted strategy can be implemented and when do we need to change it?" The difference between the predictable value of the forecasts and the actual result obtained is determined by the risk management at the level of each organization. I believe that the delimitation and association of risks with the way of the management process is carried out entails a redefinition of their importance in the current approach to the development of all activities.

FIG. 1 Risk - an essential component of the objectives achievement process

It is obvious that risk is not a concept or an element of novelty for the management process, but the strong inclination of this period towards a very pronounced uncertainty generates a repositioning of it in this system.

2. ANALYSIS OF THE CURRENT ECONOMIC CONTEXT RELATED TO RISK MANAGEMENT

The analysis of the economic situation prior to the onset of the Covid-19 pandemic did not imply that managers had high concerns about an abrupt or unpredictable evolution of the specific environmental factors of their own companies. Because as can be seen in fig. 2, the general trend of gross domestic product (as a generic indicator) from 2016-2018 was on a steady growth, so management teams had to focus on ways to achieve their goals mainly by gaining competitive advantage in the industry/ sector/ segment of activity.

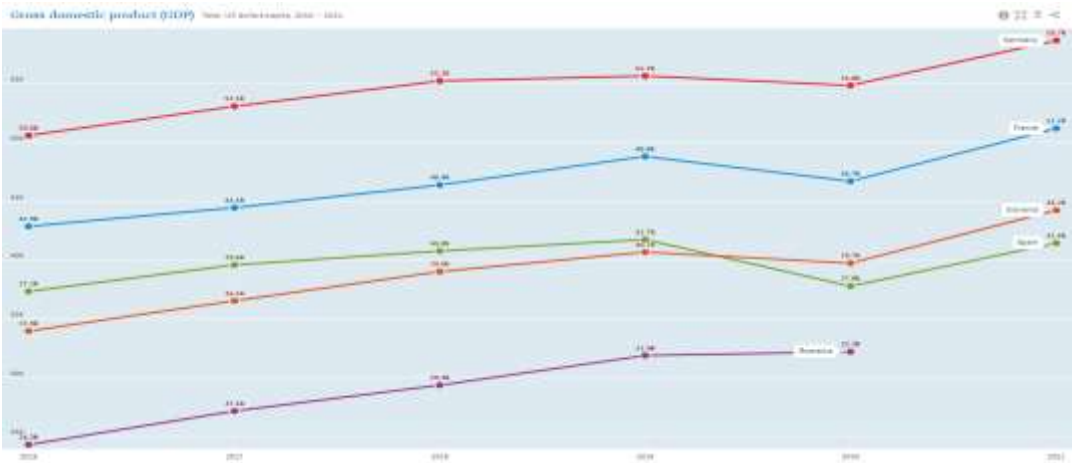

FIG. 2 Evolution of Gross Domestic Product 2016-2021 for several European countries [1]

But specific actions to maintain some control and limit the spread of the Sars-Cov-2 virus have led to a new crisis, fundamentally different from that of 2008-2010. A crisis that could not have been predicted before, and although analysts predicted a much shorter period, which extended to a similar period as the previous crisis. Looking at the same GDP indicator for the five selected countries (Germany, France, Slovenia, Spain and Romania), a sinuous and different evolution can be observed from country to country, being the result of the amounts of managerial decisions at the level of each company. It is well known that managerial decisions also include an assumed risk because they are based on future developments of various influencing factors, both internal and especially external.

In this case, the risk was generated by the multitude of current decisions taken in each country, based on the number of daily illnesses, leading to decisions within companies that were mostly reactive and less proactive as desired in a normal management process. In this context, managers have been forced to take more action to limit losses caused either by temporary cessation of activities, or by the reduction in the number of employees who were able to work normal hours, or by blocking or reducing supplies of raw materials or materials. or product distribution, etc. and less for pursuing the efficiency of the planned activities.

Moreover, the previous elements underlying the analysis, identification and determination of risks were no longer fully valid, the specific situation generating an exponential increase in new factors that had to be analyzed in a very short period of time and based on some vague or highly volatile information.

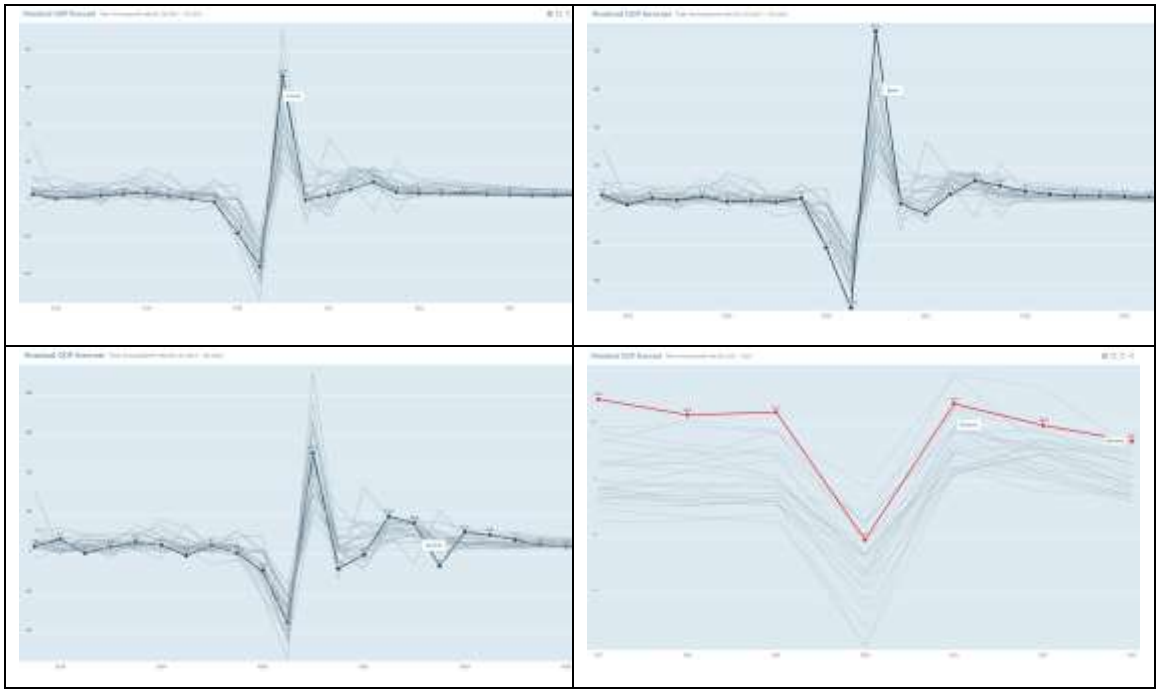

FIG. 3 Annual GDP growth rates until 2023 [1]

And the short-term predictions about GDP growth rates, as can be seen in fig. 3 for France, Spain, Austria and Romania, are not encouraging because the growth rate is inconsistent and with lower values than in the period before the pandemic.

The launch of Russia's invasion of Ukraine has not allowed the economic situation in the eurozone to recover, but rather exacerbates the evolution of certain factors of influence, especially those with far-reaching consequences in ensuring stability, at least in the short term. And the future is not too rosy: ”*The realisation of the key working assumptions underpinning them – regarding the evolution of the geopolitical situation and its reverberations in e.g. commodity markets and trade – is subject to high risks. Namely, further increases of import prices could strengthen the stagflationary forces unleashed by the war. Greater than expected second round effects could amplify them. In addition, strong inflationary pressures could lead to tighter financial conditions than those underpinning the forecast, with negative impact on domestic demand and strains on public budgets and the banking sector. A stronger-than-expected deceleration of economic activity in the US and China would further dent growth in the EU. Finally, COVID-19 remains a risk factor. At the same time, private consumption could prove more resilient to increasing prices if households were to use more of their savings for consumption.*”[2]

And when we talk about risks, they are not unique and involve a series of interconditioned events with different degrees of probability, which can multiply the losses, especially in the short term.

3. RISK MANAGEMENT - WHERE TO GO?

As stated above, the objective-risk correlation needs to be redefined, at least for a short period of time, so that managerial decisions can continue to ensure the proper functioning of the organization. ”*Strategic risk management is really about preparing for the worst but hoping for the best.*” [3] This statement would be realistic if we were in a normal situation, but the current context cannot be included in this category, so I consider that the long-term approach to the issue of risks is very dangerous.

FIG. 4 Current crisis management solutions in times of crisis

Risk management in an organization should address the following:

a. *Establishing a specialized risk management team*. The pronounced and, in some places, uncontrollable dynamics of the factors that influence the activity of a euro area organization, with contradictory information in many situations, require a relevant, fast and accurate analysis of both the list of risks and their treatment solutions. Today's risk decisions need to be fast and very accurate, so managers need adequate support for these actions.
b. *Achieving an integrated risk management*. The team specialized in risk issues should address them in a complex, systemic way. The current sources of risk are located in the area of raw materials (cereals, oil, iron, etc.), the elements of entry into specific processes and it is absolutely necessary to track the connections between effects in each compartment of the organization. The cascading effect is the most dangerous in terms of risk because the losses can often be insurmountable.
c. *Reducing the length of supply channels*. Time is the essence of monitoring and dealing with risks and if it can be reduced it would be a great advantage in achieving the proposed objectives. During the pandemic time and now during under the conflict in Ukraine, links in the supply channels are blocked or there is an increase in waiting times on various logistics platforms. If it is possible to eliminate the intermediate elements of the supply channels, then the sources of manifestation of related risks can also be eliminated.
d. *Reducing the length of distribution channels*. In the opposite direction to the previous solution, the reduction of the length of the distribution channels contributes to the control of the sources of manifestation of the risks related to this

activity. Providing products and services in the most condensed time is one of the ways to achieve a high level of consumer satisfaction and therefore reduce the risks that may arise on the road from producer to beneficiary can be achieved by reducing distribution time.

The complexity of the risk management process in the overall management process of an organization requires actions specific to the context and timing of the planned activities. That is why I do not consider the solutions presented to be exhaustive, but they are solutions available to every management team to reduce the occurrence of risks and their effects.

CONCLUSION

Risk is an intrinsic component of any economic activity and is currently managed in optimal conditions by most managers. The specific conditions of a crisis period, regardless of its nature (economic, social, political, military, etc.) generate a constant pressure on the decision-making process in any organization, with obvious implications on risk management: redefining the typology of risks, resizing the speed of reaction or reconsideration of their treatment capacity etc. leading to more or less advantageous results for the entities concerned.

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Aeronautical and Atmospheric Sciences

STATISTICAL APPROACHES TO AEROSPACE RISK MANAGEMENT

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Abstract: *Training staff on the safety line is essential to prevent and minimize losses of any kind. Safety culture is designed to motivate staff to identify risks of any kind, to report them to improve the quality of activities and to eliminate stress levels. This culture is mainly based on education focused on training courses, motivation, discipline, attitudes and understanding the concept that any member of an organization has the role of protecting and increasing the quality of life, of the goods that they exploit and that others will exploit. Understanding these concepts prepares a safe environment for everyone around you, increases trust in the collective and decreases the level of stress in carrying out activities.*

Keywords: *awareness, culture of safety, pilot inspections*

Acronyms

EPAS	European Plan for Aviation Safety	ICAO	International Civil Aviation Organization
NASA	National Aeronautics and Space Administration	NTSB	National Transportation Safety Board
SOP	Standard Operating Procedure	TRL	Technical Readiness Level

1. INTRODUCTION

There is an old saying: „A smart person learn from the others mistakes, meanwhile a naive one learns from his owns”. The educational process begins at an early age and the more we assimilate,our body improves its qualities.

Involving active in the educational process we improve our life quality and also those around. Children are watching us and learn because they want to pass on genetically the assimilated information. The educational process it’s very complicated, the eforts are very big for a positive rezult. There are very well trained and passionated theachers who put maximum effort so the information transmitted is understood.

If the education and self-esteem are important in our lives, the level of safety will be bigger. Safety is everywere and is part of our lives, that’s why, the main ideea of this article is safety, safety culture and airspace security.

The purpuse of safety education is to create awareness of staff in all sectors to prevent dangerous situations. The exercises and trainings have the role of creating a calm workplace in order to solve a real dangerous situation.

2. CULTURE OF SAFETY

The manager of the organization has the role of encouraging the safety culture in order to increase the quality of life but must pay special attention to not create any confusion with the idea of doing negative things.The fear of reporting can be eliminated when the manager appreciates and encourages any risk reporting of any kind, even be the initiator of this reporting model.

The safety culture must be implemented at any hierarchical level and at any age and must be understood. Organizational experience should not be an advantage in the line of safety, but must increase its level.

Lessons learned from voluntary reporting are subject to the safety culture because it better describe the risks in which the members of the organization have been subjected and must be analyzed down to the smallest detail.

The "Swiss cheese" analysis mode shows the shortcomings in a system, but also the fact that the model of the lessons learned has not been fully applied. In conclusion, if a mistake has been repeated, it means that a link in the chain of lessons learned has been broken.

2.1.Pilot inspections

When relations between crew members and ground maintainers are good, it turns into a partnership. The more the pilots adopt a friendly relation with the members of the technical team, the greater the rateof mutual trust. Engineers seek to develop relations and interests in long-term aircraft operation, while pilots seek to execute a safe flight. And then, why are they looking for or discovering, problems at the inspection of entry into service? They may discover problems and the flight may be cancelled and passengers may have their flight postponed. This is one reason why pilots fall into the trap of evasively taking over the aircraft. For fear of flight cancellation or delay, many pilots or engineers overlook some problems. But can't this lead to a catastrophe? Strengthening the safety culture must start from this level even if the aircraft needs additional work or the pilots do not feel at full capacity.

From the point of view of the commanding pilot, the aircraft must comply with the minimum criteria of flight safety, otherwise it will order the cancellation of the mission due to the possibility of endangering human lives.

This model could work for many years, but let's think about another aspect. We can look at flight safety as a pyramid, made up of many blocks of stone. Each block of stone is a risk factor for flight safety. If a few blocks are missing, the pyramid becomes unstable and can overturn. If the base of the pyramid is missing a few blocks, the pyramid can not be built, so the flight can not be complited.

2.2.The link between chaos theory and aviation events

The basic idea of this article is to analyze the probability of occurrence of an event. Therefore, we present some definitions:

Event: An event means performing an action regardless of the result achieved. Events can be: possible (the action has been fully performed), impossible (the action cannot take place) and random (the action may or may not take place).

The probability of an event occurring is defined as the number of favorable occurrence cases relative to the number of possible occurrences of an event. Most aviation events are reported per 100,000 hours of operation resulting in a safety indicator also called the dispersion of events.

ICAO (International Civil Aviation Organization) statistics show that in 2020, being the first year of the pandemic, the number of people who used the plane as a mean of transport was 1.8 billion, compared to 2019 when there were 4.5 billion. In the same report, the link between the number of people and the events recorded is observed. From 2019 to 2020, there is a 58% decrease in the total number of accidents. The global accident rate of 2.14 accidents relative to the number of takeoffs in 2020 decreased by 20% compared to 2019, when there were 2.94% accidents on the number of takeoffs. In conclusion, the probability of occurrence of events is related to the number of possible situations. That is, a higher number of takeoffs, a higher percentage of accidents.

The aeronautical safety model that we can approach in this theme is a pyramidal model, having at the base of the pyramid the aeronautical safety culture that is formed by basic aeronautical training courses (navigation, aerodynamics, regulations, etc.), and at the top is the finality of the aeronautic activity, that is, the disembarkation of passengers.

Knowing and understanding the situation leads to good situational awareness. An NTSB (National Transportation Safety Board) study states that a significant percentage of the number of accidents is caused by "*poor monitoring of attention*". The premise is simple: Monitoring is only effective if pilots recognize and understand what they are "monitoring." That is why training in all areas is very important. The better aviation personnel know the procedures, the greater the rate monitoring.

Solving a special situation during activities has positive results only if the staff knows the possibility of that situation occurring. In other words, a person must always be prepared to intervene in the event of a special situation. When pilots become distracted or inattentive to monitoring, they are prone not to recognize potential errors. NTSB researchers point out the importance of recognizing initial problems (cues), that is, the fact that a problem provides signals of early occurrence.

Early signals are often neglected because pilots do not give them the necessary importance. For example, a common mistake that multi-engine aircraft pilots make is the misinterpretation of the misalignment of the engine speed. This was the cause of the crash of a civilian aircraft in 1982 when the loss of both engines at a B 737 could be predicted because engine indicators were low from normal (but not below limits) and the indications fuel installations were different from normal (but not below limits).If the crew had been more rigorous in understanding the errors and not only scanned the indications, the crash would not have occurred. This is an example of continuous monitoring of attention.

A NASA report on situational awareness using an NTSB study based on accidents between 1978 and 1990 shows that most fatal accidents in civil aviation are the result of the action or inaction of the crew (the human factor has a large share). On a one-off basis, out of 302 errors identified from 37 accidents analysed, the NTSB reported that 84% of them were monitoring and situational awareness errors.It is important to note that no crew member from the analyzed accidents performed activities that could have distracted them – that is, all flights were routine flights. In other words, crew members did not monitor flight activity with maximum attention and were surprised by the appearance of a special case as if it could never happen. The basic idea is that we must carry out our work as if a special situation could arise at any time.

The same study shows that 80% of monitoring (flight surveillance) errors occurred in the approach phase for landing of the flight and at the pilot who is not at the controls on that segment. Flight experience (number of hours) was not a significant factor. In most accidents, the NTSB identified 2 major problems: inattention due to poor monitoring of the devices and errors in the decision-making process of the pilot who is not at the controls. [1, 2, 3]

2.3.Prevention

The way we can improve the quality of aeronautical safety training and culture is by adding elements in the preparation of the mission such as:

a) During the briefing setting a high tone of the officer's voice with aeronautical safety;

b) Insisting on safety features during the mission briefing on all participants in the activity;

c) Insisting on the use of SOPs in order not to omit any details;

d) Abandoning one's own idea in case of identifying better ideas;

e) Opening free discussions regardless of its nature;

f) We ask the question: "How could we have done better?"

g) Discussion about what is right and not about who is right.

3. AVIATION SAFETY

3.1.Human error

It is easy to understand that the human factor plays an important role in flight safety due to latent behavior and psychological factor. ICAO defines error as “The action or inaction performed by an organization or person that causes damage or deviations from normal behaviors.

Human error is the most common cause of aviation accidents. Even if the action is unintentional and causes damage it is considered a determining factor. In any case, uncertain conditions, regulatory violations, errors and weaknesses in a system always lead to failure. These errors, somethimes individual, create niches or holes that cause failures in the operation of the system that will inevitably collapse. Moreover, latent conditions are sometimes created by engineers or ground personnel who superficially perform tasks because they are not directly involved in the flight activity. [4, 5, 6, 9]

Table 1 Analyzes the main types of human errors in terms of intent

Type of error	**Physical factors**	**Physiological factors**	**Psychological factors**	**Psychosocial factors**
People	Physical size, Gender, Age, Strenght, Sensory limitations	Nutritional factors, Health, Lifestyle, Fatigue, Chemical dependency	Workload, Experience, Knowledge, Training, Attitude, Mental or emotional state	Interpersonal conflicts, Personal loss, Financial hardships, Recent divorce
	Physical		**Organizational**	
Environment	Weather, Location inside/outside, Workspace, Shift, Lighting, Sound level, Safety		Personnel, Supervision, Labor-management relations, Pressures, Crew structure, Size of company, Morale, Corporate culture	
Actions	Steps to perform a task, Sequence of activity, Number of people involved, Communication requirements, Information control requirements		Knowledge requirements, Skill requirements, Attitude requirements, Certification requirements, Inspection requirements	
Resources	Procedures/work cards, Technical manuals, Equipment, Tools, Computer/software		Ground handling equipment, Materials, Training, Quality systems	

3.2.Technical error

Technical errors can appear depending on the stage of technological maturity (TRL), see the figure 1, being directly proportional to the level of innovation, [7, 8]

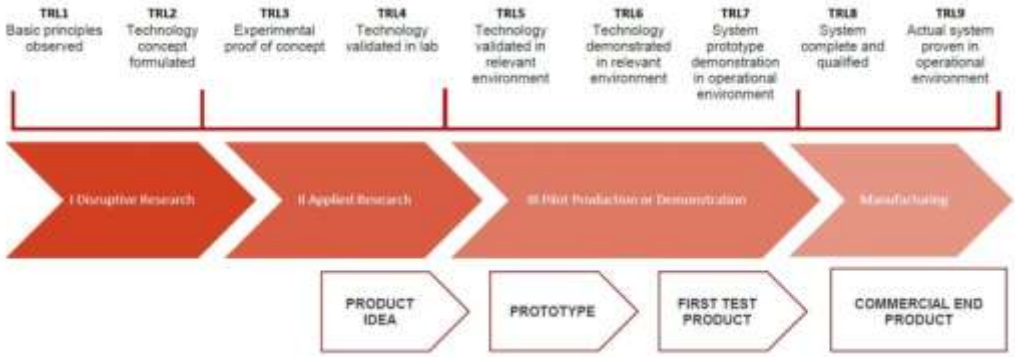

FIG. 1 Technical readiness level (TRL)

4. CONCLUSIONS

The pilots' association reports that 90% of space disorientation accidents are fatal. Spatial disorientation is a person's erroneous perception of position, attitude and acceleration relative to the outside environment. Moreover, disorientation can be recognized or go unnoticed by the affected person.

If a situation of disorientation is recognized early, there is an increased possibility of survival. Flight is not a natural state for the human body – we are not created by nature to fly. There are several causes that cause confusion such as angular acceleration, linear acceleration, vibrations, perception of movement, etc.

In any case, since flight is not a natural process for the senses of the human body, significant differences can occur between the expectations of the brain and the input information of the vestibular apparatus.

Recognizing the disorientation, the pilot can make the right decisions. About 90% of fatal accidents are due to the non-recognition of the occurrence of spatial disorientation due to poor training in this area.

Avoid using the words: "It's yours", "Did you take it?", "OK", but encouraging phrases like: "You took the commands!", "The aircraft is with you".

In conclusion, the thorough study of these phenomena through training courses significantly increases the quality of air safety.

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FEM HYPOTHESIS WHICH CAN BE APPLIED FOR FDM APPLICATIONS

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Abstract: *Nowadays, with the evolution of the additive manufacturing processes and its possibility of usage for industrial applications, the tendency is to adapt, optimize or to develop new concepts for the improvement of functional parts or assemblies characteristics. One important concept is the Finite Element Method which offers the possibility to describe mathematically all the physical phenomena which occurs during the functionality of the parts. The aim of this paper is to present several hypotheses for finite element method which could be applied for the analysis of the parts manufactured through Fused Deposition Modeling, considering also the manufacturing defectives.*

Keywords: *Finite Element Method, Fused Deposition Modeling, Additive Manufacturing*

1. INTRODUCTION

From all the Additive Manufacturing (AM) processes, Fused Deposition Modeling (FDM) is one of the most used technique due to its advantages and one of the most significant demand is to anticipate the mechanical characteristics of parts, before the manufacturing process. It is well-known that the physical phenomena can be described through a mathematical model, using Finite Element Method (FEM) [1], but due to the printing parameters, materials and defectives which appear especially during manufacturing process, the FEM assumptions and theories development are challenging, the simulation results being necessary to be verified through tests in order to check the reliability of Finite Element Analysis (FEA) [2,3]. As it is presented in literature [3], the FEA results are not every time reliable to predict the future parts behavior. The researches consider the similarity with the composite materials a starting point in order to describe parts obtained through FDM method considering its structure, stiffness and strength [2].

1.1 Fused Deposition Modeling – Description

Fused Deposition Modeling is an Additive Manufacturing process which implies the creation of a specific part by adding material layer by layer, related to the part cross-section geometries. This process implies material extrusion for part formation. The main advantage of this process is the manufacturing of parts with a complex geometry and also for functional prototypes with lower costs, which is not possible to obtain through traditional manufacturing methods [2,3].

In general, materials vary from thermoplastic polymers to composite filaments and the mechanical characteristics of the final part are influenced, mainly, by the material and by printing parameters. The manufacturing parameters with the highest impact are the layer thickness and the part positioning on the building-plate.

In case of materials with chopped or continuous fibers, the porosity of the final part must be considered – the polymer is not adhering to fibers totally, causing material voids. Voids can be caused also by abnormal material deposition.

The defectives, such as material gaps, material conglomerates, non-compliant geometry or/and material rasters and fibers out of matrix which appear after manufacturing have a major impact on the mechanical properties values. For materials with chopped fibers must be considered the fact that after deposition, the fibers have a randomized orientation, the part being considered to be manufactured from an anisotropic material. It must be also considered that the part have maximized mechanical properties values on the manufacturing direction [2]. Beside of the manufacturing defectives, a part may be defined with design, assembly or service issues, affecting the conditions of usage [4]. In Fig. 1 is presented a part which has manufacturing issues – the ideal design from CAD is supposed to modification due to FDM process limitation.

FIG. 1 FDM Application – Manufacturing issues [7]

Considering the manufacturing manner, it must be considered also the thermal effect which determines the quality of the deposited material and the level of residual stresses for each part – heat transfer into the vicinity deposited material and the possibility of material slip over the already deposited material. Furthermore, it has to be mentioned the non-uniformity of part cooling, which cause morphological issues, has an increased impact over the part quality and mechanical behavior [5, 11]. Hereafter, in Fig. 2 is presented the temperature variation, considering the manner of material deposition – initially are created the edges of the cross-section in order to maintain the geometric stability and afterwards, the nozzle is passing for material deposition in order to fill the edges – the highest temperature is recorded on the latest deposited material and in its vicinity.

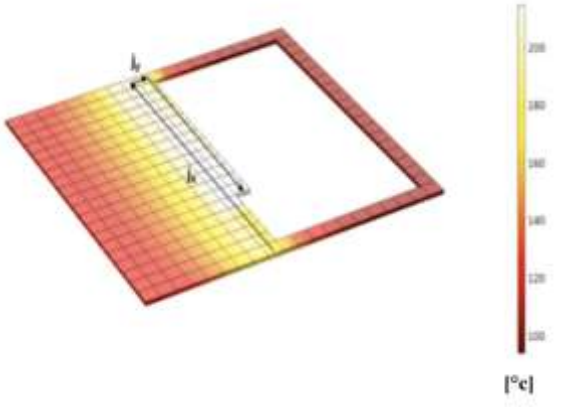

FIG. 2 FDM temperature variation [11]

Based on [2,3], the results obtained in tests are lower compared with the results presented by the filament producers – it is recommended to perform specimen tests in order to obtain the material description which can be used for FEA – issue caused by the part non-homogeneity and material anisotropy.

1.2 Finite Element Analysis – Generalities

In order to solve different engineering issues caused by structural, thermal or other physical phenomena, Finite Element Analysis is used as an analysis appliance based on Finite Element Method. FEM is a numerical technique which describes mathematically through equations physical phenomena. Hereafter in Fig. 3 is presented schematically the workflow with FEM.

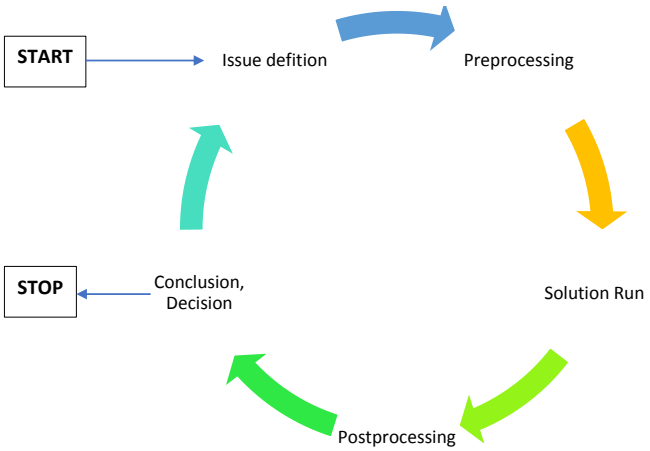

FIG. 3 FEM workflow

The result accuracy is influenced by the accuracy of the equation definitions, if they imply all the characteristics of the interested phenomena – in this case is obtained an ideal model – but considering the large amount of variables for some phenomena, the idealization is not possible every time, the results being obtained based on assumptions. The results represent the behavior of the engineering system which must be analyzed, which is not accurate in all cases.

Considering all the steps for a FEA, in each step can be applied assumptions with a different level of impact over the final results, causing inaccuracies and impossibility of usage. Mainly, these steps are referring to: modeling/meshing, material definition, loads definition, boundary condition definition and the analysis solution [1, 3].

1.3 Filament description for FEM Applications

The material resulted after manufacturing is anisotropic, with many similarities to composite materials – it has different properties in all directions of a random material block which is defined in Figure 4 [12, 15]

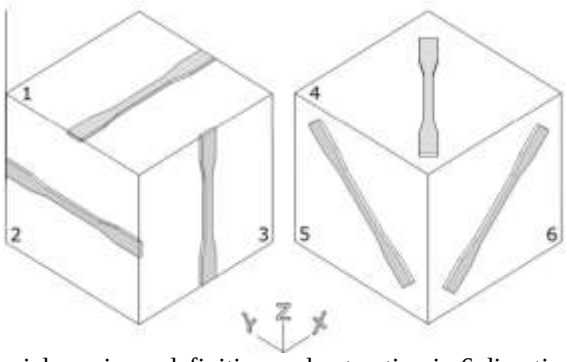

FIG. 4 Material specimen definition and extraction in 6 directions [15]

According to developed research by different authors [2, 10, 15], the material used for FDM applications is defined as an orthotropic material with a linear behavior, as an assumption and to reduce the mathematical system from 36 components – for anisotropic material, which are defining the relation between stress and strains considering Hooke's Law into a linear elastic regime. Based on this assumption – the material has 3 mutually perpendicular planes of symmetry, the new reduced mathematical system has 9 components.

2. FEA APPLICABILITY FOR FDM APPLICATIONS

The researches have a different approach for FEA in case of FDM parts, considering much or less the entire description of the phenomena which appear during manufacturing and also in usage, under the influence of certain loads and external environment. In the Table 1 is presented a literature review of methods and assumptions used for FEA of FDM applications, for the first 2 steps which has an increased impact over the results.

Table 1. Literature review – FEA Assumptions for FDM applications

Ref.	Modeling/ meshing	Material definition	Remarks
[3]	CAD fidelity with the printed part, HEX6 elements	Isotropic, orthotropic, laminar material approach	Analysis not able to predict the crack area, large deviations from tests
[6]	Modelled gaps, fine mesh	Isotropic material (PLA)	Stress concentrators near gaps Laminar material approach to be done
[9]	Shell elements	Orthotropic approach	No validation with experimental data
[10]	2 models: as a solid & as a stack with laminae	Orthotropic & laminar approach	Delamination can be identified for laminar approach No validation with experimental data
[13]	Solid & Temperature considered	Orthotropic approach	Comparison with experimental tests
[14]	Shell elements	Each component with its properties	Comparison with experimental tests
[15]	Solid	Isotropic	The anisotropy must be defined

As it is stated in [3], in order to obtain a feasible FEA, it is important to understand the FDM process and its each parameter influence over the mechanical properties. As a conclusion from Table 1, it must be mentioned that there is no ideal model or method to perform a FEA for a FDM part, in this case validation tests being a must.

In order to obtain a closer design to the final part, in a research [3] is used the G-Code to recreate the ideal design from CAD Model. Due to the fact that the G-Code has layer intersections and/or overlaps, the geometry is supposed to be checked and "cleaned" by interferences in order to have the possibility to create the part meshing. The disadvantage of this method is the high time for processing and running. In order to use lower resources, another approach is to use a continuous model and if there any infill is used, this should be modelled on its position.

As there can be different methods of material modelling, the most reliable approach is to model material as an orthotropic one, but still in this manner, the results do not have the expected accuracies [3]. The orthotropic material modeling takes in consideration the material anisotropy of the FDM part.

For a proper accuracy, in another study [7] is modelled the part in Additive3D by Abaqus with the temperature history during and after the deposition process, considering also the residual stresses and warpage of the part based on the material crystallization phases. The heat transfer can be simulated also with MatEx, taking in consideration the fact that real-time temperature measurements are difficult to be performed due to its limitation of measurement on the surface or near the surface [8]. It must be mentioned that no temperature influence is considered for calculation [3, 6, 9,10].

In the literature [10] it is highlighted the realistic behavior of the layer-by-layer model, in this manner existing the possibility of identification of other failure modes, such as delamination – it is not possible to identify for solid models.

3. FEM HYPOTHESIS FOR FDM APPLICATIONS

Considering the literature review above presented, it can be summed up that any method obtained not so accurate results, in each research being used some specific assumptions, with a different level of impact. Discussing also about the study from [2], the phenomena which appears during FDM process must be defined in FEM as much as possible, considering the time and computational resources limitations.

The majority of the researchers used an orthotropic approach of the material or a laminar approach – both methods are reliable and can be developed considering also a detailed modelling [3], but also considering the temperature effect and the manufacturing defectives.

Detailed modelling can be performed into an automatic manner [1], considering the G code obtained for slicing, the intersections and overlaps between geometry being mandatory to be corrected in order to create the mesh. For meshing, more detailed information solid elements are chosen. The element size must be adapted also by computational resources, but a fine mesh should be used, reported to the layer thickness.

One first approach is to perform an analysis considering a solid model with a similar geometry as the printed part, but also with temperature effect applied. Another approach is to perform an analysis with the assumptions mentioned above, but with material defined in lamina, with a specific material orientation – in order to obtain information about other failure modes which are identified in experimental test. Due to the similarity with composite materials, another approach is to consider the model to be made from a composite material, where the properties for each component must be defined – in case of usage of filament with fibers.

After post-processing, the obtained data should be compared with experimental results, in order to validate the tests.

CONCLUSIONS

For researchers the applicability of FEA is a challenge due to its many variables which interfere into the model definition in FEM environment. As long as too many assumptions are make and with a certain impact, the results of analysis are going to be not so accurate.

As long as many researches consider modeling in detail the resulted part after manufacturing a difficult process, a possibility of time and work load reduction is to automatize and to use the G Code for the part which is going to be analyzed. Another important topic is regarding the material definition, which can be considered as an orthotropic material in order to obtain as much as possible the realistic behavior. In order to validate the hypothesis used, it is recommended to perform experimental tests.

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DEVELOPMENT AND IMPLEMENTATION OF AN AUTOMATED PILOT SYSTEM FOR A FIXED-WING TWIN-ENGINE AIRPLANE UAV

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Abstract: *When controlling a UAV, we have to rely on the line of site of the operator and aft wards on the communication with the ground control station. This implies expensive equipment used in communication, a skilled operator and a UAV with low autonomy. In order to address these issues an automated piloting system needs to be implemented thus offering the needed autonomy to the UAV. An automated pilot can also stabilize the aircraft and allow for the control of the UAV to be done by people without intensive training or special skills. In the present paper we present the development and implementation of such a system, built on Cube Orange flight controller, and implemented on a fixed-wing UAV with twin-engines, fabricated using additive manufacture technologies.*

Keywords: *Aerospace, Fixed-wing UAV, Automated Pilot, GCS, Additive manufacture*

1. INTRODUCTION

Unmanned Aerial Vehicles systems have become more affordable to build, but still, there is the need for careful planning, designing and implementation. The research is focused on a couple of directions: UAV quad-copter development [1,2,4,5,7], UAV fixed wing development [6], UAV automated system integration [1,2,3,4,5,6], Communication interfaces [3,8,9], Simulation, Navigation, Stability and missions types [1,2,3,4,5,6,7].

In general, a fixed-wing UAV system is composed from main 3 subsystems: GCS (Ground control station), Communications link and the actual UAV with receivers and autopilot (Fig. 1, Fig. 3) [1,2,3,4,5,6].

The Ground control station is a Digital Micro Device and XLRS extended device. The station model is GCSD4, professional ground station for FPV and UAV up to la 200KM (Fig. 2) [10].

The GCSD4 includes [10] (Fig. 3): Directional patch antenna (SMP-4G-LTE); 5dBi omnidirectional antenna; Latest generation long range radio control and telemetry transmitter; Video screen with analog video receiver at 5.8Ghz and HDMI input for Digital video; Embedded and integrated PC with touch screen and windows 10; Software; Joysticks and command buttons; Suitcase and an analogical video system (RXVID3 video receiver with 5.8Ghz transmitter and patch antenna 2.4Ghz 17dBi (ANTPLA24G17DB).

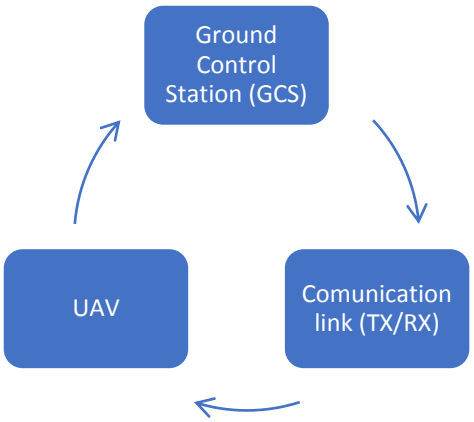

FIG. 1 UAV system

FIG. 2 Ground control station [10]

The communication link is comprised from a Smart Base Station (SMBTS) which actually is a transmitter of radio control and Telemetry to and from the UAV, mounted on a 12dBi directional biquad antenna (BQ89) that significantly improves the performance, safety and range of the signal without loss of radio frequency (RF).

There is no RF loss because of the way the antenna is build, the transmitter is mounted on the antenna itself, so the length of the antenna cable is minimal. The connection with the GCS case is done using a standard ethernet cable.

The combination between the transmitter and antenna assembly (SMBTS + BQ89) is called a Smart Antenna. Because of this system the UAV is capable to carry out long distance missions up to 100 KM.

The standard cable length is 3m but it can reach 10 m or more if we improve the quality of the cable (from CAT5 we go to CAT6.A or CAT7).

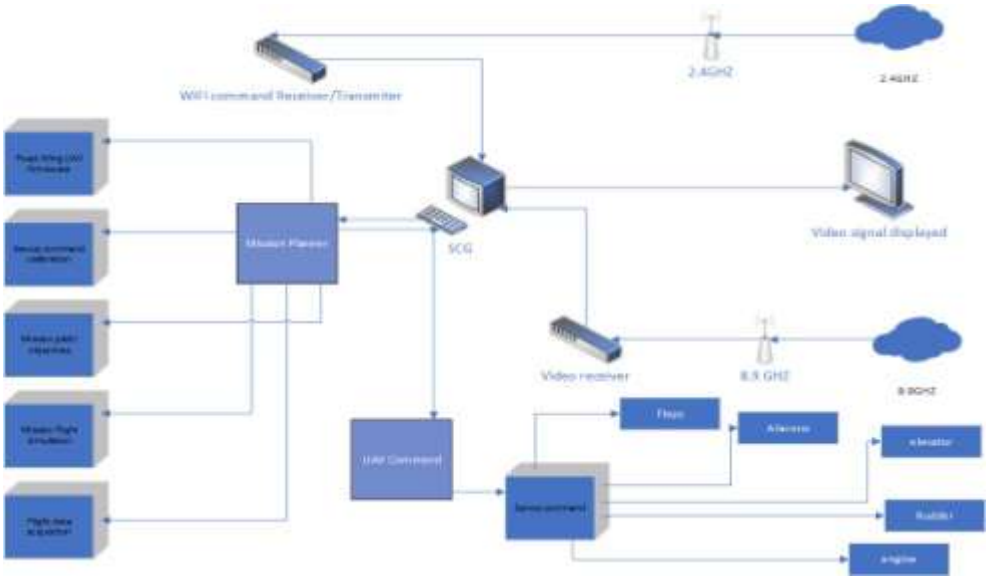

FIG. 3 GCS – Ground control station and connection

Regarding the telemetry transmission from the UAV to the GCS there is an internal radiomodem (data link) with radio control, a MAVLINK and a transparent protocol. The MAVLINK data is retreive via USB-PC or bluetooth from GCSD4-V2.

FIG. 4 The Smart Antennas SMBTS (Smart Base Station) back view

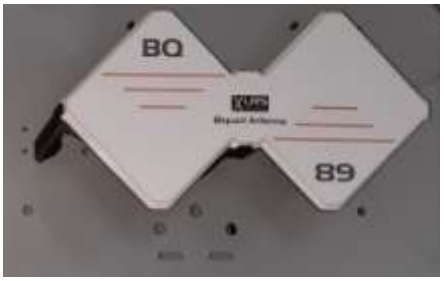

FIG. 5 The Smart Antennas SMBTS (Smart Base Station) front view

This communication technology is compatible with the major entry level Flight Controller platforms like RXLRS receiver, Pixhawk autopilots and APM. As a software framework everything is implemented over Mission Planner.

The ethernet connection cables from the SMBTS to the GCSD4-V2 do not work in straight or crossover ethernet connection, instead the protocol and the interfaced used are RCBus and FastRCBus with power for SMBTS.

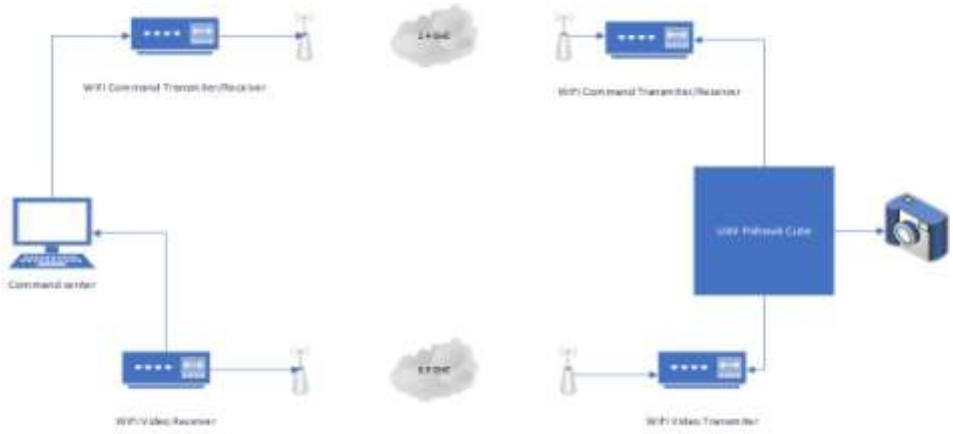

FIG. 6 Model that shows the connection between Ground Control Station with Smart Antenna (GCSD4V2) and the UAV systems

The UAV configuration is that of a fixed wing with twin engines mounted in front of the leading edge. The tail has the horizontal stabilizer mounted on top of the vertical stabilizer; empennage configuration known as a T-tail. Also, for landing, the UAV uses a conventional fix three-wheel landing gear.

FIG. 7 Simulation of the model aircraft made from 3D printed composite materials

The engines of the UAV were manufactured from A6 steel using Selective Laser Sintering (SLS), which is a layered based additive manufacturing technique, on a 3D System SPRO 60 SD machine. Each engine is equipped with can be equipped with a 15-inch or 17-inch propeller made from carbon fiber or other materials. The manufacture engines are brushless DC electric motors, known as synchronous DC motor or electronically commuted motors ECM.

The UAV parts were also constructed using additive manufacture method. But instead of SLS was used the FDM (Fused Deposition Modeling) method o construction. So, for the fuselage and vertical tail, as a printing material, short fiber glass composites were used, and for the rest of the components short carbon filament composites. Everting was printed on Zotrax M300 dual and Ultimaker S5.

FIG. 8 Firmware upload selection window from Mission Planner software.

As a main board controller is set up a Cube Orange platform from CubePilot PTY LTD, which can support multiple drone configurations. The controller was flashed with an open-source firmware, ArduPlane V4.2.0 firmware. Arduplane is the fixed-wing branch of the Ardupilot which gives full autonomous capabilities to an aircraft. The firmware is uploaded in the Cube Orange using Mission Planer software throw the path Setup->Install Firmware->ArduPlane V4.2 (Fig 8.). All these steps are done on the GCS station where the software resides, and the Cube Orange is linked with the GCS via the USB port.

Cube Orange I/O ports [11]:

- 14 PWM servo outputs (8 from IO, 6 from FMU);
- Radio control receiver (R/C) inputs for
    - CPPM (Combinatorial Pulse Position Modulation) – analog signal;
    - Spektrum / DSM – digital signal;
    - and Serial Bus – serial communication protocol;
- Analogue / PWM (Pulse width Modulation) RSSI input;
- Serial Bus servo output;
- 5 general purpose serial ports, 2 with full flow control;
- Two I2C ports;
- One SPI port (un-buffered, for short cables only not recommended for use);
- Two CAN Bus interface;
- 3 Analogue inputs;
- High-powered piezo buzzer driver; High-power RGB LED; Safety switch / LED.

Table 1. Cube Orange characteristics [11]

Characteristics name	Characteristics value
Processor	STM32H753
Remote Signal	PPM/SBUS/DSM
I/O PWN Voltage	3.3V/5V software selectable
Redundancy	Triple Redundancy
Isolation system	Y
Temp regulator	Y
Number of Accelerometer	3
Number of Gyroscope	3
Number of Magnetometer	1
Number of Barometer	2
Compass	1

FIG. 9 Cube Orange with Pixhawk motherboard

The Cube Orange accessories can be expanded using CAN Bus interface. We connected on the CAN a Here 3 RTK and GNSS positioning device which has a built-in magnetometer, gyroscope, accelerometer and compass.

FIG. 10 Ground control station linked with Cube Orange and Here 3

FIG. 11 Enabling CAN settings on Mission Planer software

The Here 3 needs to be configured and paired with the Cube Orange. This step is made using again the Mission Planner software installed on the GCS.

Steps to configure Hero 3 RTK GNNS system:

Connected with the USB cable to the Cube Orange, but without pressing the connecting button we select Initial Setup from Mission Planner, then we go to Optional Hardware-> UAVCAN and we select SLCan Mode CAN1 (Fig. 11). At this moment the settings for Here 3 will pop-up and we choose Parameters from the right menu (Fig. 12).

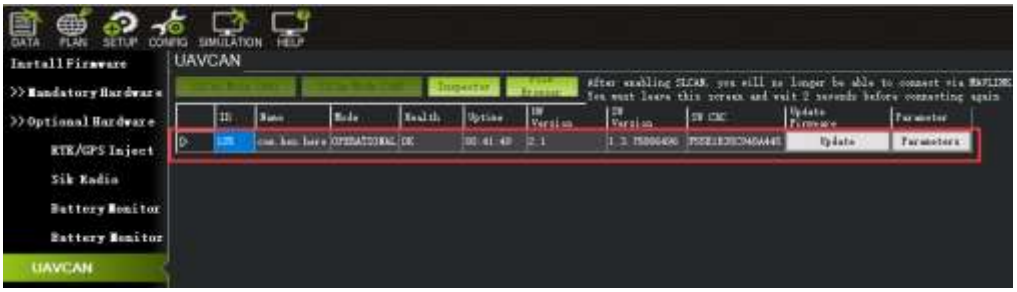

FIG. 12 Initializing CAN port parameters setting on Mission Planner software

In parameter setting page, we need to change uavcan.node_id to 0-125 and click Commit Params to save the changes and completed manual CAN id allocation.

After manually setting the Here3 node id, we need to connect the Here3 interfaces to the flight controller CAN 1.

FIG 13 CAN port parameters editing on Mission Planner software

The last step is to turn on the flight controller and connect it to Mission Planner. Then we go to Config Tuning then Full Parameter List and we need to modify the parameters from table 2.

To be sure that the Hero3 indication are in accordance with the date provided by the cube we need to mount the cube Orange and the Hero 3 with they're directional arrows (marked with paint on both devices – on the image we colored them in green for better contrast) pointing in the same directions (Fig. 14.).

Table 2. *CAN protocol parameters*

Parameter name	Parameter value
CAN_D1_PROTOCOL	1
CAN_P1_DRIVER	1
GPS_TYPE	9
NTF_LED_TYPES	231

FIG. 14 Here 3 and Cube Orange linked together

Once the Hero 3 is linked with the Cube Pro the initial setup can be initialized. This is done from Setup -> Mandatory Hardware and here we calibrate first the accelerometer (Fig. 15).

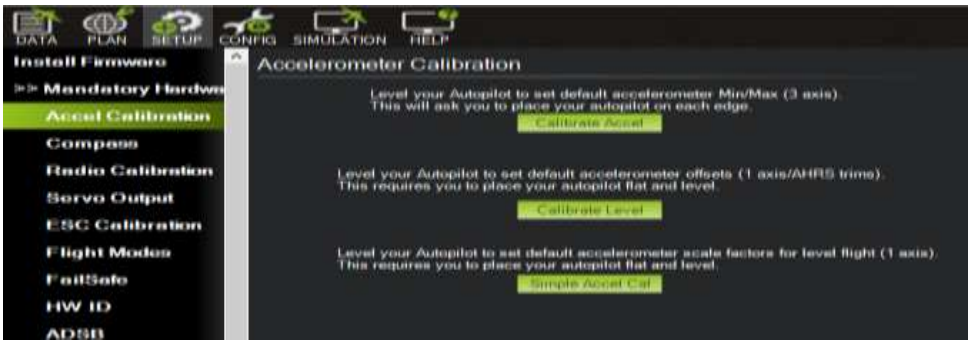

FIG. 15 Accelerometer Calibration on Mission Planner software

As it can be seen in table 1 the Cube Orange has 3 Accelerometers (one for each axis of the airplane) so we need to calibrate each one. The steps are easy we just need to tilt the UAV, or in this particular case the Cube pro and the Here 3 mounted on a plane Styrofoam board, on each axis (Fig. 14, Fig. 16, Fig. 17). The directions are: Place vehicle Level, Place vehicle Left and Place vehicle nose Down.

FIG. 16 Accelerometer calibration nose down

FIG. 17 Accelerometer calibration Left

At this point the internal sensors of the Cube orange and the Here 3 are calibrated and the next logical step is to connect the Manual receptor RXLRS or more exactly the radio control and data link receiver. This is the device that enables the long-range communicating with MAVLINK telemetry and transparent radio modem up to 100 kb RF.

The device can also control up to 16 servos (Fig. 18), 8 multifunction outputs for servos or other functions and another 8 using a double RXLRS configuration.

FIG. 18 RXLRS- radio control and data link receiver [10]

The RXLRS has the following connections:

- Ch1 – to Ch8 – multifunction outputs for servos and other functions
  - Any channel can be used as power supply;
  - Chanel 7 is used for cube orange also SPPM connection;
  - Chanel 8 can be used as RCBUS 2 connection (two RXLRS configuration or RXLRS with OSD and Video transmitter configuration);
- One RCBUS connection (two RXLRS configuration or RXLRS with OSD and Video transmitter configuration);
- One modem connection (TX and RX);
- One antenna connector;

FIG. 19 Cube Top connectors [12]

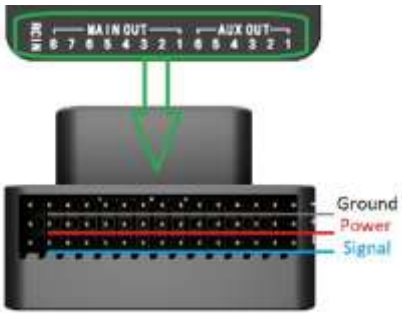

FIG. 20 Cube front connectors [12]

On the Cube Orange flight controller there are the following connectors (Fig. 19, Fig. 20) [12]: 2 GPS connectors, 2 Telemetry connectors, One IC2 connector, One USB connector, One analog to digital converter 3.3 V, 2 CAN connectors (one with internal 3.3V transceiver, one on expansion connector), One Spektrum DSM receiver, 2 Power connectors, One S BUS connector, One serial 5 Connector, One RCIN connector, IO Ports: 14 PWM servo outputs (8 from IO, 6 from FMU), Internal microUSB port and external microUSB port extension.

FIG. 21 Cube Orange, RXLRS, and antennas that make the data link

FIG. 22 Servo

The servo connection with the RCIN connector for the cube is situated on the side, Fig. 20 we, and is divided in two; main output and aux output.

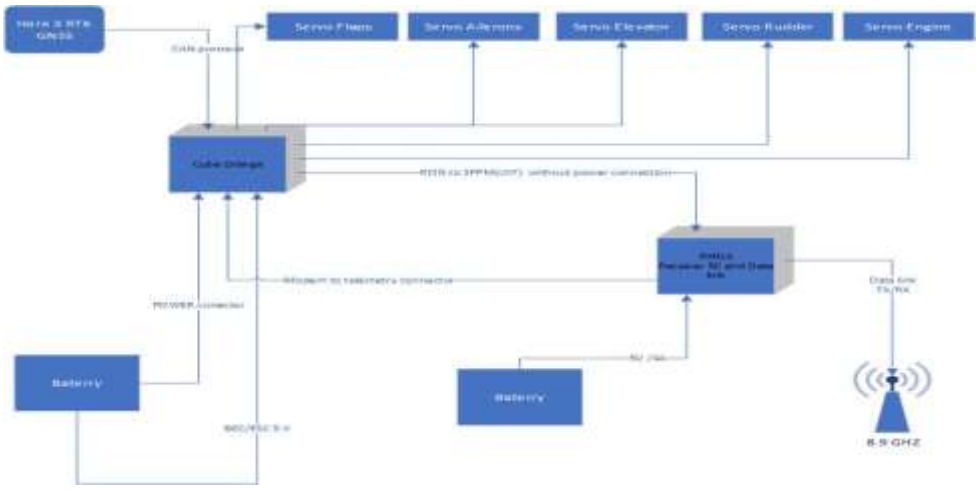

FIG. 23 Flight controller schematics for the UAV made with Cube Orange, RXRLS, Here 3 and servos

Flight controller schematic can be seen on Fig. 23 and a test connection with all the equipment is seen on Fig. 21.

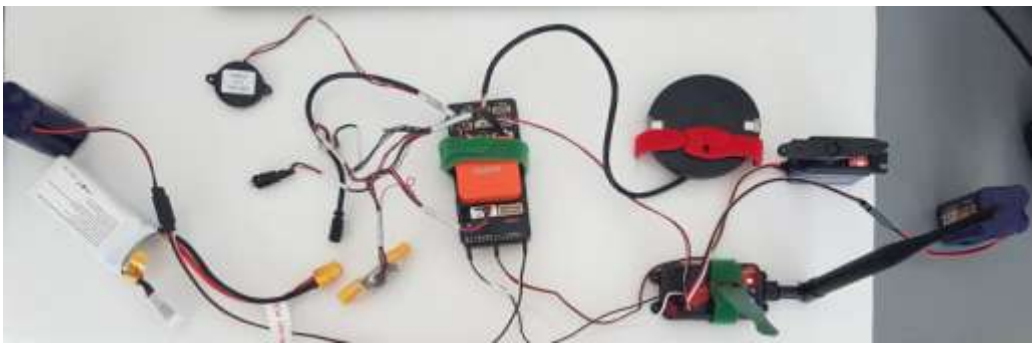

FIG. 24 Flight controller schematics for the UAV made with Cube Orange, RXRLS, Here 3 and servos

The brain of the flight controller is the Cube Orange with the Pixhawk board which is power on the power port from a 12V battery. From the same battery, using the CubeOrange splitter, power is transmitted to a 5V Output Voltage Regulator Modules (BEC) from where we sent a 5V connector to the 1 from the aux out connector from the Pixhawk. In doing this we power the cube and the servos with the same battery.

On the main out we connect the five servos and on the RCIN connection comes the RXLRS- radio control and data link receiver. On the RXLRS comes the 8.9 GHZ airplane antenna, and from the modem connector we go to the telemetry (TELEM 1) port from the Pixhawk.

CONCLUSIONS

Using this configuration, the UAV is flown in Autotune mode, on his first takeoff; this will start the tuning process for the autopilot. On the second flight, after takeoff, the airplane will be put in RTL mode (Return To Launch mode), thus testing navigation and finishing the autopilot calibration

Once the hole configuration is finished, we move to mission planer software from the SGC and begin configuring the communication between the SGS and servos command.

Automated piloting system can assist the pilot in normal flight by stabilizing the aircraft and letting the pilot focus on the mission at hand.

By using an automated piloting system we can pilot UAV even when is out of the line of site or I out of signal range.

An airplane cannot hover, this functionality is available only if it has tilt wing, tilt rotor or directional reaction streams. So, the airplane, cannot be stopped in midair and wait commands for the next move, but by using an autonomous pilot, we can put the aircraft in loiter mode (encircling a point in space) until we decide for the next move.

When we have to pilot more than one UAV (a swarm) we really need an autonomous flying system, this is not something that cannot be achieve with a simple controller.

ACKNOWLEDGEMENT

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MISSION MANAGEMENT FOR AN AUTOMATED PILOT SYSTEM MOUNTED ON A FIXED-WING TWIN-ENGINE AIRPLANE UAV

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Abstract: *UAV systems used automated pilots which can be configured based on the mission. The entry level market for this type of systems is not focus mainly on fixed-wing configurations. On this paper we asses, develop and simulate missions for an automated piloting system, built on a Cube Orange architecture. The flight controller is mounted on a fixed-wing twin-engine airplane built using additive manufacturing technologies. For the management and simulation of UAV mission we use Mission Planner, and open-source software from ArduPilot. The missions is simulated to obtain an improvement of the automated piloting system, evaluate the terrain from the flight path, avoid dangers, keep out of restricted areas and find the optimal routes.* .

Keywords: *Aerospace, Fixed-wing UAV, Automated Pilot, UAV Mission Planning, Additive manufacture*

1. INTRODUCTION

Unmanned Aerial Vehicles systems have become more affordable to build, but still, there is the need for careful planning, designing and implementation. The research is focused on a couple of directions: UAV quad-copter development [1,2,4,5,7], UAV fixed wing development [6], UAV automated system integration [1,2,3,4,5,6], Communication interfaces [3,8,9], Simulation, Navigation, Stability and missions types [1,2,3,4,5,6,7].

The UAV community is expanding each day with products and solution reigning from underwater to ground and air vehicles. In the near futures they're numbers will increase as prices go down, this will lead to crowded sky's and communication band. On these premises an autopilot with flight instructions on board that does not need ground guidance in achieving is goal is crucial. Such a possible mission (mapping an area) was developed in the present paper.

When making an autonomous flying vehicle, one of the most important factors, is the flying path of the aircraft. Based on the mission profile this flying path needs to change sometimes even during flight.

On the present paper, we used a 3D printed airplane, with 3D printed engines, which has implemented an automated control system built around a CubePro Orange processor mounted an PixHawk motherboard.

The airplane was manufactures using additive manufacturing technologies, more exactly, for the fuselage and wings we used Fused Deposition Modeling and as material

reinforced composite with short fiberglass for the fuselage and reinforced composite with short carbon fiber for the wing. The parts were manufactured on a Zortrax M300 Dual, used for composites with fiberglass, and Ultimaker S5, used for composites with carbon fibers.

On the airplane were mounted two brushless motors, manufactured using Selective Laser Sintering method from A6 steel on a 3D System SPRO 60 SD. The manufactured motors develop 10 kgf each and are equipped with 15 inch counter rotating blades.

FIG. 1 Simulation of the model aircraft made from 3D printed composite materials [10]

The CubePro Orange controller was mounted on the airplane using as interface a PixHawk motherboard. We are using this controller to command the servos in flight (engines, flaps, ailerons, stabilizer and direction) but also to send telemetry to the Ground Control station using a wireless 8GHz transmitter. Alongside telemetry we send video signal from a Tau 2 Longwave Infrared Thermal Camera Module using a 5GHz analog video transmitter. The video signal has over imposed the telemetry information gather during flight.

When computing the flying path one of the major influencers of the outcome is the Tau 2 Longwave Infrared Thermal Camera Module. Exposure time, focal length and objective dimensions are parameters that directly influence the altitude of the airplane and the flight speed.

The flight path is based on aircraft mission, and each mission has two repeating segments of the flight path, takeoff and landing. We need to define each path segments as a single path, saved it and append it each time we need to take off and land.

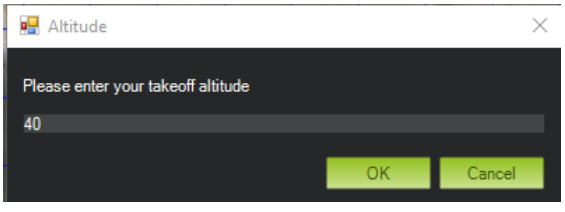

FIG. 2 Takeoff altitude

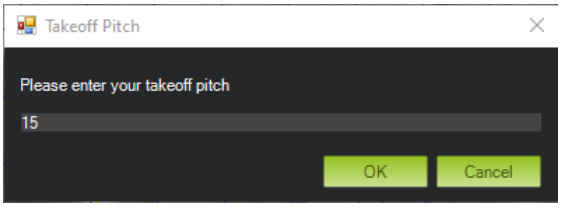

FIG. 3 Takeoff pitch angle

To define the takeoff segments the first step is to study the terrain and select an appropriated take off runway, the runway needs to be straight and have sufficient length in order to reach takeoff speed flight. In Mission Planner we select first the home location and define a takeoff with the following parameters, takeoff altitude 40 m and pitch 15 meters (Fig.2 and Fig. 3). This two values depend on the airplane design and were computed when we first calibrated the aircraft [10]. The automatic takeoff means that the throttle is to maximum and the airplane climb to the designated altitude with the designate minimum pitch angle (how steeply the aircraft will climb during the takeoff).

The designated altitude, during takeoff, defines the altitude, above the home location, that the airplane needs to reach in order for the takeoff to be considered complete. Takeoff direction is set from the direction the plane is pointing when the automatic takeoff command is started.

Automatic landing is part of the mission. In order to land the aircraft, the autopilot needs to know the latitude and longitude of the touchdown pot along with the altitude which will be 0 this time. The last step in the landing procedure is the flare point, is the stage were the autopilot cuts off the throttle and raises the pitch in order to increase drag a slow down the aircraft to touchdown. The flare point is defined by two more parameters the time in seconds before the aircraft would hit the ground if it continued with is current descent rate and the second parameter is the altitude above ground, in meters, at which the aircraft will flare, not taking into account the value of the first parameter.

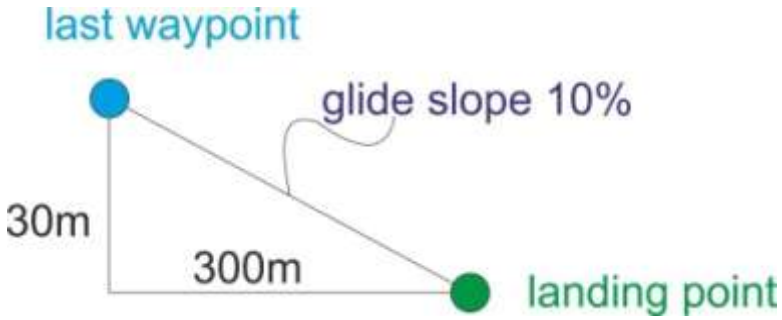

FIG. 4 Glide slope case study

Besides the flare point on landing, at a great importance is the glide slope. The glide slope represents the ratio of the distance from the last waypoint to the landing point. The recommended value for the glide slope is about 10%, this means that the distance between the landing point and the last waypoint should be 300 m and the altitude of the last waypoint should be 30 m (Fig. 4).

Last of the parameters that we need to take in account is the landing speed. The landing speed should be a speed above the stall speed of the aircraft, but low enough that the aircraft is able to lose altitude and land in a reasonable distance.

FIG. 5 Landing path generated in Mission planner

Taking all the above parameters into account we will generate a landing path based on 6-7 waypoints. First, we will need to align the airplane with the runway and we will do an approach path with descent in order to aircraft to runway and having the necessary distance to land. If we cannot do a straight approach, we can generate a downward helicoidal path that will take us to the desired altitude with the desired slope of approach. In the present paper we took into account a sideway approach with a straight landing on the Sânpetru airfield (Fig.5). As it can be seen from Fig. 5 starting from waypoint 6 we start to descend with 30 m at each waypoint until we reach the last waypoint were we have 30 m and a distance to the landing point of 300 m.

FIG. 6 Survey grid with picture squares simulation overlap

Our final goal is to generate a survey grid for 3D or thermal rendering of the terrain to be used in search and rescue missions or mapping technologies.

When aiming for a survey grid mission, the parameters that influences the path are the ones that create a good rendering. That means that we need to accomplish at least 100 pictures, at the overlap between consecutive picture should be between 65% and 80%, but higher would be better. The altitude of the mission will depend on photographed subject, for large flat area a good detail will be achieve with a 40-80 m altitude, while for buildings flying higher the 100m will reduce distortions.

The higher the altitude of the vehicle the wider apart we can create the tracks, and because we aimed for an overlap of at least 65% then we can create a strategy with tracks between 25 and 100 m, but by increasing the altitude to 120 m and using a 40 m distance between tracks we obtained an 80% overlap (Fig.6).

To this grid we appended takeoff and landing segments and we obtained our final flight plan for our autopilot Fig. 7.

In order to reduce development times for future missions we modularized the mission and created separated segments that can be used as individual flight paths or as parts of a bigger flight path. Based on the mounted FLIR camera we generated a grid pattern that will provide around 1000 pictures of the area, pictures that will be used in future experiments to generate 3D terrain mapping, air survey data or search and rescue missions. Path optimization for distance, load and flight time is an ongoing problem which will need further studies.

FIG. 7 Defined flight path with landing, survey grid and landing attached.

CONCLUSIONS

Automatic path generation and automated pilots provide a good replacement for human pilots when doing repetitive work, but also can assist in normal flight to stabilize the aircraft.

When doing repetitive work a human can became board and make mistakes, this is not the case for automated system, they excel at doing repetitive work without error, if the environment parameters remain the same, and the system was programed correctly.

When a UAV has the capability to take off and land on its own, and also complete a mission, this create an opportunity to use multiple autonomous vehicles in order to reduce time and speed up the process. Time is at most important in search and rescue missions, and time is converted into money when surveying a terrain. Also the weather has a great impact on the flight time, and being able to do more in less time is a necessity nowadays.

By using a path generation software in conjunction with a good configured autonomous guiding system, the pilot does not need to be an experience pilot and can control the aircraft from a distance just by changing the waypoints or flight modes.

The flight time is directly linked with the battery consumption, by configuring a flight path beforehand and doing a flight simulation we know if the mission can be accomplish and if we have reserves for other unplanned objectives.

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TECHNICAL SOLUTIONS AVAILABLE IN THE PRESENT GEOPOLITICAL SITUATION

Sorin DINEA

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Abstract: *The paper will show some technical solutions that are available in a present geopolitical situation, which result from the previous experimental researches of many of the Romanian and international researchers, including Henri Coanda. The paper takes into consideration that all the real scale positively tested researches represent available ways which may be reloaded based on the present technology, even though they are 50 years old, 100 years old or more.*

The available real scale positively tested researches that will be shown in the paper, will include a solution for aeronautical sciences, especially thrust&lift propulsion and also a solution for atmospheric health&cleaning. The paper shows that usually we do not need to spend a lot of time&money on researches that were done before, but just to know them and use them in accordance with the present technology and opportunities.[1][2]

Keywords: *Coanda, thrust, effect, pipeline transport, Constantinesco, Sonics, HHO, Brawn*

1. INTRODUCTION

We are passing through a very strange and unique geopolitical situation that will be not described here. The geopolitical equilibrium seems to be rebalanced between Western and Eastern philosophies, cultures, lifestyles and powers. The Humankind should accept that the future way to live and develop should take useful parts both from the West and East together. Therefore, the technology should be now reconsidered in order to be sustainable for the human Society and the Environment, in equal amounts.

The time for rebalance and reconsideration is very short, because there is a high risk of self destruction. Moreover, the geopolitical situation overlaps an intense spiritual transformation of the entire Human race, in order to engage in the right way the evolution for raising the Awareness of each person and evolution group.

Science and technology are created in order to support finding and using the easiest and most rapid way to pass over the present geopolitical situation, from both sides. Therefore, science and morale should sustainably join and cooperate in order to find this way.

There are destructive technologies using explosions but also sustainable technologies using implosion. There are thrust technologies using over pressure but also thrust technologies using vacuum pressure. There are transportation ways using self propulsed devices but also duct containers that have no propulsion unit on them.

It depend on us what technology we shall develop or how the sustainable way is going to change the existing destructive technology into future sustainable technology.

The synthesis paper will present only 4 previous researches that were proven as positive solutions to our society, coming from Henri Coanda, George Constantinescu and some Australian and American public researches.

2. HENRI COANDA HIGH EFFCIENCY THRUST

In the early '90 I was student at *Aerospace Faculty* of *Politehnica University of Bucharest.*Because of my personal affinity with Henri Coanda creations, I was preoccupied with his work. Therefore I discovered that the Henri Coanda flying saucer called "Aerodina Lenticulara", which means "Lens Shape Aerodyne" or "Lens Shape Aircraft", should have been finished in the US in 1969, according with Henri Coanda's claims back in 1967.

2.1 Coanda was right!

So I discovered this story and some drawings of this "Lens Shape Aerodyne" [3] and I ran to one of my university professors, who was teaching Fluid Mechanics, to find out more. During a break on one of his courses I found an opportunity to ask him: *How about "Aerodina Lenticulara"? Why have I not seen before this flying machine actually flying, because I've foundit very interesting and simple as a flying device.*

The answer that came was beyond my expectations: *Well dear, if was it a good flying machine, it has already been built byothers by now.*

It was a shocking answer that put me in a scientific dilemma: *Whom should I believe: my university professor I was learning from, or ...Henri Coanda the international genius!?*

Shortly after the shock I had got, I resumed my individual research on the entire creation of Henri Coanda. After so many years since the above episode, I am able to present you the true conclusion behind the "Lens Shape Aerodyne": Coanda was right!

2.2 The Wing lift and Coanda Effect produce the same thrust

In the present paper we will shortly demonstrate why the "Lens Shape Aerodyne", having no moving parts and VTOL capability, has at least the same lifting efficiency as an aircraft lift based on the moving wings.

First, we will remind you that "Lens Shape Aerodyne" is based on the Coanda Effect phenomenon, meaning the attachment of the jet to an adjacent divergent wall, transforms a free jet into a curved jet. Therefore, many times, the researchers have considered that the Coanda Effect is similar to Bernoulli Effect, but it is not. The Coanda Effect is a two way mixing flows phenomenon, not isentropic, rotational phenomenon that has the inertial (centrifugal) and pressureforces dominant towards the viscous forces. The Coanda effect working device is called "ejector". With the exception of the importance of the viscosity, that is lower too as the previews one, the Bernoulli phenomenon is totally different, as a single flow, isentropic and in line phenomenon, having constriction and expansion of the stream lines inside a "nozzle" that is a variable area channel for a single mass flow.

A complex "ejector" has an up flow part, a "mixer" (Coanda effect curved foil) and a down flow part, a "nozzle" (after the fluids are mixed) as a divergent or convergent part, but a "nozzle" has no ejector as a constitutive part at all.

Second, let us see the lifting wing as a reactive machine based on a fluid transformer phenomenon that transforms <low flow> at <high pressure> of the trust engine into a <large flow> at <low pressure> of the back wing downward atmospheric current. This transformation phenomenon is similar and more understandable if we mean to an electrical transformer that gets <low amps> at <high voltage> into a <large amps> at <low voltage>.

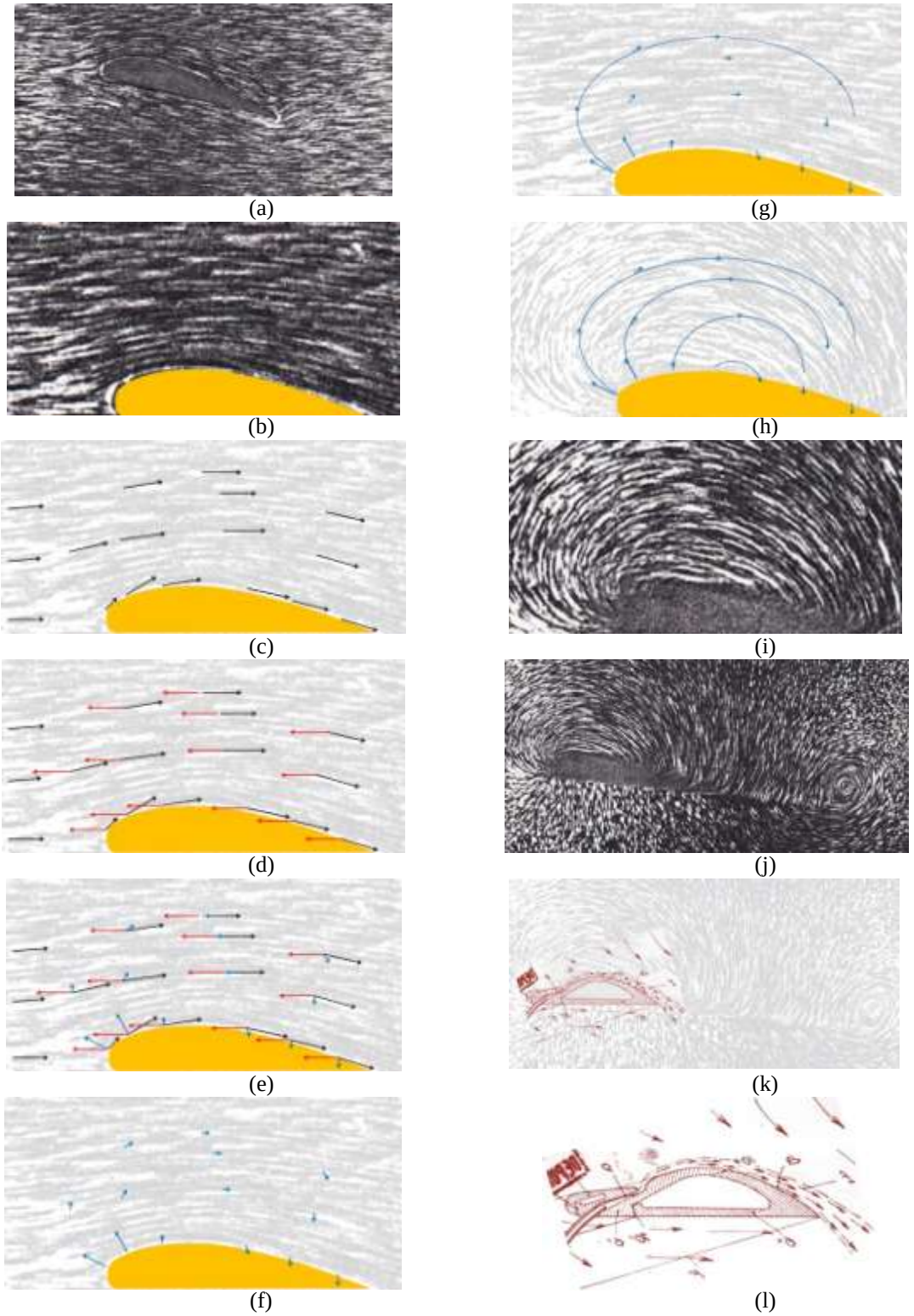


FIG.1 The way to transform the conventional Lift Effect streamlines into the Canada Effect streamlines, by changing the referential of the movement: (a) Streamlines over the wing airfoil shape(camera on wing), (b) Nearest the airfoil shape, (c) Some velocities of the airflow, (d) Changing the referential (reducing the airfoil velocity), (e) Combining the velocities (blue=resultant), (f) New velocity (camera fixed on the air referential, (g) Recreating the streamlines, (h) The new streamlines over upside wing, (i) Airflow smoke visualization (camera fixed on air), (j) Moving airfoil in front of the fixed cameraphoto, (k) Path lines similarity of Coanda effect and lift wing), (l) Coanda patent extract of the Coanda effect circular wing.

2.3 Coanda Effect Circular wing design

Based on the above visualization we may consider that, even if it is totally different when it is generated, the Coanda effect has the same effect on the thrust as does the Bernoulli lift on a wing, as long as the stream lines of the environmental air are maintained the same.

Because of the fact that the lift produced by a running wing represents a phenomenon that creates an action=disturbance over the free atmosphere, the atmosphere's response will be by reaction=lift over the wing, therefore we may consider that any other device that produces the same action=disturbance over the free atmosphere will naturally receive the same response as the lift.

The wings need to move in order to produce the lift over the wing, but the Coanda thruster is capable of producing the same lift without any wings movements. Therefore, the Coanda thruster has no left-right wings as we know from birds, insects and airplanes, but just a circular well- designed and controlled wing, as it is shown below based on a mirrored section from the Coanda patents [4].

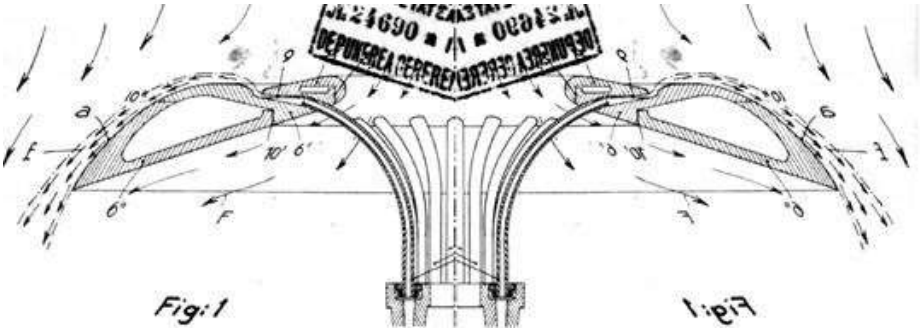


FIG.2 Coanda Effect circular wing

According to the Coanda archives [5], the first successful test of the thruster was back in 1934, and it looks as follows:

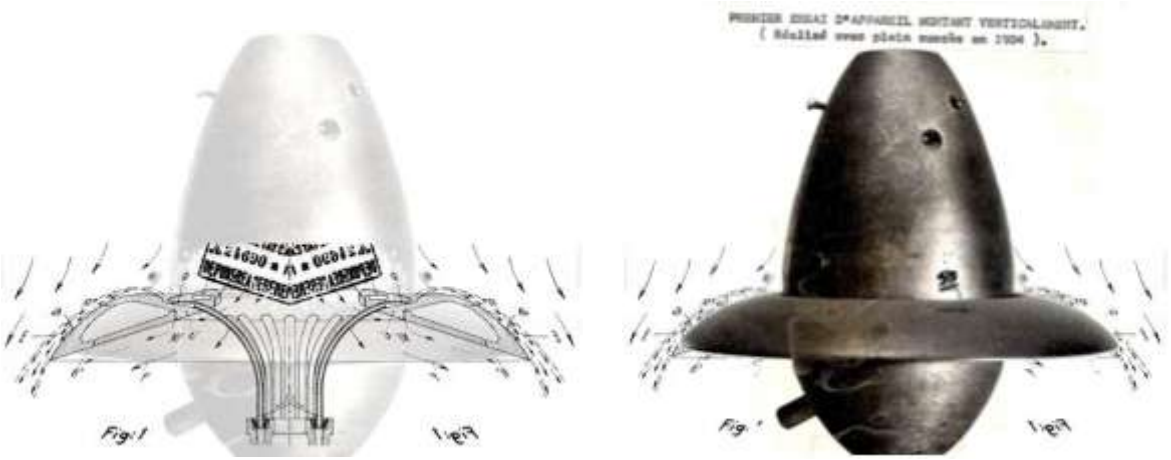
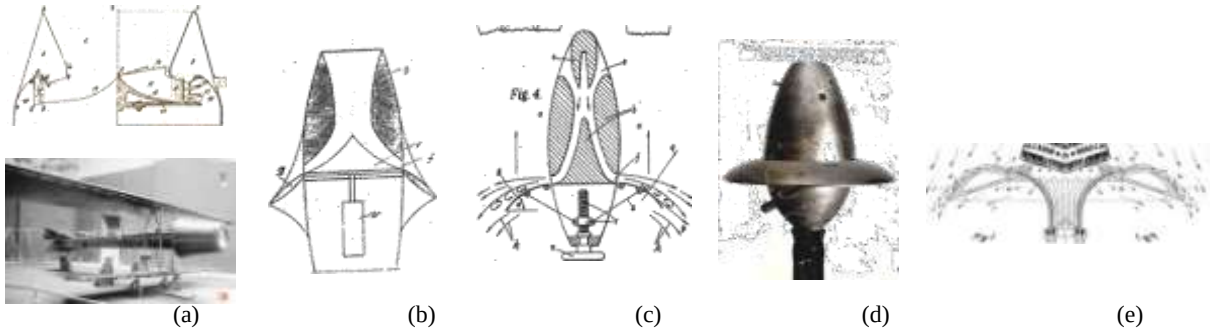


FIG.3 The Coanda Effect thruster successfully tested in 1932

It becomes clear that Henri Coanda favorite application were the air thruster and lifting devices. Moreover, it is correct to think that the Coanda Thruster was born inside the first jet aircraft of the world which was tested back in December 1910, even most of the historians think that Henri Coanda abandoned the idea of the jet thrust, because he didn't recover and reload the first jet aircraft "Coanda 1910" in another version.

2.4 Developing the 1910 jet aircraft thruster

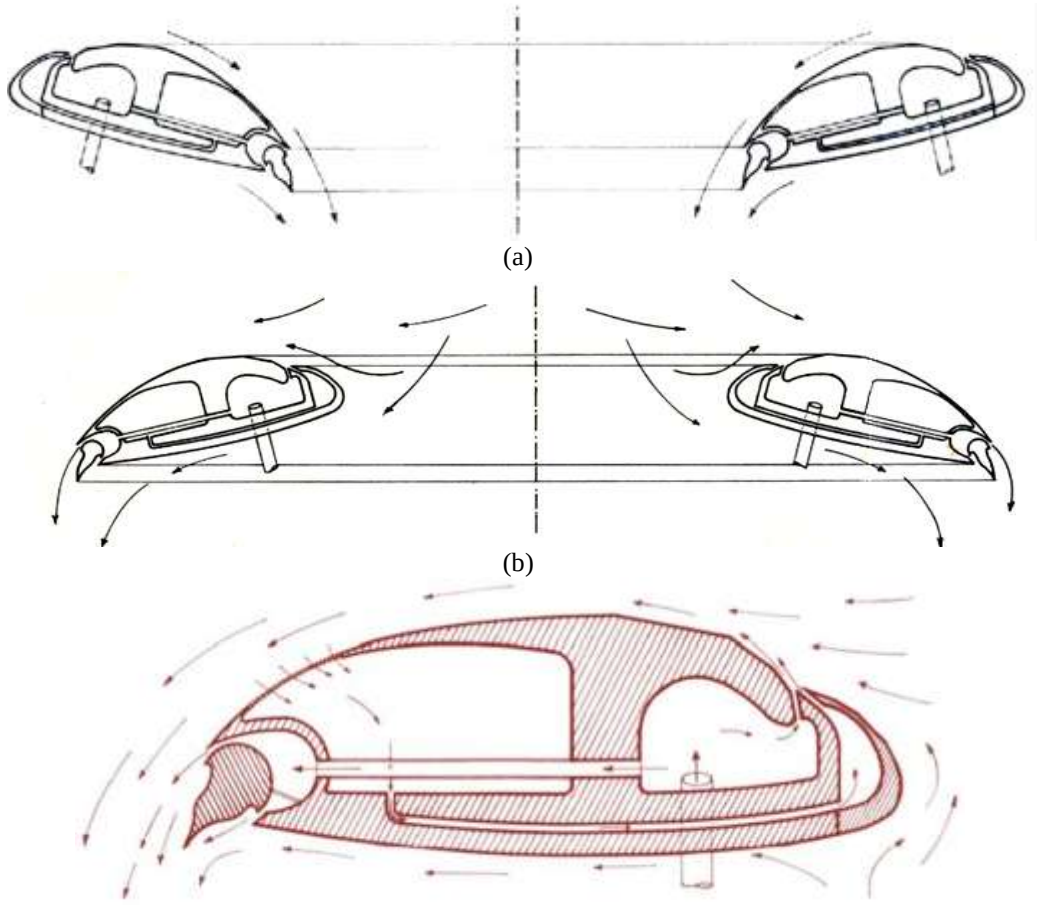
We have found out that Henri Coanda continued and developed the first jet thrust idea in 1910, generating new thrusters with more and more efficiency, as soon as he understood the Coanda effect phenomenon, 20 years later.



(a) (b) (c) (d) (e)

FIG.4 Coanda Effect thruster step design: (a) 1910| FR416541first addition no 13502, (b) 1932| patent FR762688, (c) 1934| patent GB431646, (d) 1934| test device, (e) 1935| patent FR796843

Also , we have more reasons to consider that until 1934 Henri Coanda completed the design and the solution for having high efficiency thruster based on the Coanda effect and circular wing. The two ways of producing lift for the Coanda lens shape aircraft were as follows:



(a)

(b)

(c)

FIG.5 High efficiency thruster based on Coanda effect and circular wing: (a) Coanda internal ejector designed by Henri Coanda for high lift efficiency (flow towards interior), (b) Coanda external ejector designed by Henri Coanda for high lift efficiency (flow towards exterior), (c) Section over circular wing lifting device

After 1934 he focused on the production of the primary jet that was feeding the thruster in order to create a fully functional thruster without any mechanical moving parts (rotors and pistons). Done it!

3. HENRI COANDA PIPE LINE TRAIN

We may consider the Henri Coanda idea to eliminate the power and propulsion devices from atransport line as a revolutionary one. This task allows him to imagine and to test a pipe line transport having a container as a vehicle without any engine on it. The system is very simple if you have available the Coanda ejectors, because any movement is done by using depression and over pressure on the external walls of the container itself, as follows:

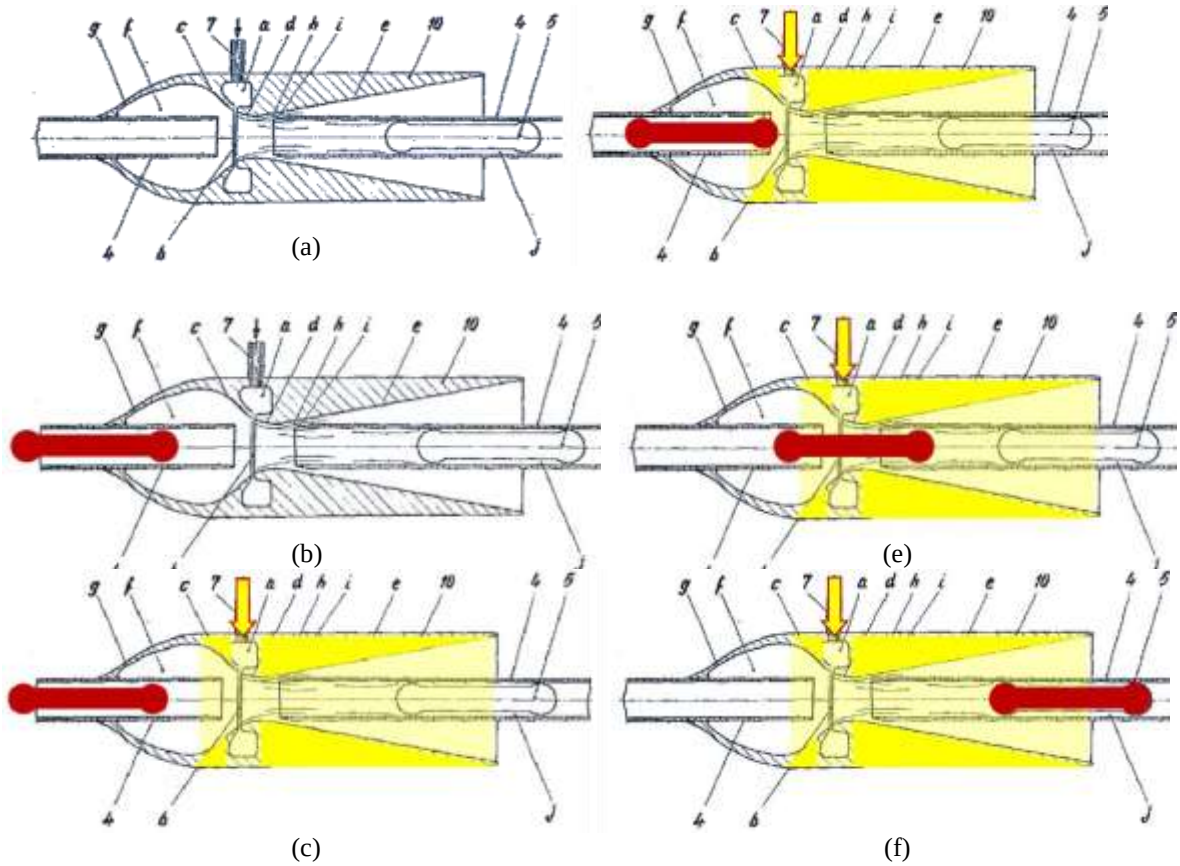


FIG.6. Coanda pipeline container transport: (a) base design according with the patent RO55357/1970, (b) the container, (c) ejector is powered on, (d) the container is sucked into the running ejector, (e) the container is moving fast throw ejector, (f) the container is pushed back outside the ejector

The impact of the Henri Coanda solutions on the Romanian research headquarters was very strong once Henri Coanda decided to return to Romania, back in 1967. The tube (pipeline) transport system was one of the mains projects that was developed by the Romanian authorities and continued after Henri Coanda passed away, back in 1972.

The main applications were industrial, carrying different raw materials.

Russia, Japan and Romania were the first three countries to successfully apply the solutions ofthe tube transport on a large scale for industrial applications, back in the 80s.

An interesting application related to the tourism was the transparent duct transport in order to have tourist tours in the mountains and under the lakes or Black Sea, too.

Recovering Henri Coanda's idea for duct transport, it becomes realistic to think that "we need to get off the roads all the heavy trucks that are dangerous for the other vehicles" as Henri Coandabelieved.

(a) (b)

FIG.7 Coanda pipeline transport experiments: (a) 1970 Transport tube experiment done personally by Henri Coanda at INCREST facility in Bucharest, Romania, (b) 1980 Pipeline human transport at experimental base at Maneciu Ungureni, Prahova county, Romania [6]

4. GOGU CONSTANTINESCU SONIC CANNON

Geoge (Gogu) Constantinescu (1881-1964) is one of the greatest inventors in the world. Not only because he invented many devices based on the true fact of the compressibility of liquids,but also because he created a new theory: the *Theory of Sonics*.

Sonics is the way to transport energy using liquid internal vibrations based on liquids compressibility, elasticity and friction. The liquids only vibrate but not flow. It is not about hydraulics, but Sonics, using sound waves.

Geoge Constantinescu was a very good theorist, inventor, designer, experimental engineer and also a very good entrepreneur for his inventions. He was a Brilliant Mind inside a single person.

Based on his theory, he created sonic devices that were able to synchronize the shooting of theairplane gun between the aircraft's own propeller blades. During the WWI, the British Government asked him to produce 50000 sonic devices for the British aircraft [7], giving to the allied troops the power of the aircraft fire which turned them into war winners.

We do not intend to present the entire creation of Gogu Constantinescu, because it is very complex and it should be presented in a different paper. We will present here only the Sonic Cannon.

4.1 The Water compressibility experiment

Base on the fact that the sonic effect is totally different from the hydraulic effect over liquids, it was necessary for Gogu Constantinescu to present separately the sonic effect, in order to show the differences.

The Presentation of the sonic effect was necessary because when he wanted to fill a patent in the US at the Patent Office he was refused because of the fact that "liquids are incompressible". It was necessary the pledge of a Royal Society member for confirming the existence and working of a sonic machine that had been previously built in London.

A demonstrative experiment of the compressibility of a fluid was welcome to be done. The following images are extracted from a video back in the 1920s [8]. First, he prepared the device:

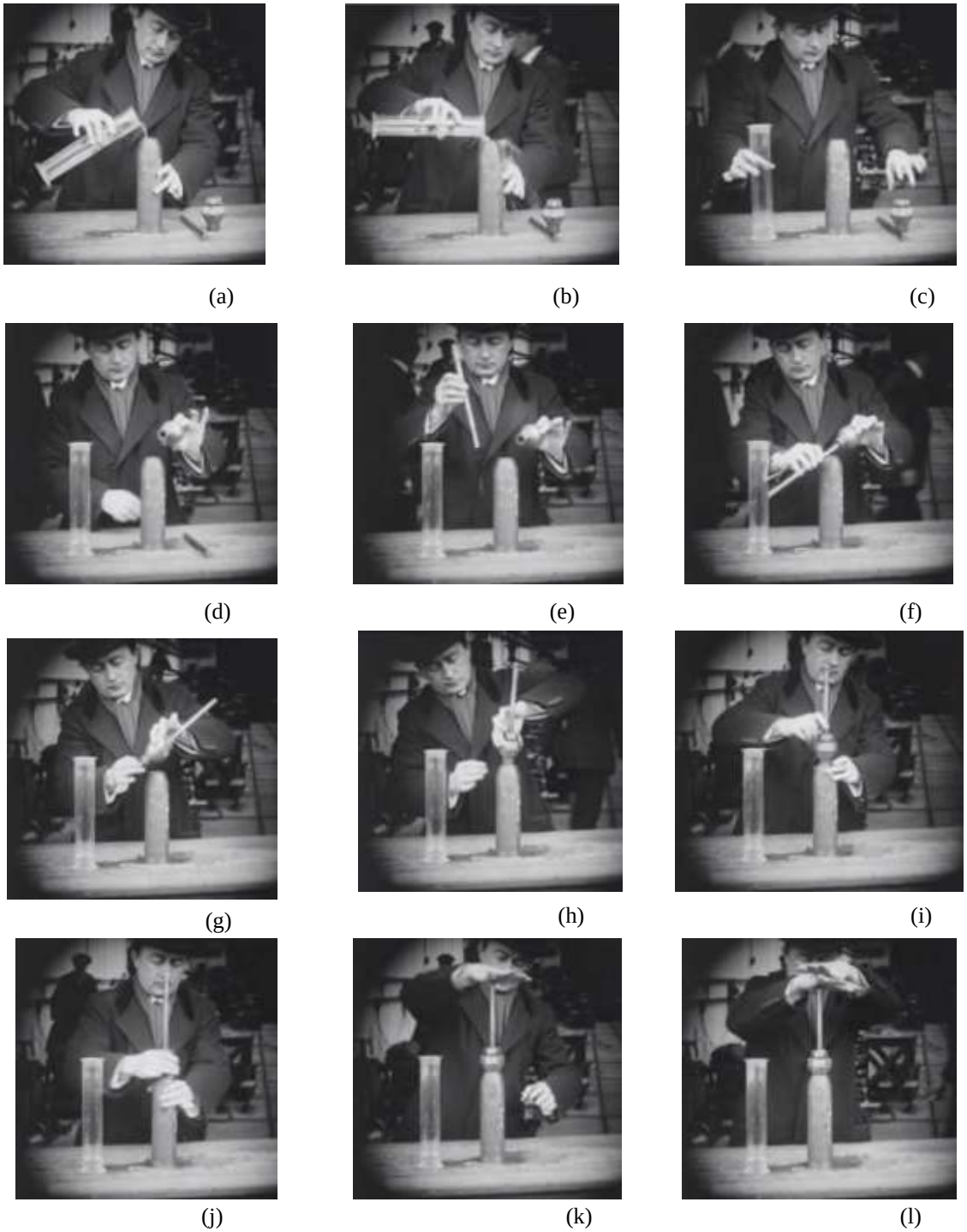
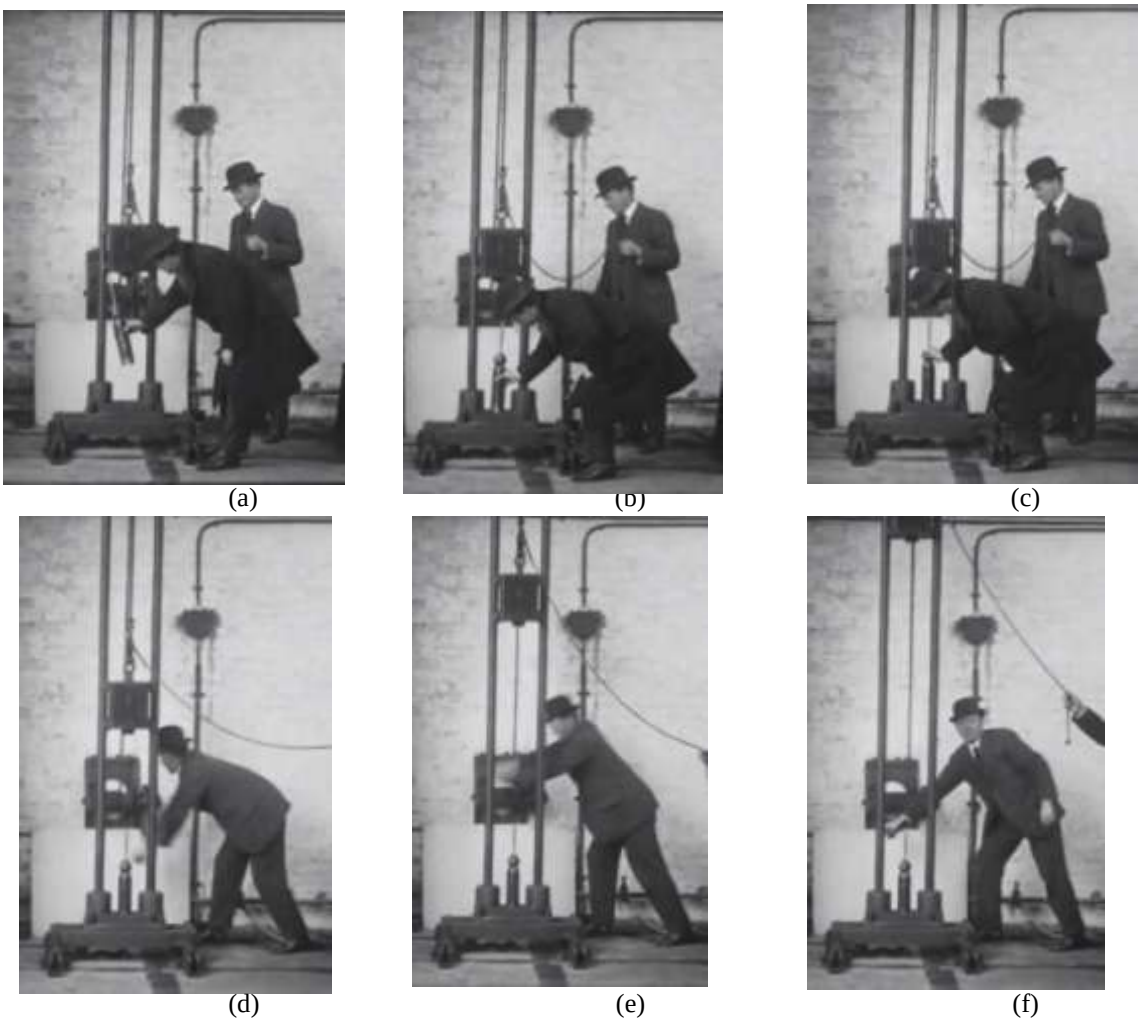


FIG.8 Gogu Constantinescu is preparing the water compressibility experiment: (a) filling a reservoirwith water, (b) until water overflows, (c) takes the upper side of the device, (d) showing that it has a circular hole, (e) taking a cylindrical rod piston, (f) mounting the rod inside, (g) up to the end of the rod, (h) mounting the 3 pieces device, (i) in a vertical position, (j) screwing the assembly, (k) the rod is rigid when it is pushed with one hand, (l) and pushing it with two hands also

Secondly, he mounted the testing 3 pieces devices (main body +piston rod +upper screwedpart) into a fixed position on the experimental stand.

After the rise of the test weight up to 2,5m high, that has an estimated mass of 100kg, it wasfree fall of the weight over the piston.

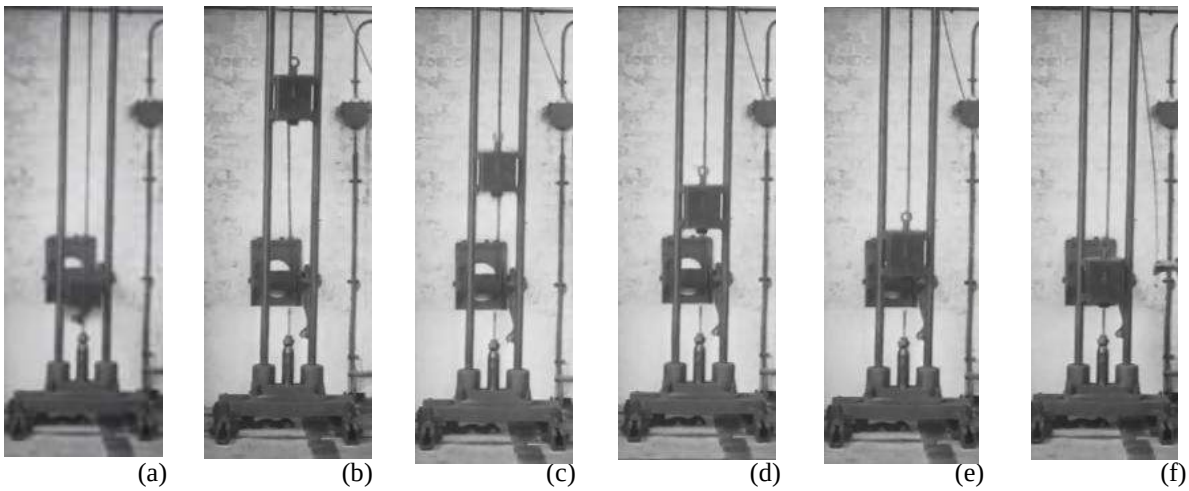
The piston is compressing the water and the elasticity of the compressed water is pushing back the mass and rising it again. Several down-up oscillations are done until the oscillation is stopped.



(a) (b) (c)

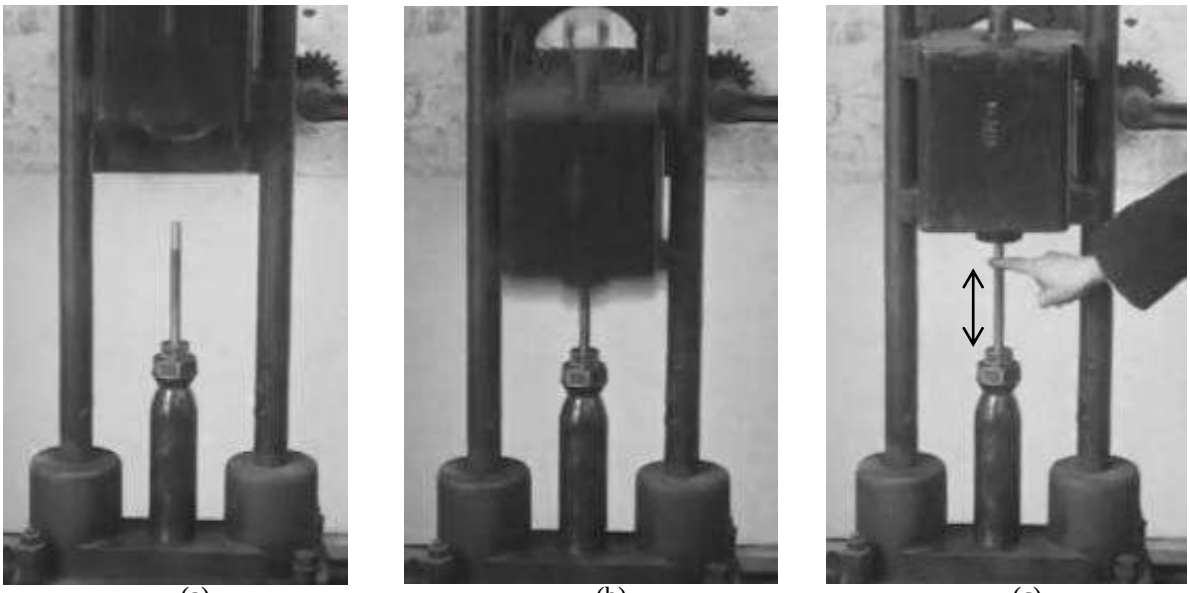
(d) (e) (f)

FIG.9 The Gogu Constantinescu water compressibility experiment: (a) Bringing the test device on the experimental stand, (b) Putting in the right position, (c) Fixing it in the position, (d) Rising the weight manually, (e) Rising the weight at 2m high, (f) Rising the weight at 2,5m high



(a) (b) (c) (d) (e) (f)

FIG.10 The Gogu Constantinescu water compressibility experiment. A detailed view of moving thepiston, which means that the water inside was compressed: (a) Fall on piston, (b) First retreat, (c) Second retreat, (d) Third retreat, (e) Fourth retreat, (f) Fifth retreat



(a) (b) (c)

FIG.11 The Gogu Constantinescu water compressibility experiment. A detailed view of moving the piston, which means that the water inside was compressed: (a) Piston free, (b) Piston is compressing water, (b) Limit of the moving piston, from finger to the bottom showed after the experiment was done

Gogu Constantinescu claims that the pressure inside the main body of the test device (that is confirmed to be a former body of a shell adapted to the experiment) is up to 2000bar. At 2000bar, water seems to be compressed up to 90% of the initial volume.

Physics lets us know to consider that the 2000bar is easy to be produced by the free falling of a 100kg mass from 2m high over a piston-rod considered to have a section of about 1cm2. Similar with what Constantinescu shows us in the above described experiment, we may consider:

$$p[Pa] = \frac{F\,[N\,]}{A[m^2]} = \frac{100\ kg\ 200\ \frac{m}{s^2}}{1\ cm^2} = \frac{20000\ N}{0{,}0001\ m^2} = 200000000Pa = 2000\ bar \quad (1)$$

When the 100 kg falling mass movement is stopped by the compressed water piston rod, we might consider that the acceleration is about 20 times that of the Earth acceleration (g = 9.8 m/s2). Intuitively, this is possible when the time falling is about 20 times longer than the time of the rod movement when compressing water (the touch between the falling mass and the rod until stopped).

4.2 The sonic cannon

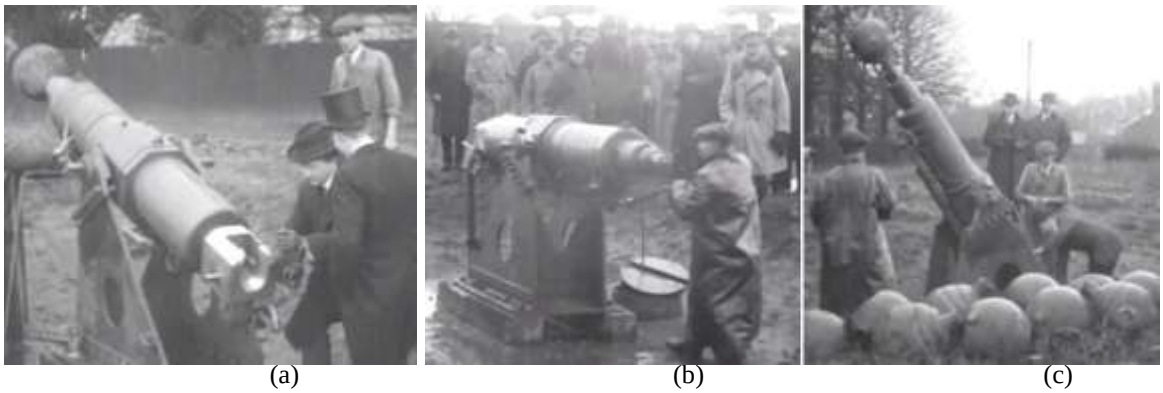
Based on the above experiment, Gogu Constantinescu has imagined a device that creates a rapid expansion of compressed water that was previously prepared by themanual force of an operator.

First, it was a small demonstrator cannon that deployed a grenade of about 1kg at 150m, usingonly ½ liter compressed oil at 1000bar.

Second, another demonstrator cannon deployed a shell/projectile of about 8kg at 500m, using3 liters of compressed oil at 2000bar.

Third, the real sonic cannon (pictures below [8]) deployed a shell/projectile of about 100kg at 1500m, using compressed oil, probably at 2000-2500bar, without any fire and explosion and without any noise.

The construction of the cannon was very serious and robust, on a 1:1 scale, as a working device that demonstrated the new capability for real application.



(a) (b) (c)

FIG.12. Gogu Constantinescu sonic cannon public test (a) First, Gogu Constantinescu is presented andhe is preparing the cannon for a real public demonstration, (b) A companion arms the sonic cannon, (c) The sonic cannon was finally prepared for the real test

Just after the sonic cannon was prepared, the test was completed by deploying the spherical shell (projectile).

(a) (b)

FIG.13 Gogu Constantinescu's sonic cannon public test (a) Just before the deployment, (b) Just after the deployment

This unbelievable efficiency of the device is based on the fact that during compression, liquids are not generating as high temperature as gases do. The temperature generated by the liquids for a 2500bar compression is less than 1degree and the volume is 10% lower than the uncompressed liquid. Therefore, almost the entire energy is recovered during the deployment through elasticity.

It is obvious that by omitting the compressibility of liquids, some of the very special applications might have not been discovered at all, or might have been lost by ignorance if tested before, therefore we do believe that the sonic capability might be reloaded as defense devices in many sizes and shapes, including being part of a complex device that hunts and shoots down hypersonic missiles.

5. HHO FOR PISTON ENGINE

The water electrolysis phenomenon was discovered about 200 years ago. Splitting the water molecule into Hydrogen (H2) and Oxygen (O2) using electricity turned out to be very challengingnot only from an energetic perspective, but also from a medical one. This should not be surprising as long as life on Earth is based on hydrogen and oxygen. Electricity is not the only way to split the water molecule, but it is a sustainable one.

5.1 An Australian Brown's Gas

One of these devices is the HHO generator for piston engines, also known as the Brown's Gas after the Australian inventor Research Professor Yull Brown who discovered, tested and described it as follows: *"Brown's Gas is a stoichiometric mixture of hydrogen and oxygen in the exact ratio of two parts hydrogen to one part oxygen"* [9]

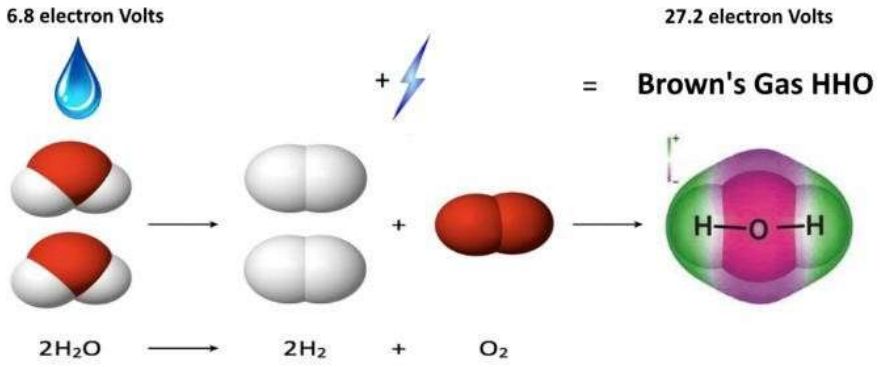


FIG.14 Brown's Gas HHO molecular reaction

The name HHO comes from the fact that the Brown gas is exactly two parts Hydrogen and one part Oxygen. HHO may also be found as YBG (Yull Brown Gas).

The most interesting and important capability of the HHO gas is that it IMPLODES not EXPLODES.

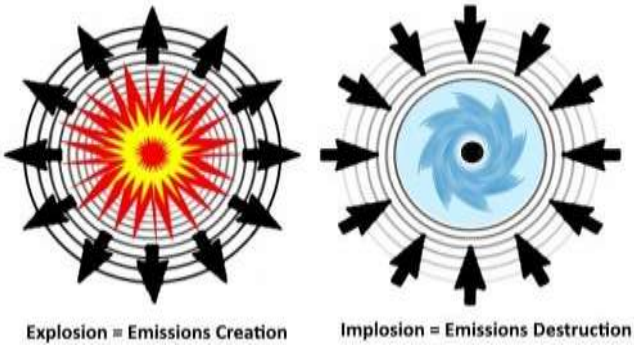


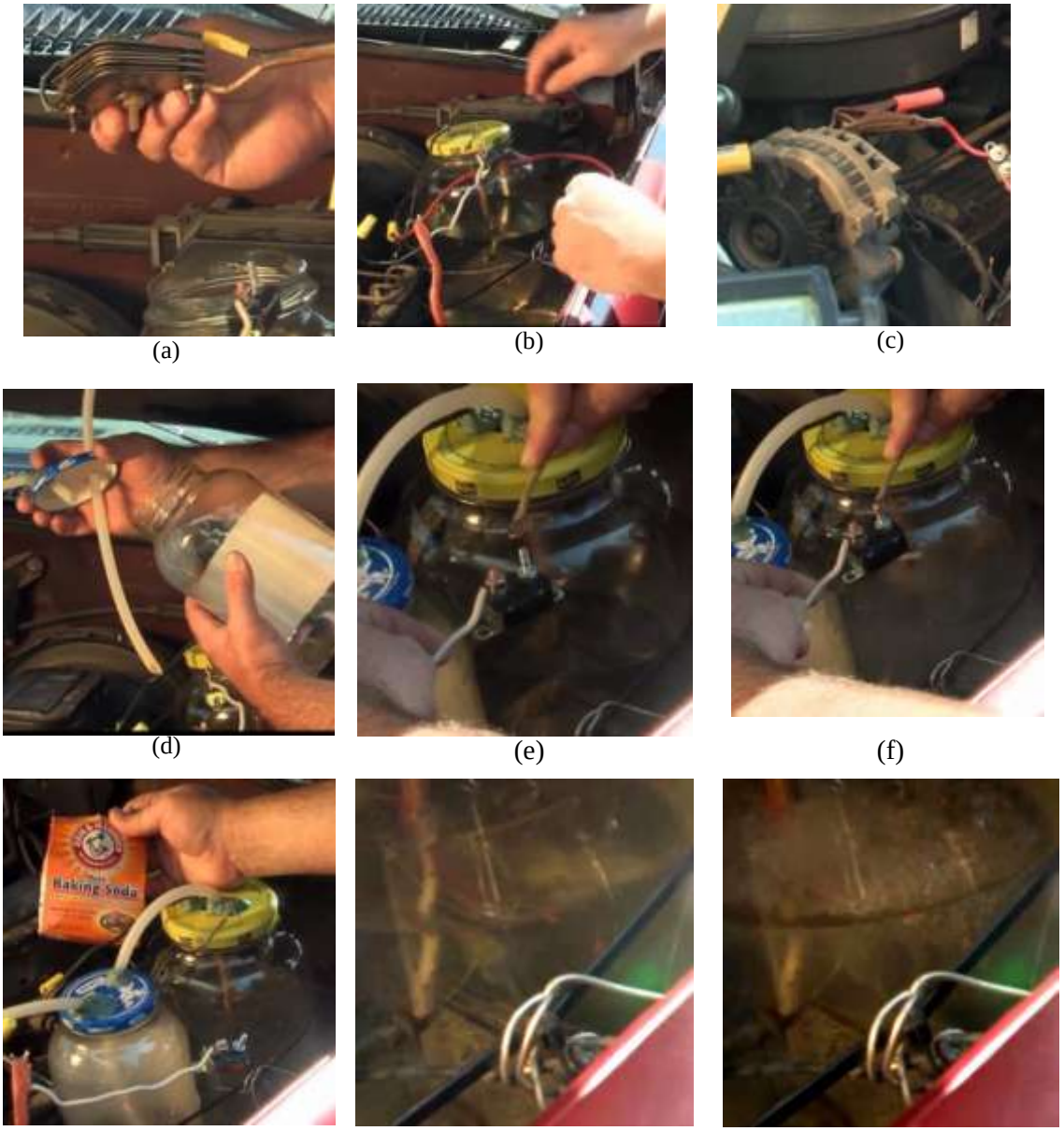
FIG.15 Usual exothermal explosion reaction vs Implosion of the Brown's Gas HHO exothermal reaction

There are also many unusual properties that we do not need to talk about in this paper but the use of the HHO gas wherever it exists burners, in industry, engines, turbines or others.

5.2 An American car experiment

Being educated in a free world, most of the creative civil Americans have discovered and tested in they own garages, laboratories or homes many interesting useful devices aimed at having an easier life.

We will let you know how the HHO is used by one of the Americans whose YouTube video ishas had 4M views since 2011[10]. We find it attractive to present it in this paper, because he tested the home made HHO generator which works on his car for 20000 miles.



(a) (b) (c)

(d) (e) (f)

(g) (h) (i)

FIG.16 An American car test | You Tube Metalpress TV (a) The stainless steel water electrolyser, (b) The water bottle + electrolyser, (c) Power at the alternator (25Amp), (d) Safety bottle, (e) 0 A, No HHO production, (f) 25A, HHO production, (g) Add 1-2g of Baking soda, (h) Before HHO production, (i) DuringHHO production

(a) (b)

FIG.17. An American car test | You Tube Metalpress TV (a) The pictures of the tested car, (b) Water coming out from the exhaust

The HHO generator is powered by the car alternator at 25A, and the HHO gas is conducted to the input of the air in the engine, right after the air filter. All the connections are well done inorder to avoid any leaks. The second bottle is done in order to create a hydrogen gas protection.

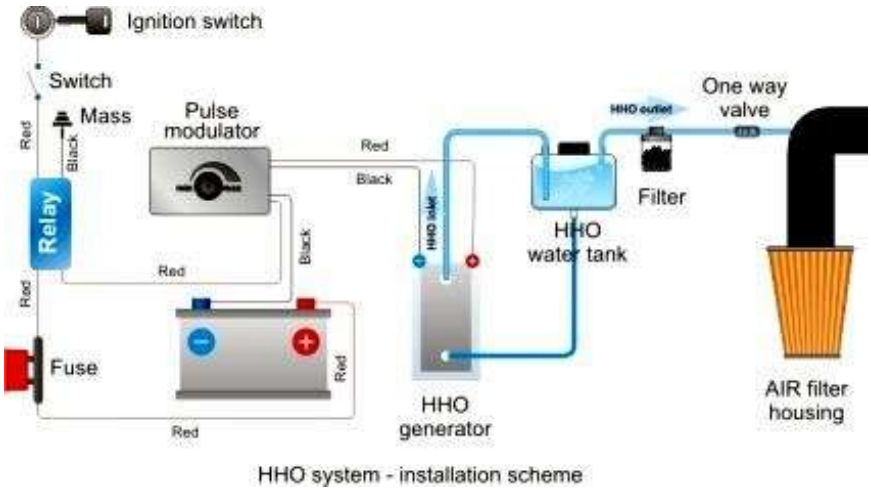


FIG.18 A scheme of the car HHO generator[11]:

We really appreciate the effort of doing the video and the fact that he shared it with everybody. The final of the video is relevant: *"[…] We hope that you will take advantage of it. Thanks for watching"*. We, the watchers, need to thank this American, so: Thank you!

Common HHO devices used for the piston engine generate 75% less harmful gas emission and reduce the engine fuel consumption by 20-30%. The commercial cost is up to 3-700Euro/car.

We found the HHO gas being a very powerful alternative to the actual polluting fuels. Therefore, we strongly believe that the transition from the actual piston engine cars to the future hydrogen cars is represented by the HHO devices.

6. CONCLUSION

Human society's behavior has proven to be very destructive for the Society itself. The old philosophy used to dominate other peoples or nations has not been evolved for 3000 years but the way to put into practice that old philosophy is changing when related to the existing technology. Therefore, the main goal of the Human Society's evolution is not simply to develop highly advanced technology, but to develop highly advanced technology guided by highly advanced moral and individual, group and nation awareness. It is obvious that awareness should be developed based on high spirituality, not high materiality. We are first spiritual beings, and secondly material.

The highly advanced Coanda Effect vacuum thrust, the circular wing, the Coanda pipeline transport, the implosion water engine, the water compressibility gun, cannon or missiles, the HHO generators for cars, truck, ships or trains represent some of the available technologies that have been intentionally avoided for many decades in order to maintaineconomic, political and military control over the nations.

The Human society's industry turns out to be very destructive for the Environment starting150 years ago. Now, suddenly Humankind has discovered, or has been helped to discover, that it is hurting itself with its own self destructive philosophy of life and society and with its way of living, including existing technology and industry.

Therefore, in the last years the political trend is to find solutions to reduce de CO2 emissions and more. For transportation the main alternative future solution till now has been considered to be the electric battery engines for cars, trucks, trains, ships, airplanes etc

We, and many others, consider that Hydrogen represents the alternative fuel that we need. Hydrogen fuel represents not only the liquid hydrogen that needs special ways to be used, but also the compressed hydrogen as a gas, because it represents the easiest way to produce, store and use hydrogen. HHO may become an alternative that should be taken into consideration.

We recommend to all the local public administrations of the polluted towns and cities financially sustain the production and adaptation of the HHO devices for all the cars that run inside their cities. It seems to be the cheapest and most effective technical solution that is available in order to reduce town's pollution.

We also recommend the military defense industry to start to use water compressibility as part of the systems which will shoot down hypersonic missiles for self protection.

We recommend start using the transport systems having no propulsion systems inside but outside the main transportation duct or pipeline.

All the technologies that were shown in the present paper are sustainable, with no polluting effect on the Environment (gas, noise, explosions), low cost, already successfully tested in experiments, unusually related to the actual technology that we already know and accept.

Let's use them all!

REFERENCES

[1] ***The paper was presented at the 23 rd edition of the International Conference AFASES, 2022 at Aeronautical and Atmospheric Sciences Conference, program position no 10, Friday 27 May 2022, h16.00, ROOM F-E3.11;
[2] ***The paper called "The current Henri Coanda" was never presented because it was supposed to be presented as Keynote Speakers, but it was later announced to be on the section Aeronautical and Atmospheric Sciences Conference, program position no 11;
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RISK MANAGEMENT, AN EXAMPLE OF ENFORCING IT TO PROVIDE FLIGHT SAFETY AND OPERATIONAL CAPABILITIES

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***Abstract**: The mission of flight safety is to ensure the conditions for the conduct of aeronautical activities at an accepted level of risk. The primary objectives of aviation safety are to avoid loss of life and injury to persons. The following objectives, as a priority, are to avoid material damage and limit the effects of aviation events. As a result, at least two elements of operational capabilities are in the attention of aviation safety processes: personnel (in number and training for combat) and aircraft (in terms of their availability and performance). The fundamental working tool of aviation safety is risk management.*

***Keywords**: operational risk management, operational capabilities, flight safety, human factor, crew resource management*

Acronyms

CAS	*Close Air Support mission*	*COM*	*Communication*
ICAO	*International Civil Aviation Organization*	*IFF*	*Identification, friend or foe*
NVG	*Night Vision Goggles*	*NAV*	*Navigation*
RWR	*Radar warning receive*		

1. OPERATIONAL RISK MANAGEMENT, A FUNDAMENTAL TOOL FOR AERONAUTICAL SAFETY

Operational risk management is described as a process that has two basic objectives: identifying potential threats / hazards followed by implementing measures to reduce the risks associated with threats. In the Romanian Air Force, risk management is defined by the application of six steps [1], in a model similar to that applied in USAF [5] and ICAO:

- Identifying potential hazards / threats;
- Risk analysis: cause / effect analysis, identification of risk components: severity, probability, exposure;
- Identifying possible risk reduction measures;
- Establishing risk reduction measures: applying the criteria of efficiency, opportunity, feasibility, etc.;
- Implementation of risk reduction measures: who, what, when and by what means, responsibilities;
- Assessing the effect of risk reduction measures and monitoring the evolution of the situation.

It should be emphasized that the basic element in aviation safety is the identification of hazards / threats. This requires information. The need for an effective information / reporting system lies primarily in the need to support the identification of hazards / threats.

All other stages should take place naturally, with the effective participation of staff, at least bound by the fundamental instinct of conservation, specific to the human race.

The major difficulty is the crew's awareness that this tool is helpful and not a new bureaucratic means of loading time to prepare for the mission.

There are several dimensions on which aviation safety can be based:

- Temporal and hierarchical: strategic level, planned, situations in time crisis;
- Prevention strategy: reactive, proactive, predictive;
- Constituent factors of the aeronautical system: human, technical, environmental, management, mission;

It should be emphasized that the whole doctrine and philosophy, the normative documents and the activities should be directed to the pilots, in the procedures of execution of the flight missions and the way of preparation of the missions but especially in the formation, development and maintenance of decision-making and piloting skills.

FIG. 1 Operational risk management

2. MISSION ANALYSIS

2.1. The risk management process

The risk management process is initiated by the analysis of the mission and the consideration of the possible contributing factors to the occurrence of aviation events. Combined with "KILL - LIVE CHAIN" [2], threats to the mission and its phases can be established. In the table below are given some elements of analysis to establish the safety measures by applying this mechanism, having as example the elements KILL CHAIN. Taking into account a CAS (Close Air Support mission) [6], we can correlate a number of operational elements with mission-specific security measures. Table no. 1 KILL CHAIN and the contribution of aircraft performance and risk factors to the assessment of operational capabilities [4].

Table no. 1 KILL CHAIN

KILL CHAIN	Operational Element	Factors of influence
Distance / Target	Flight profile: altitude, speed	Runway condition, Wind, BASH, Obstacle, Fuel on board, Flight to target.
Persistence	Flightmode: altitude, speed Fuel on board	Wind. Fuel on board, Combined mng system.
Target discovery	Radar, IFF, RWR, NVG system performance	Time, brightness, Visibility, Ceiling
Target identification	Radar, IFF, RWR, NVG system performance	Visibility, Day Night, Knowing the enemy
Target tracking	Maneuvering performance	Maneuvering restrictions limits. Obstacle, Misperception - dangerous approach
Attack	Maneuvering performance. Weapon depth. Performance of Radar, IFF, RWR, NVG systems	Maneuvering restrictions, Obstacle. Approaching the wingman, The distance to the explosion
Assessing attack	Maneuvering Performance. Sensors performance.	Maneuvering restrictions, Obstacle. Approaching the wingman, The distance to the explosion

2.2. Identify mission-specific hazards / threats and risk assessment

Identifying hazards / threats is the fundamental step in aviation safety. It is recommended that a list of threats specific to each mission be developed against which effective action can be taken. Keeping an interception mission in mind, the main dangers can be:

- Fuel limit;
- Dangerous approach / ground impact / obstruction;
- Loss of aircraft control
- Shoot / launch incidents;
- Loss of orientation;

Latent conditions for threats are:

- Incorrect planning and longer flight time than planned;
- Deviation from the path;
- Incorrect study of the obstacle;
- Wrong altimetry;
- Failure of the navigation system;
- Defect of the barometric system;
- Exceeding the limits of the flight tire;
- Incorrect setting of warnings;
- Distance perception error;
- Execution of maneuvers in conditions of low visibility or inadequate visual contrast;
- Focusing attention / distracting from critical elements
- Incorrect communication procedures within the crew / formation / operational controller of the mission.

The risk analysis may include the following:

a. The probability of occurrence of events or activation of latent conditions is difficult to estimate but can be said to be proportional to the interruption of the flight in the respective conditions and inversely proportional to the experience of the pilots.

b. Exposure is a constant in combat situations, given that all crews are exposed to danger under the same conditions.

c. Severity may vary from pilot to pilot, and experience and quality of training may play an important role in limiting the development of special situations or limiting the effects of aviation events.

2.3. Identifying and establishing safety measures

Indeed, security measures focus proactively on elements of mission planning, preparation and execution (application of procedures) with emphasis on the following:

a. Prevention of loss of aerodynamic control of the aircraft:

- Study of the permitted flight tire, depending on the operating configuration;
- Setting the warning system compatible with the permitted flight tire;
- Study of the decision time available in special situations;
- Designing / establishing attack procedures and maneuvers according to the available diagram;
- Establishing clearance / avoidance maneuvers according to the available tire;
- Establishing the procedures for verifying the operation of the systems (NAV, COM, Pitot Tube);
- Study of weather conditions: turbulence, visibility, icing, other dangerous weather conditions

b. Preventing impact with ground in controlled flight:

- Altimetry procedure;
- Establishing the procedures for verifying the operation of the systems (NAV, Pitot Tube);
- Studying the map: marking obstacles and relief, setting the navigation and warning system;
- Study of take-off / landing procedures;
- Study of weather conditions: turbulence, visibility, icing, other dangerous weather conditions;
- Avoiding deviation from living;
- Identifying moments of concentration / distraction;
- Taking into account the position of the Sun, ceiling, clouds, natural horizon, and landmarks for establishing attack maneuvers.

c. Fuel limit:

- Calculation of fuel according to the ordered profile;
- Establishing an alternative profile, especially for base return;
- Setting the warning system;
- Establishing the minimum amount of fuel for mission interruption;
- Establishing the procedures for verifying the operation of the systems (NAV, Pitot Tube);

d. Operation of the armament system:

- Coupling / decoupling the weapon system at the entrance / exit of the attack, after violating the target;
- Entering the area of the own aerodrome with the disconnected weapon system;
- IFF identification rules to avoid fratricide;
- Procedures in case of blocking / failure of the armament system;
- Asymmetric flight.

2.4. Implementing safety measures and evaluating their effect

The application of aviation safety measures is the direct and unequivocal responsibility of pilots and crew members. Where appropriate, doctrinal procedures or changes shall be established / updated. We believe that they need to be monitored by air safety commanders and officers, as well as flight instructors, in order to enhance safety. It is important to carry out the objective control process of the mission so that the benefits of compliance with safety measures as well as the weaknesses and factors that can trigger potential hazards or latent conditions for the occurrence of aviation events can be highlighted.

2.5. Strategic security processes for maintaining operational capabilities

We consider institutionalized training one of the fundamental elements for increasing the level of aviation safety for the benefit of operational capabilities. The selection provides people with the most developed potential for training and development in the military pilot profession. Continuous, coordinated, systematic training in the areas that are essential for the flight is the fundamental condition for:

- Prevention of latent conditions / preconditions for an aviation event;
- Creates the theoretical basis, decision-making skills, piloting technique and effective risk management for the precise execution of missions.

CONCLUSIONS

Aviation safety cannot be separated from the quality of mission execution. Even if it is apparently put into practice by the staff belonging to the specialized structure and commanders, aviation safety is a problem for all those who carry out aviation activities.

Operational capabilities are based on the number of staff trained under certain conditions and the resources available. It is obvious that by carrying out risk reduction actions and achieving aviation safety objectives, the preservation of operational capabilities is supported.

The effort of the prevention processes is focused on:

-Systematic identification of hazards and safety measures for all missions, permanently;

-Simplification of procedures / missions;

-Concentrating the effort of aeronautical activities in periods close to important exercises or missions;

-Continuous communication and search for those mechanisms specific to the human being to activate the conservation instinct and the desire for knowledge as well as to increase professional motivation as essential engines to ensure an acceptable level of aviation safety.

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NORD ATLANTIC CYCLONES TRACKS IN EUROPE AND THEIR INFLUENCE OVER AMOUNT OF PRECIPITATION RECORDED IN ROMANIA (1985-2015)

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Abstract: *The region of Romania is characterized in terms of continental temperate climate with oceanic influences. Thus, the precipitation regime and the thermal regime in this part of Europe are strongly influenced by the frequency of cyclones whose trajectories cross Europe from west to east coming from the Atlantic Ocean. The present study analyzes the variation of the amount of precipitation in Romania depending on the frequency and variation of the geographical position of the trajectories of the North Atlantic cyclones in the area of the European continent. Using the classic method of identification and tracking, 1189 cyclones were found that crossed Europe north of the Alps in a period of 30 years between December 1, 1985 - November 30, 2015, of which 71% generated precipitation in Romania. Their influence on the amount recorded at meteorological stations in Romania varies between 43% in the northwest of the country to 13% in the southern regions.*

Keywords: *extra-tropical cyclones, North Atlantic, precipitation, Romania.*

1. INTRODUCTION

Extratropical cyclones are complex phenomena whose variability determines both the appearance of daily weather and the appearance of climate for long periods of time. They are also responsible for regulating the temperature, humidity and precipitation in the regions crossed (Varino et al, 2018), and at the same time, they are responsible for some severe manifestations of characteristic phenomena that have negative consequences on communities across the continent, (Browning, 2004), (Pfahl and Wernli, 2012). Precipitations in the European region are generated by extratropical cyclones, convection and orographic convection, (Hawcroft et al., 2012).Central and eastern regions of Europe receive their rainfall from the atmospheric fronts associated with cyclones and North Atlantic basins and from the presence of cyclones of Mediterranean origin. For the central-eastern regions of the European continent, any change in the frequency or position of cyclone trajectories is unmistakably reflected in the wide variation in the amount of precipitation and in important changes in thermal regimes. Studies of extratropical cyclones in the Northern Hemisphere are based on the frequency of cyclogenesis, the frequency of trajectories, the intensity of baric systems, and the density of trajectory types (New et al, 2013). The results obtained in relation to these parameters, oscillate to a large extent depending on the data used and their resolution and depending on the methods of identifying the cyclone and tracking trajectories, (Ulbrich et al, 2009; Wang et al 2006, 2013).

For the North Atlantic region, a vast region where the cyclones that cross Europe originate, negative trends in the frequency of cyclones have been identified over the past century during the winterGulev et al 2001, (1958-1999), Chang and Fu 2002, McCabe, 2001. Positive trends in cyclone intensity were detected by Gulev et al, 2001, Paciorek et al, 2002 and Trigo et al 2006. Numerous studies found significant changes in the position of trajectories in the northern hemisphere Yin, 2005; Chang et al. 2012 and 2013; Zappa et al. 2013, Harvey et al 2020. There has also been an eastward expansion of North Atlantic trajectories across Europe Bengstsson et al 2006, Harvey et al 2020.

This article aims to analyze the variation of the amount of precipitation recorded at meteorological stations in Romania, depending on the frequency of North Atlantic cyclones that crossed Europe from west to east north of the Alps, for a period of 30 years between 1 December 1985 and 30 November 2015.

2. DATA AND METHODS

Data used

In order to compile the data series, it was necessary to inventory the cyclones that crossed the region of Europe in the period 1986-2015. Each cyclone formed at mean sea level was identified and tracked using mean sea pressure (MSLP) and pseudo-potential temperature maps at 850 hPa, available at http://www1.wetter3.de/archiv_gfs_dt.html, (WASA 1998; Alexandersson et al. 2000; Hoskins and Hodges 2002;). Cyclones that formed or crossed the European region were recorded in an area with a western boundary at 20°W, a northern boundary at 65°N, a southern boundary at 30°S, and an eastern boundary at 45°E.

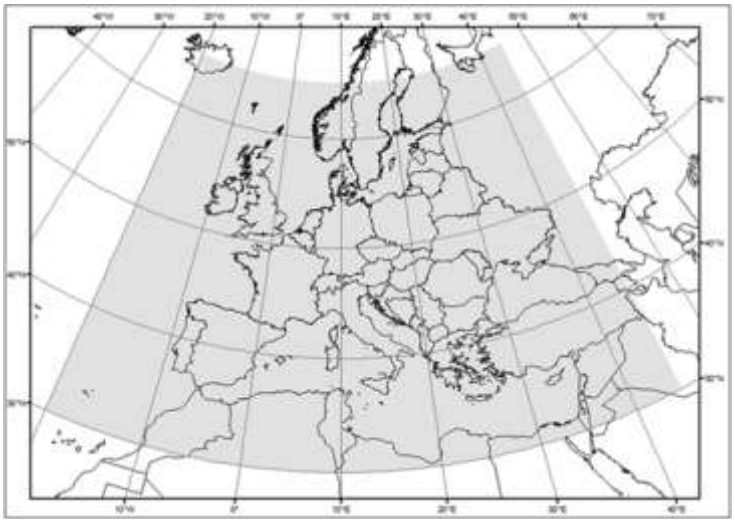

FIG 1 Study area

The data fields provided by the *European Center for Medium-Range Weather Forecast, (ECMWF),* were used to correlate the NACs with the precipitation in the Romanian region through the ERA-Interim program for the same period December 1985-November 2015, (Dee et al, 2011) – surface data were used: wind at 10 meters, temperature and dew point temperature at 2 m, MSLP, lower, medium and upper cloud cover, total coverage, and total precipitation. These data were downloaded using a temporary resolution of 3 hours and a spatial resolution of 0,75°× 0,75°, in a geographical area with a western boundary of 45°V chosen so as to frame the southern border of Greenland, the N limit at 70° S at 30° to fully cover the southern shore of the

Mediterranean Sea and the eastern limit of 45° to cover the eastern Black Sea (Fig. 1). This data was viewed and analyzed using the Integrated data viewer (IDV) program 5.6.

Cyclone identification and tracking

The identification of cyclones on these maps was performed classically, following the minimum value of the pressure surrounded by at least one closed isobar with a maximum value of 1015 hPa, (Hart, 2003; Linello, 2006). The evolution of the cyclone was followed with a time resolution of 6 hours, for at least 24 hours, the threshold needed to filter weak systems. Cyclone tracks were manually plotted using the position of the minimum pressure value at MSLP in ArcGIS 10.8. For each of these trajectories, a temporal characteristic was assigned - the date and time of cyclogenesis identification and a geographical characteristic - the geographical region of origin. The cyclone identified by the method described above with the initial position at time t_0 , after 6 hours is found at the next position at time t_1 , provided that it is at a distance of at least 2° latitudinal from the starting point. When the cyclone developed two centers (bicentric cyclone), the track followed was that of the center that had the lowest pressure and the longest travel. If the second center had a journey of more than 24 hours, it was registered as a new individual from the first closed isobar.

Cyclones classification

Cyclones that crossed Europe from W to E at north of the Alps chain were selected for the database. This includes Atlantic cyclones from the Gulf Stream region, (Rudeva and Gulev, 2011), western and central North Atlantic, eastern Canada and Terra Nova Island – NACs, cyclones from the Icelandic semi-permanent cyclone or formed in the region of Iceland or the SE Greenland, between 60°N and 65°N, and cyclones formed between Iceland and Norway Sea, (Serreze et al, 1997; Serreze, 2007), – ICs, cyclones formed in the Central European region within the Icelandic foothills and Atlantic, (Hofstater, 2016), – TCs and cyclones that intersect the continent from the north along the polar and extrapolar circulations – NCs. This selection excluded the Atlantic and Icelandic cyclones that crossed the continent south of the Alps through the Mediterranean Sea, the cyclone formed in the Mediterranean, the cyclones that after crossing Romania demoted to the Black Sea, and the continental cyclones formed in the hot season in southeastern Europe.

Precipitation data

Precipitation analysis is based on two different data sets. The first set is represented by the daily precipitation recorded between December 1, 1985 and November 30, 2015 at 31 weather stations spread relatively homogeneously on the territory of Romania, (table, 1). The second set consists of the total daily precipitation from the ERA Interim ECMWF, specified above.

Analysis of the NACs activity

Polynomial interpolation was used for the analysis of the spatial distribution, for the centroid of each 3x3 degree grid. This interpolation method was chosen considering the homogeneous distribution of points at the level of the studied area. The evolution of the frequency over time was highlighted by the difference between the decades, the rasters obtained reflecting the spatial evolution of the frequency of the tracks from one decade to another during the study period: D_2 -D_1 , D_3 -D_2 and D_3 -D_1 :

D_1 - TD for the period 1986-1995 (1985-1995 for winter season);

D_2 - TD for the period 1996-2005 (1995-2005 for winter season);

D_3 - TD for the period 2006-2015 (2005-2015 for winter season).

Correlation of cyclone activity with precipitation

The data set taken from the ERA-interim was processed using IDV 5.6 to obtain the presure topography at MSLP, the wind image and the precipitation distribution image. The MSLP pressure was represented as isobars every 5 hPa with the pressure of 1015 hPa

as the reference value. For the representation of the wind, the meridian and longitudinal components were used, obtaining a conventional representation in the form of barbs. Precipitation was displayed in mm from a minimum value of 0.1 mm to a maximum value chosen in such a way as to cover the full range of values, with a temporary resolution of 3 hours. The footprint of the precipitations associated with the Atlantic depressions that intersected the region of Romania in a certain time interval was correlated with the corresponding time period from the precipitation data from the meteorological stations. This selection resulted in the amount of precipitation associated with the North Atlantic Low-pressure systems for each of the 31 weather stations.

Table 1 Geographical coordinates of the weather stations.

WEATHER STATION	LATITUDE	LONGITUDE	ALTITUDE
Arad	46°08’	21°21’	117
Bacău	46°35’	26°56’	190
Baia Mare	47°40’	23°3’	216
Bistrita	47°08’	24°3’	366
Botoșani	47°44’	26°39’	161
Brașov	45°42’	25°23’	534
București-Băneasa	44°30’	26°08’	90
Buzău	45°09’	26°49’	96
Călărasi	44°22’	27°21’	19
Caransebeș	45°25’	21°15’	241
Cluj-Napoca	47°46’	23°34’	410
Craiova	44°19’	23°52’	192
Constanța	44°13’	28°38’	12
Deva	45°53’	22°24’	230
Drobeta-Turnul-Severin	44°38’	21°38’	77
Galați	45°29’	28°02’	72
Miercurea Ciuc	46°22’	25°24’	661
Iași	47°10’	27°38’	102
Râmicu-Valcea	45°46’	24°22’	237
Roșiorii de Vede	44°06’	24°59’	102
Ocna Șugatag	47°47’	23°56’	503
Oradea	47°02’	21°54’	136
Sibiu	45°48’	24°09’	443
Sulina	44°13’	28°38’	2
Tg. Mures	46°23’	24°32’	308
Timișoara	45°46’	21°15’	86
Tg.Jiu	45°02’	23°17’	205
Tulcea	45°11’	29°40’	4
Turnu-Magurele	43°45’	24°53	31
Vf.Omu	45°27’	25°27’	2504
Satu Mare	47°48’	21°52’	123

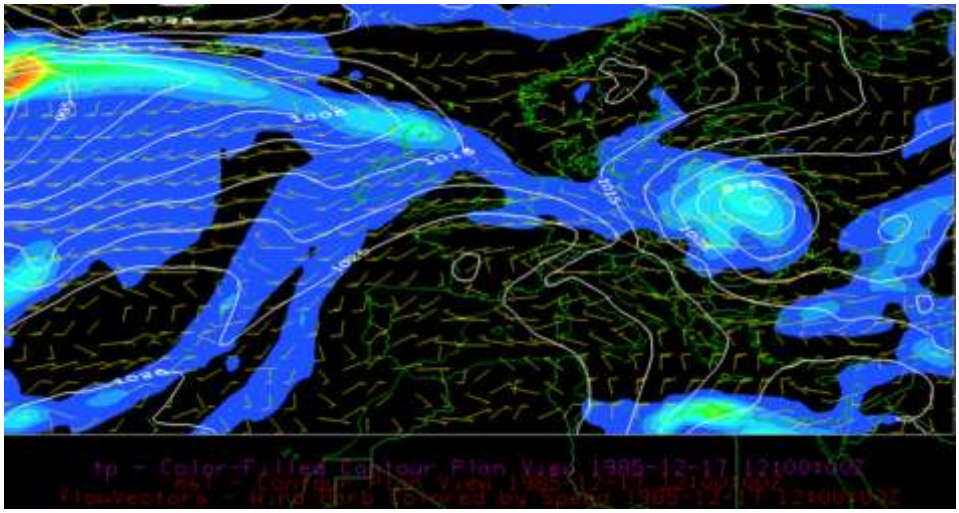

FIG. 2 Image of the cyclone and associated precipitation at 1985.12.17

They were processed in the same way as the spatial distribution of the trajectories in order to highlight the evolution of precipitation over the study period.

The spatial distribution of the meteorological stations taken into account allows the differentiated selection in case the Romanian territory was both under the influence of an Atlantic low-pressure systems and under the influence of a Mediterranean cyclone on the same day. The resulting values were analyzed seasonally and by decade as well as the inventoried cyclones.

3. RESULTS

Between December 1985 and November 2015, 1189 cyclones crossed Europe from V to E north of the Alps, resulting in an average of 39.6 cyclones/year. The spatial distribution of the tracks frequency is maximum in the region of Scotland, North Sea, Scandinavian and Baltic Sea and minimums in the southern regions of the continent. The region of Romania is located in an area where the frequency distribution of tracks is minimal.

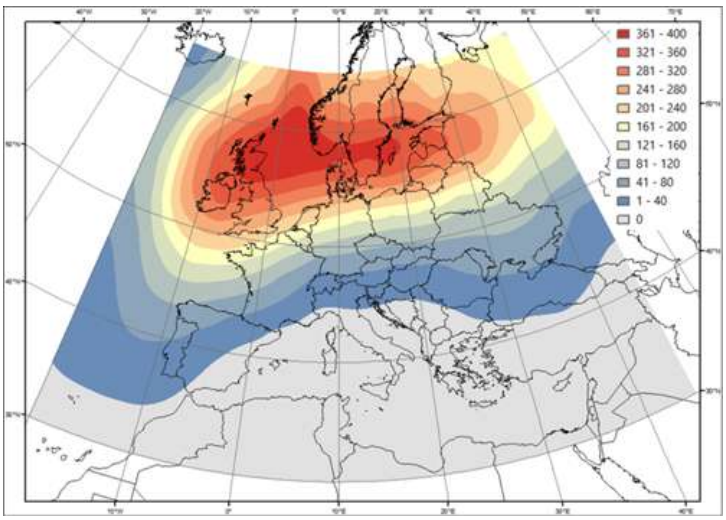

FIG. 3 Distribution of the frequency of the trajectories of extratropical cyclones that cross Europe north of the Alps in the period 1986-2015.

The spatial distribution of the frequency of the trajectories differs from one season to another, its maximum having different positions within the continent.

In winter the classes with the highest frequencies of the trajectories are located in the region of the Baltic Sea, in the spring in the region of Scotland and in summer and autumn in the basin of the North Sea with extension to the Baltic Sea.

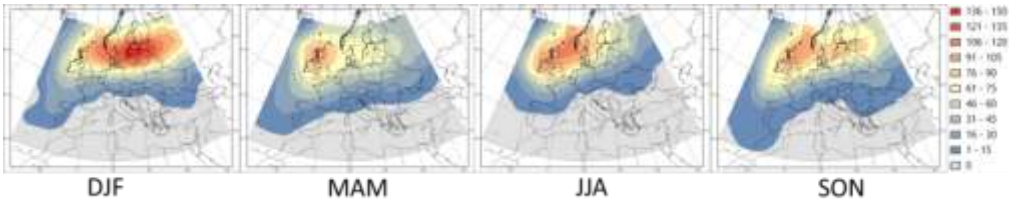

FIG. 4 Spatial distribution of tracks frequency over the seasons.

The spatial distribution of North Atlantic cyclone tracks over the seasons has been divided into 10 classes, with greater agglutination in the North and North Baltic regions. Romania is within the classes with minimum frequencies during the study period, except for the winter of the first decade and during the spring of the second decade when the northern half is within the class of 7 - 12 tracks, (Fig. 5). In the winter of the second decade, there is an expansion to the east of the region with a high frequency of trajectories. In the autumn of the first decade, the spatial distribution of the frequency shows two regions of maximum, the first covering the northern half of the North Sea. and the second the central region of the Baltic Sea. This season, the frequency of tracks decreases, with grades 13-18 and 19-24 retreating north.

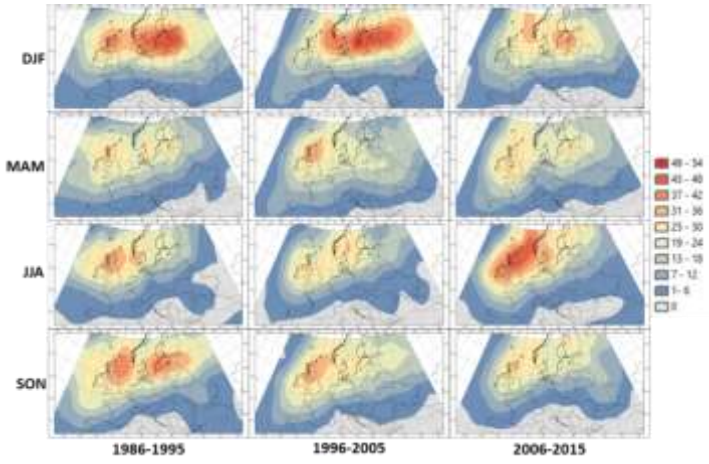

FIG. 5 Distribuția spațială a frecvenței traiectoriilor anotimpual de-a lungul celor trei decade

From one decade to another, a differentiated evolution is observed, depending on the season of the frequency distribution of the cyclone. In winter and summer there are regions where the frequency difference is maximum, while during the transition seasons it reaches only an intermediate class. In winter we find significant changes from 50°N to negative ones occupying an increasingly large area from one decade to another. In the region of Romania, a lower frequency of trajectories was found in the second decade compared to the first and in the third decade compared to the first. In spring, the maximum differences are from 8 to 13 trajectories in both positive and negative directions and the area where these changes take place has extended to the south up to 40°N.

The region of Romania registers a weak increase of the trajectories in the second decade compared to the first and in the third decade compared to the first. In summer, the area where changes are taking place is retreating north of 50°N, with the central southern regions of the continent unchanging except for the western regions where the frequency of trajectories increases in the second decade compared to the first and in the third decade compared to the first. At 50°N in the second decade compared to the first, the zones with negative and positive anomalies alternate meridianally, while at the last two differences the increase of the frequency is manifested in almost the whole region, the maximum being 20 to 25 registered in D_3 -D_2 in North Sea. In autumn, the decrease in trajectory frequencies occupies large areas at all intervals, starting meridianally at D_2 -D_1 and continuing quasi-latitudinally at D_3 -D_2 and D_3 -D_1 .

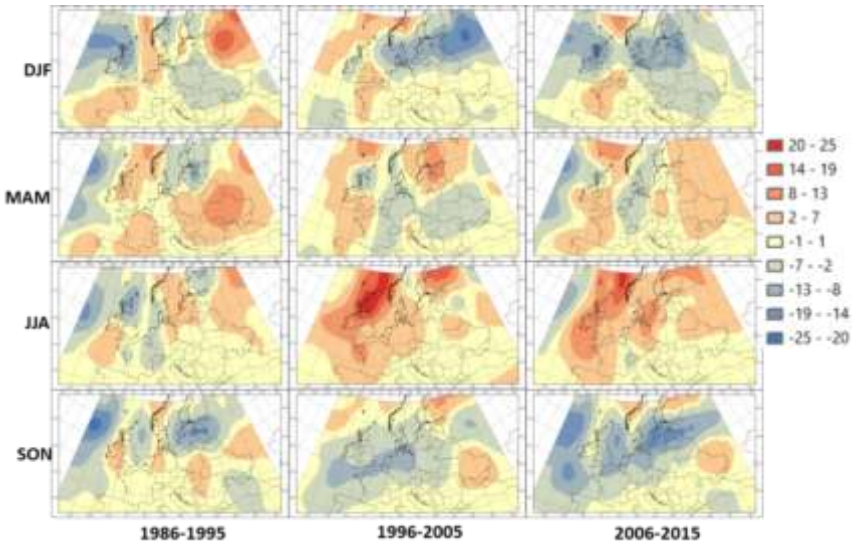

FIG. 5 Seasonal spatial distribution of NACs TD anomaly over the 10-yrs sub-periods

Out of the total of 1189 North Atlantic cyclones that crossed the continent from west to east at MSLP, a number of 847 (71.2%) cyclones generated precipitation that was recorded at weather stations in Romania. The minimum of 48.7% was registered in the autumn of the first decade and the maximum of 93.8% in the summer of the second decade (table, 2).

Table 2. Frequency of the NACs occurrence by seasons over the period 1985-2015.

DECADE	ACs	ICs	TCc	NCs	TOTAL	ROMANIA	%
DJF 1986-1995	55	31	21	13	120	80	66,7
DJF 1996-2005	30	51	21	3	105	78	74,3
DJF 2006-2015	28	40	23	3	94	66	70,2
MAM 1986-1995	42	22	25	6	95	66	69,5
MAM 1996-2005	37	27	26	3	93	79	84,9
MAM 2006-2015	37	35	32	1	105	81	77,1
JJA 1986-1995	43	15	26	3	87	58	66,7
JJA 1996-2005	30	29	20	1	80	75	93,8
JJA 2006-2015	51	25	27	0	103	66	64,1
SON 1986-1995	52	30	33	4	119	58	48,7
SON 1996-2005	38	45	17	2	102	80	78,4
SON 2006-2015	27	30	28	1	86	60	69,8
TOTAL	470	380	299	40	1189	847	71,2

North Atlantic cyclones usually travel west to north-northeast and have tracks between 50° and 60°N, resulting in their center usually passing north of Romania. The distribution of precipitation generated by the North Atlantic cyclones on the Romanian territory respects a staggering N - S and V - E but also a staggering generated by relief with the maximum at the northwest and western stations, (Baia-Mare - Cluj-Napoca> 30%) , average at the stations that occupy a central latitude and meridian position, (Arad - Buzău, between 20 and 30%), small, (Tg.-Jiu - Sulina, between 15 and 20%), and minimum, (Turnu-Măgurele - Craiova <15%). The difference between the last two categories is given by the northern depressions which have a general N - S displacement and mainly affect the east of the country. The descending order obtained in the graph below will be maintained for comparison in the decadal-seasonal analysis, (Fig. 7).

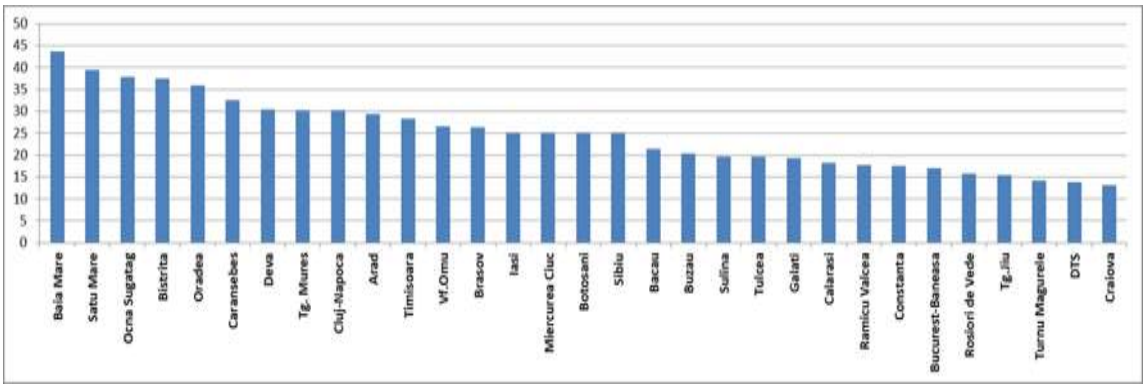

FIG. 7 Distribution of the influence of North Atlantic cyclones on the amount of precipitation in the region of Romania in %.

The greatest influence of NACs on precipitation was recorded in the type of winter at the stations in northwestern Romania, exceeding 50% in Baia-Mare, Ocna Șugatag and Bistrita. The influence of these cyclones on precipitation during spring and summer decreases substantially by a maximum of less than 40% and it is interesting to note that during summer the influence of NACs on precipitation is greater than during spring, (Fig. 7).

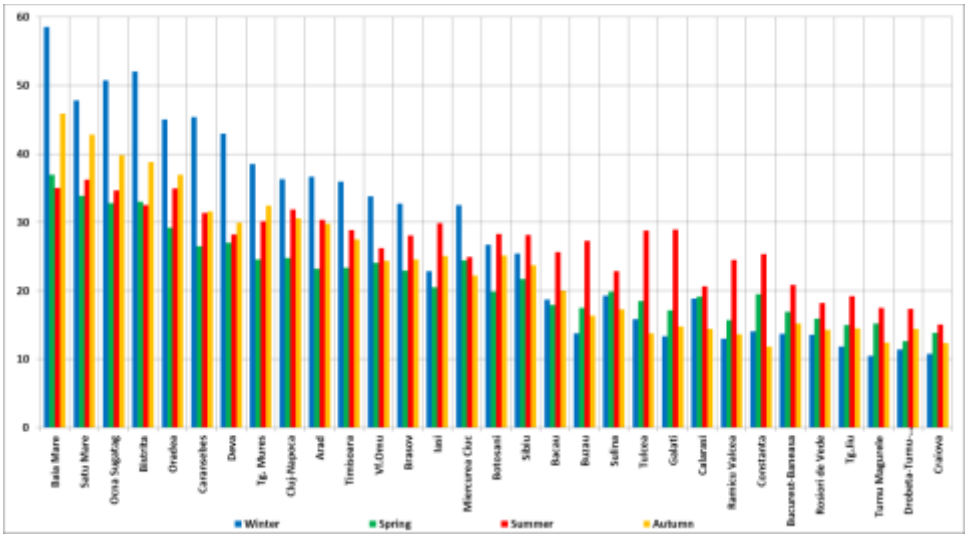

FIG. 8 Distribution of the influence of North Atlantic cyclones on the amount of precipitation in the region of Romania over the seasons in %.

During the three decades, in winter, the number of tracks decreased from one decade to the next both in number on the continent and as an influence on the amount of precipitation in Romania because the amount of precipitation generated by cyclones and the number of days with precipitation. The amount of precipitation generated by cyclones and summed at the stations decreased from 149.1 mm in the first decade to 122.9 mm in the third decade. Between the first and second decade, the number of cyclones decreased by 2 individuals. This small difference is not decisive for the amount of precipitation, which decreases in half of the stations by up to 25% and increased by a maximum of 20% in the other half. The second difference, between the third and second decade, brings a decrease in the number of cyclones with 12 individuals which led to a decrease in the amount of precipitation in 29 of the stations by 4% to 50% except for Omu and Calarasi where the amount of precipitation increased by 45.6% and 47.8%. Between the third and the first decade, the number of trajectories decreases by 14 individuals, resulting in a decrease in precipitation at the vast majority of stations, with the same exceptions persisting (Fig. 8a, b).

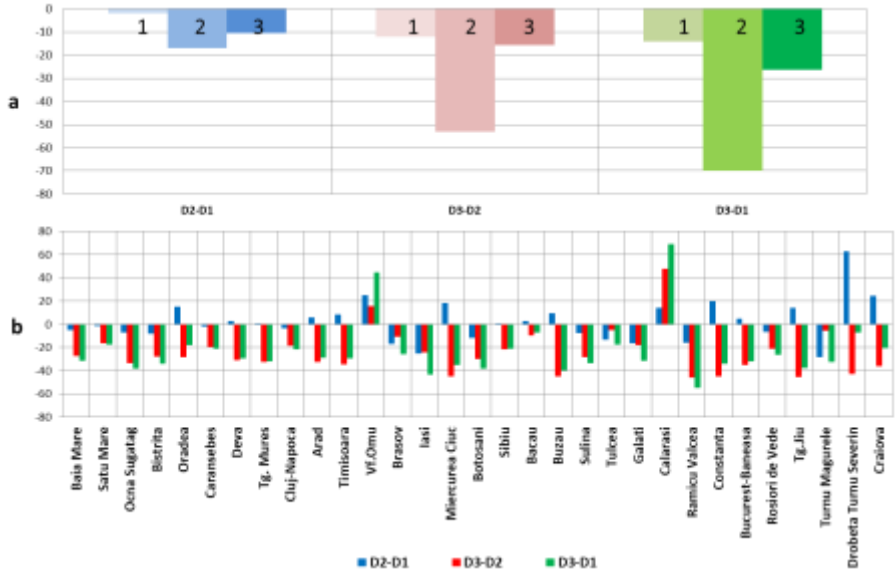

FIG. 8 a). 1 - the difference in the number of track from one decade to another; 2 - the difference in the number of days with precipitation; 3 - the difference in the amount of precipitation/cyclone/Romania; b). Evolution of precipitation generated by cyclones during winter in %.

In the spring, the number of cyclones that affected the amount of rainfall from one decade to another increased. The first difference, (D_2 -D_1), increases the number of cyclones in the number of days with precipitation and the amount of precipitation/cyclone/Romania thus, increasing the amount of precipitation at all stations between 11.8 and 188%, the only exception in this case being Sulina station where the amount of precipitation decreased by 26.5% (fig. 9b). The second difference, (D_3 -D_2), indicates an increase in the number of cyclones by 2 individuals but decreases the number of days with precipitation and the amount of precipitation / cyclone / Ro resulting in a decrease in the amount of pp at almost all stations by 3.8 to 66.8 %.

The third difference, between the third and first decade, brings an increase of 15 individuals in the number of cyclones, the increase in the number of days with precipitation and the amount of precipitation/cyclone /Ro resulting in an increase in precipitation at most stations, with the exception of Sulina Tulcea, Bucharest and Drobeta-Turnu-Severin.

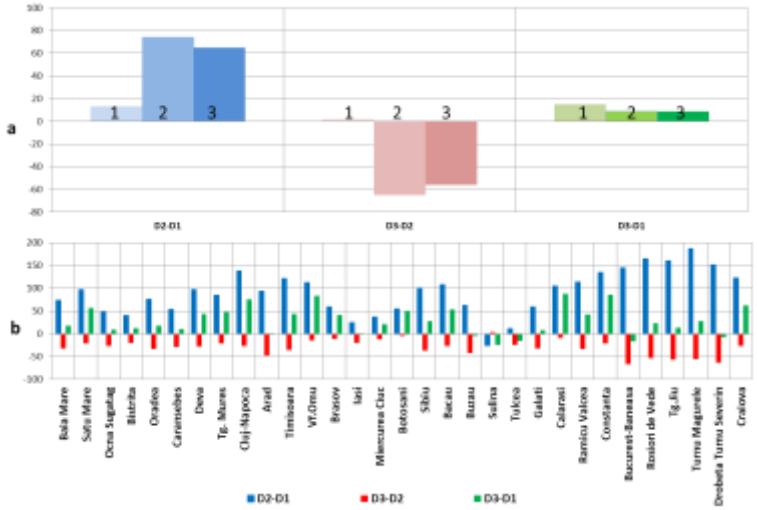

FIG. 9 a). 1 - the difference in the number of track from one decade to another; 2 - the difference in the number of days with precipitation; 3 - the difference in the amount of precipitation/cyclone/Romania; b). Evolution of precipitation generated by cyclones during spring in %.

In the summer, in the case of the first difference, there was an increase in the number of cilones by 17 cyclone, as well as an increase in the amount of precipitation at all stations. From the graph it can be seen that this increase is moderate (below 100%), in the vast majority of stations with just over 100% in two cases and two other cases with spectacular increases of over 200%, in Tulcea, respectively 400% in Constanța. These two anomalies can be attributed to local factors favored by cyclonic passages. The second difference (D3-D2) indicates a decrease of 9 individuals and a decrease in the number of days with precipitation as well as a decrease in cpp / cyclone / Ro resulting in a decrease in precipitation at all stations with values between 4.6% and 58%. The third difference, (D3-D1), indicates an increase by 8 in the number of cyclones, an increase in the number of days by pp but a significant decrease in the cant.pp / cyclone / Ro. Under these conditions, the amount of precipitation decreased in the vast majority of stations by 0.3 to 47%, with the exception of Sulina, Tulcea, Călărași, Constanța and Roșiorii de Vede where the amount of precipitation increased significantly with values between 36.1 and 130, 9%.

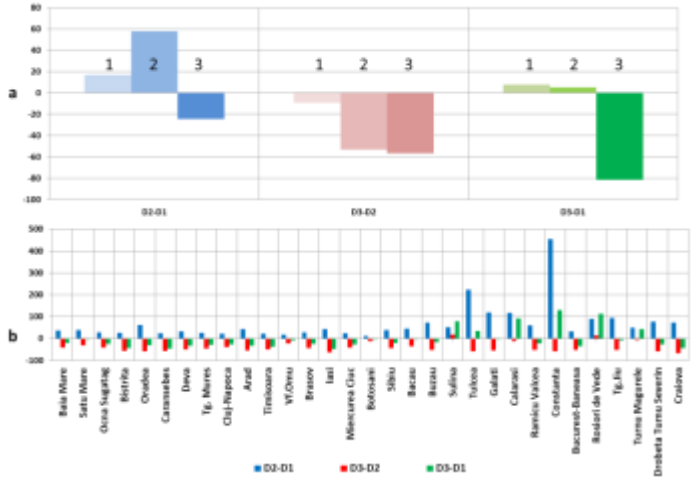

FIG. 10 a). 1 - the difference in the number of track from one decade to another; 2 - the difference in the number of days with precipitation; 3 - the difference in the amount of precipitation/cyclone/Romania; b). Evolution of precipitation generated by cyclones during summer in %.

In autumn, the first difference indicates both the increase in the number of cyclones by (22 cyclones) and the increase in the amount of precipitation at almost all stations with values ranging from 3,6% to 104,8%, except for Constața where rainfall decreased by 7,6 %. The second difference indicates a decrease by 20 in the number of cyclones, a decrease in the number of days by pp but an increase in cant.pp/cyclone/Ro inducing a negative evolution of precipitation in 23 cases with values between 2.8% and 46 ,3%. At the other stations the amount of precipitation increased with values between 15% and 65%. The third difference indicates the increase by 2 of the number of cyclones, the increase of the number of daily precipitation but also the increase of cant.pp / cyclone / Ro this inducing the increase of precipitation at 22 stations by 4 to 147%. In the other 9 cases, the amount of precipitation decreased.

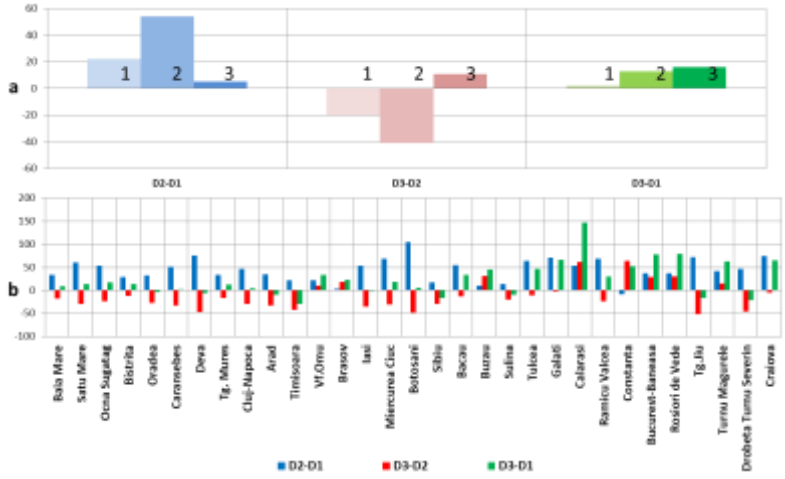

FIG. 10 a). 1 - the difference in the number of track from one decade to another; 2 - the difference in the number of days with precipitation; 3 - the difference in the amount of precipitation/cyclone/Romania; b). Evolution of precipitation generated by cyclones during summer in %.

CONLUSIONS

Using a classical method of identifying cyclones, a number of 1189 Cyclones were identified at MSLP that crossed Europe from V to E at north of the Alps. From the intersection of the footprint of the precipitation on the ground with the amount of precipitation registered at the meteorological stations, it resulted that 71.2% of the NACs that crossed Europe generated precipitation on the Romanian territory. The influence of North Atlantic cyclones on rainfall in Romania varies significantly from northwest to southeast but also from one season to another.

At the level of the continent, it was observed the decrease of the tracks frequency during the winter and the increase of their frequency during the summer, in the period 1986-2015. During the autumn, the frequency of the trajectories that occupy a large part of the studied area was observed to decrease.

The amount of precipitation generated by the North Atlantic cyclones in winter decreased between 1986 and 2015. During the spring it increased significantly in the second decade compared to the first and in the third decade compared to the first. Although the frequency of trajectories increased during the summer in Europe, the amount of precipitation generated by cyclones in Romania decreased significantly from 278.3 mm in the first decade to 196.8 mm in the third decade.

The variations of the precipitation have moderate values at the western stations and extreme at the S and S-E stations - result of some local factors favored by the cyclonic passages.

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A BRIEF HISTORY OF UAVs IN THE 1970s

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Abstract: *The technological development of the UAV domain has produced a conceptual revolution in the design, architecture and operation of these technical systems. The evolution of unmanned aerial systems has followed the same technological curve as manned aircraft and the continuous technological development of the UAV field has produced a conceptual revolution in the design, architecture and operation of these technical systems. After the 1970s, on the one hand, a series of modernizations of the launch-recovery systems of the air vectors took place and on the other hand, the development of miniaturized classes of UAVs.*

The article summarizes information about the most relevant historical landmarks regarding the experimental and operational technological achievements of the 1970s and 1980s.

Keywords: *UAV history, CL-227 Sentinel, Tadiran Mastiff, Ryan 147, performances aircraft*

Acronims

C2/C3	*Command, control / communication*	*HALE*	*High altitude long endurance*
HIMAT	*Highly Maneuverable Aircraft Technology*	*JATO*	*Jet-assisted take-off*
MAV	*Micro/miniature aerial vehicles*	*NAV*	*Nano aerial vehicles*
PAV	*Pico aerial vehicles*	*RPA/H*	*Remotely piloted aircraft/ helicopter*
RPV	*Remotely piloted vehicle*	*SD*	*Smart dusts (drone miniaturization)*
SIGINT	*Signal inteligence*	*UCAS*	*Unmanned combat aerial vehicles*
VTOL	*Vertical take-off*	*µUAV*	*Micro unmanned aerial vehicles*
C4ISR	*Command, Control, Communications, Computers (C4) Intelligence, Surveillance and Reconnaissance (ISR)*		
ISTAR	*intelligence, surveillance, target acquisition, and reconnaissance*		
MBLE	*Manufacture Belge De Lampes Et De Matériel Electronique*		

1. INTRODUCTION

1.1.Initial considerations

The bibliographic study carried out in this paper includes chronological and state-owned approaches, rather than temporal aspects of the major conflicts that began or took place during the 1970s, such as the Yom Kippur War or the Vietnam War. The analyzed period includes a series of projects on unmanned aircraft in different technological and operational stages (life cycle), the following paragraphs containing the most relevant constructive examples. The chronological approach for the period 1970-1980 regarding unmanned aircraft includes mainly state topics in alphabetical order. The exemplified producers being: Argentina, Belgium, Canada, Israel, USA, USSR and UAVs made in multinational productions.

1.2. Characterization of unmanned aircraft from 1970-1980

The standards used for unmanned aerial vehicle technologies have reached the level of maturity required for functional optimizations imposed by both end-user requirements

and cost levels generated over the life cycle of UAVs as complex technical systems depending on the class, type and main uses of the UAV. them. In this context we can mention a number of advantages and disadvantages, recorded in the following paragraphs.

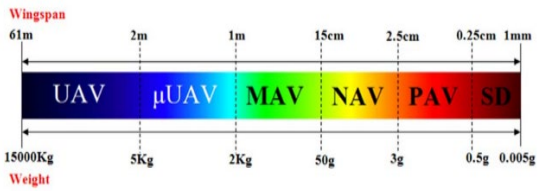
The most relevant advantages of the period studied on UAVs are: technical aspects of environmental protection, lower costs compared to piloted aircraft (for the same type of use), good quality of information taken from areas of interest (eg images), levels of superior accuracy due to GPS equipment, C3 and C4ISR technologies optimized according to the level of UAV equipment, high levels of reliability of integrated equipment, low risks both on the intrinsic operation of the UAV and from the perspective of missions (emergencies, crisis and conflicts), reduced implications on the health of the C2 crew of UAVs, perfectible capabilities sense and avoid, optimized levels of technical versatility of some classes of UAVs depending on the type of mission.

The disadvantages of using UAVs over the studied period can be summarized in: altered privacy levels with implications of individual freedom versus public security (commercial uses), legislative uncertainty (summary and non-aligned national regulations), insufficient security levels for hardware and software populated areas altered or C2 piracy situations, high levels of vulnerability to wildlife (airborne collisions) appropriate to the size and use of UAVs, possible criminal uses (espionage, drug trafficking), non-standard levels of vulnerability and encryption of C2 / C3 systems to piracy (especially for civil uses), dependence on atmospheric and climatic conditions of UAVs, insufficiently standardized levels of theoretical and practical training of operators for technical and operational skills. [1, 6, 22, 23, 38]

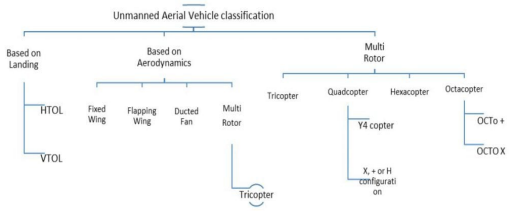
1.3.UAV classification

The continuous technological development of the UAV domain has produced a conceptual revolution regarding the design, architecture and operation of these technical systems. According to the specialized references [1, 2, 3] unmanned aerial systems have been identified with several names and acronyms throughout the historical evolution, the most used being: drones, RPV (remotely piloted vehicle), UAV (unmanned aerial vehicle) , UCAV (uninhabited combat aerial vehicle), UCAS (uninhabited combat aircraft system), RPA (remotely piloted aircraft), RPH (remotely piloted helicopter), MAV (micro aerial vehicle), the evolution of unmanned aerial systems followed the same technological curve as aircraft with human pilot on board.

Scientific studies [2, 3, 4, 5, 8, 9] provide a series of classifications of unmanned aerial vehicles from the civilian and military perspectives of UAVs. The most common classifications of UAVs are based on traditional criteria, such as: kinetic and mass performance criteria (weight, altitude and range); criteria regarding the constructive concept (type of load-bearing surface: fixed / rotating); criteria based on use / missions (civilian, military, mixed); propulsion type (propeller / reaction), see Fig. 1.1.



(a)



(b)

FIG. 1.1. UAV(S) classification
(a). The spectrum of the UAV classification [9], (b). classification of constructive concepts [10]

2. UAV HISTORICAL REFERENCES FOR THE PERIOD 1970-1980.

The period 1970-1980 is characterized by the adoption of constructive and aerodynamic concepts for optimizing flight performance, especially flight time and altitude. Information on significant unmanned aircraft projects can be accessed in classic online lists [17-21], some constructive benchmarks are set out in the following paragraphs, see Fig. 2.1.

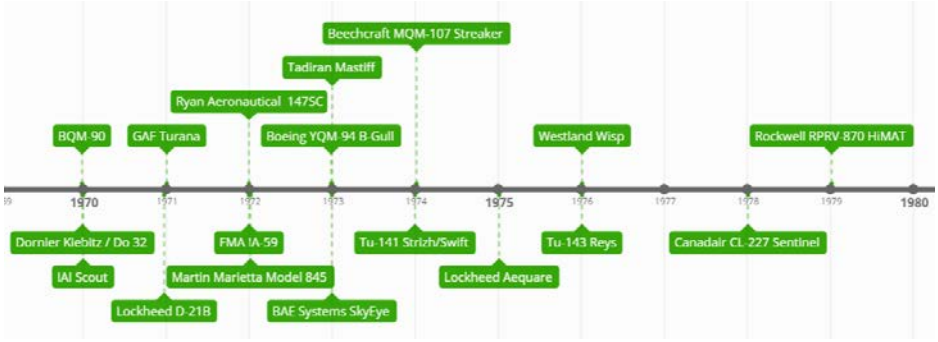


FIG. 2.1 UAV timeline for 1970-1980

Argentina produced in 1972 (until 1979) the FMA IA-59 prototype [39]. and Australia has been building 23 GAF Turana target drones since 1960 (with its first flight in 1971), which are powered by a solid rocket booster engine, see Table 2.1. [26].

FIG. 2.2. FMA IA-59, [39]

FIG. 2.3. GAF Turana, [26]

In the 1970s in Belgium, the MBLE Epervier drone was produced for the armed forces, which could fly for 25 minutes at a speed of 500 km / h at a total mass of 142 kg, [27], see Fig. 2.4.

Table 2.1 Turana and MBLE Epervier features

Performances	**Turana**	**MBLE Epervier**
Span (m)	1,6	2,38
Speed. max. (km/h)	650	500 (cruise)
Weight empty/max. (kg)	1470/1786	-/142
Ceiling (m)	6100	1830
Autonomy (h)	-	0.45
Propulsion	1 x Solid rocket booster 80kgf	1 x turbojet 0,5 kN

Canada produced in 1978 a prototype VTOL reconnaissance UAV with rotating wing type CL-227 Sentinel of Canadair / Bombardier, see figure 2.5, [28].

FIG. 2.4. MBLE Epervier [27].

FIG. 2.5. CL-227 Sentinel[28].

During the 1970s, Israel was the main producer of UAVs with two relevant examples of air carriers: IAI Scout and competitor Mastiff (1973), used both for real-time data acquisition in ISTAR monitoring and reconnaissance missions (mobility enemy units and surveillance of Syrian air bases) as well as in electronic warfare missions (location and radio interference), [1, 11, 12, 14], see Figures 2.6 and 2.7 and Table 2.2.

FIG. 2.6. IAI Scout, [13]

FIG. 2.7. Tadiran Electronic Systems Mastiff , [15]

Table 2.2 IAI Scout and Tadiran Mastiff features

Performances	IAI Scout	Tadiran Mastiff
Span (m)	4,96	4,25
Speed. max. (km/h)	176	185
Weight empty/max (kg)	96/159	72/138
Ceiling (m)	4600	4480
Autonomy (h)	7,5	7,5
Range (km)	-	50
Propulsion	1 x 22 CP	-

The British projects focused on rotary wing UAVs: Westland Wisp coaxial VTOL type (1976, 3 copies) in Figure 2.8, or on conversion to remote control target drones, for example Canberra U10 / D10 (18 copies) and U14 / D14 (6 copies) at English Electric), Fig. 2.9 [35, 36].

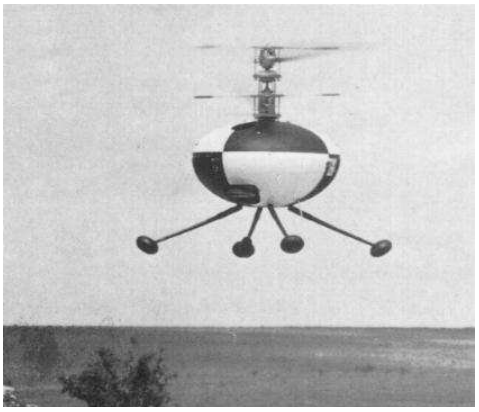


FIG. 2.8. Westland Wisp, [36]

FIG. 2.9. Canberra U10, [35]

In the US, according to [16], Ryan Aeronautical operated a series of modifications to the Model-147 Lightning Bug UAV, created the 147SC (AQM 34L) and 147N variants, and since 1972 it has been possible to transmit data online from onboard sensors, see figure 2.10 and table 2.3. Ryan 147 being produced in 28 variants and having missions in the period 1964-1974.

In the late 1960s and early 1970s, the COMPASS DWELL program developed the Martin Marietta 845 as a remotely piloted aircraft to be used as a communications relay in the Vietnam War (for 24 hours), see Table 2.3. [31]

Lockheed has been producing (since 1964) 38 D21s for supersonic reconnaissance missions (over Mach 3), the D21B flying in 1970, see Figure 2.11. [38]

FIG. 2.10. Ryan 147SC, [16]

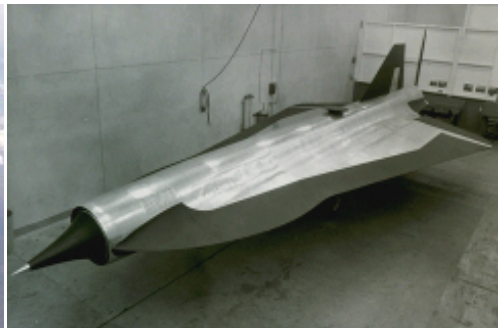


FIG. 2.11. D21B prototype, [29]

Table 2.3 Martin Marietta 845 and Ryan 147A features

Performances	Martin Marietta 845	Ryan 147A
Span (m)	18	4
Seed. max. (km/h)	240	-
Weight empty /max (kg)	- / 1050	-
Ceiling (m)	-	16800
Autonomy (h)	28	-
Range (km)	-	1930
Propulsion	1 x TIO360, 200 CP	1 x J69-T-41A

Between 1974 and 2003, Beechcraft produced the MQM-107 Streaker vector in over 2,200 units as a target towing drone, used primarily by the United States military and 11 other states. The US Air Force uses them in training shootings for their air-to-air missiles, such as the AIM-9 Sidewinder and AIM-120 AMRAAM, see Fig. 2.12 and Table 2.4.

FIG. 2.12. MQM-107 Streaker, [30]

FIG. 2.13. HIMAT, [32]

Table 2.4 Lockheed D21 and MQM-107 Streaker features

Performances	Lockheed D21	MQM-107 Streaker
Span (m)	5,8	3
Speed. max. (km/h)	4062	925
Weight empty/max (kg)	- / 5000	- / 664
Ceiling (m)	29000	12000
Range (km)	5600	-
Propulsion	1 x ramjet RJ43	1 x Microturbo TRI 60

In the 1970s, a series of prototypes were made in the USA that tested various innovative technologies, the manufacturing units being Rockwell International / Boeing with HIMAT (NASA user) [32] or the US Navy with XBQM-108A as a VTOL vector. successfully the first tests the project being canceled, see figure 2.13 and table 2.4. The YQM-94 B-Gull prototypes (also called Compass Cope B) manufactured by Boeing (1973), see Figure 2.14 and Ryan YQM-98 R-Tern (also called Compass Cope R) manufactured by Ryan Aeronautical (1974) were designed for air reconnaissance missions, communications relay or atmospheric data sampling (Table 2.5), [40, 41, 42].

FIG. 2.14. YQM-94 B-Gull, [40]

FIG. 2.15. YQM-98 R-Tern, [42]

Table 2.5 YOM-94 B-Gull and Ryan YOM-98 R-Tern features

Performances	YQM-94 B-Gull	Ryan YQM-98 R-Tern
Span (m)	27,43	24,75
Speed. max. (km/h)	-	735
Weight empty/max (kg)	- /5897	2540/6490
Ceiling (m)	21340	-
Autonomy (h)	30	30
Propulsion	1 x General Electric J97-GE-100 , 23.4 kN	1 x Garrett YF104-GA-100 , 18 kN

In the period 1970-1980 Soviet UAV technology is materialized by Lavochkin La-17 (produced since the 1950s) maintained in service until the 1980s (used USSR / Russia, China and Syria) and the series Tu-123/141/143 for reconnaissance missions, see figures 2.16 and 2.17.

FIG. 2.16. Tu-123 Yastreb, [24]

FIG. 2.17. Tu-143 Reys, [33]

Designed in the 1960s and retired in 1979, the Tu-123 Yastreb / Hawk concept (52 units) was similar to the D-21 (USA) SIGINT on-board and / or data acquisition, with JATO launch and powered by a KR15 jet engine. / R-15 (see figure 2.12), strategic supersonic drone used for HALE missions. Tu-141 Strizh / Swift (introduced in 1974 / over 140 units) is a continuation of the Tu-123 project but with a medium range and Tu-143 Reys (introduced in 1976, produced in over 900 units) tactical reconnaissance (60-70 km), see Fig. 2.13 and Table 2.6. [24, 25]

Table 2.6 Tu-123 and Tu-143 features

Performances	**Tu-123**	**Tu-143**
Span (m)	8,41	2,24
Speed max. (km/h)	2700	950
Weight empty/max (kg)	11450/35610	-/1230
Ceiling (m)	22800	5000
Range (km)	3200	200
Propulsion	1 x Tumansky KR-15	1 x Klimov TR-117

The US-UK collaboration generated the BAE Systems SkyEye model as a reconnaissance UAV with a series of subvariants, flying the first prototype (RPA-12) in 1973, produced in over 40 units, with two 50hp engines (R4E-50) and 98HP (R4E-100), see figure 2.18 and table 2.7. [34, 37]

Table 2.7 BAE Systems SkyEye R4E features

Performances	**Values**	**Performances**	**Values**
Span (m)	7,32	Ceiling (m)	4880
Speed max. (km/h)	200	Autonomy (h)	8
Weight empty /max (kg)	-/ 570	Propulsion	1 x 52CP

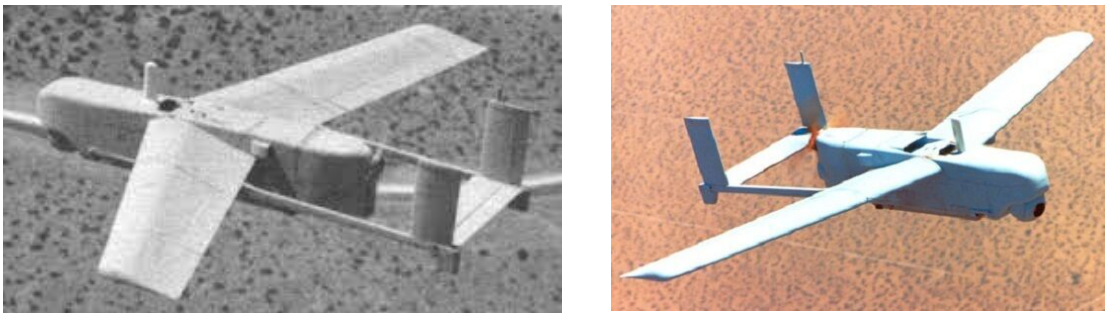
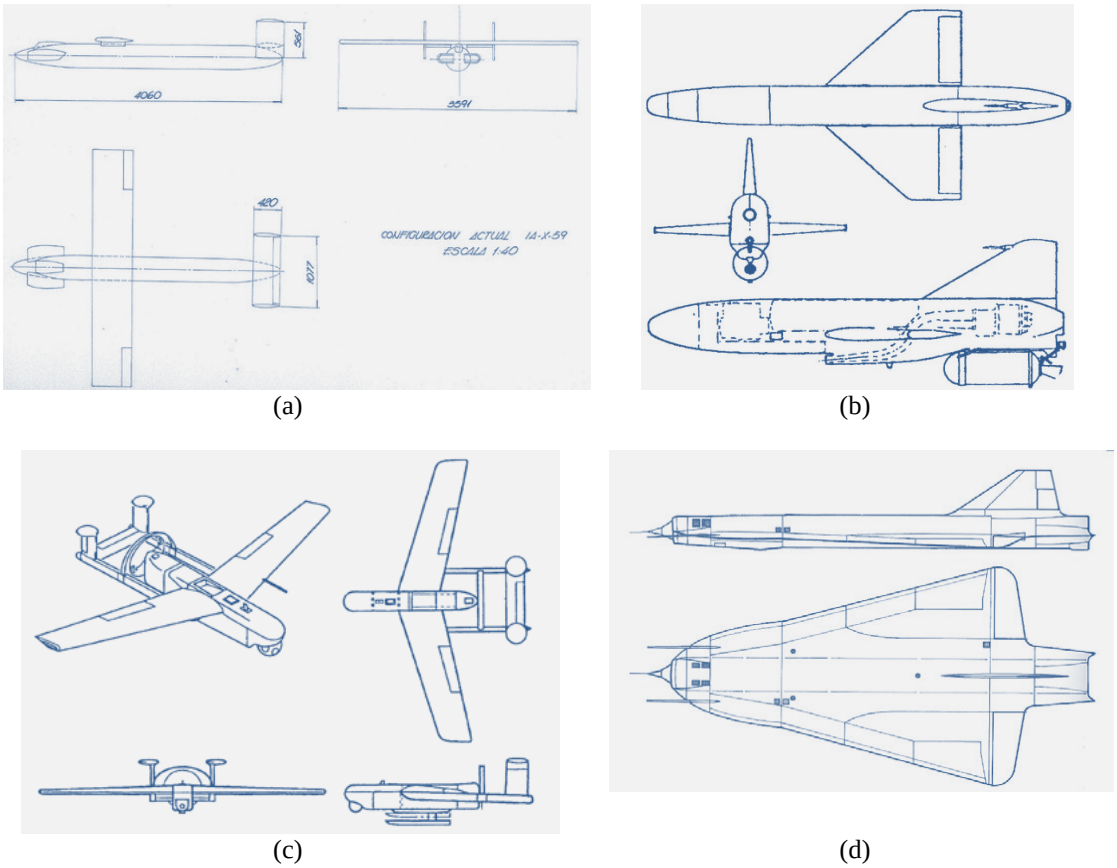


FIG. 2.18. R4E SkyEye, [34, 37]

3. ASPECTS OF UAV GEOMETRIES AND COMPARATIVE PERFORMANCE

3.1. Aspects of UAV geometries

A series of references provide some aspects of the aerodynamic concepts of unmanned aerial vehicles of the 1970s. The most relevant are set out in Fig. 3.1.

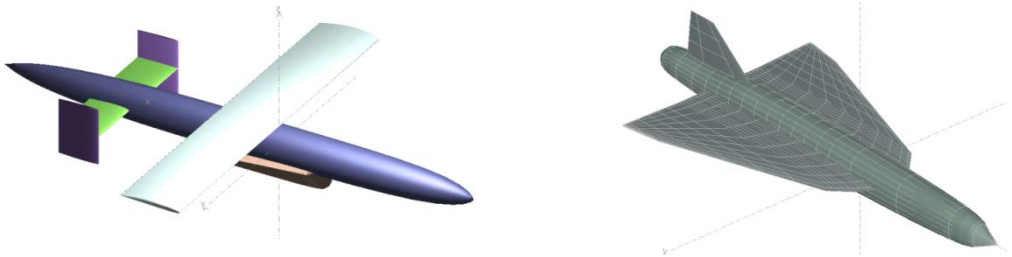


(a) (b)

(c) (d)

FIG. 3.1. UAV geometry, (a). FMA. I.A.X-59 [43], (b). GAF Turana [44], (c).R4E-50 Skyowl [37], (d). D-21 [45]

The relevant references provide a series of quantifiable aspects regarding the typology of air vectors used in the period 1970-1980, vectors at different stages of the life cycle (design, manufacture, operation / use). Figure 3.2 exemplifies a 3D geometry made with the XFLR5 freeware tool, [46].

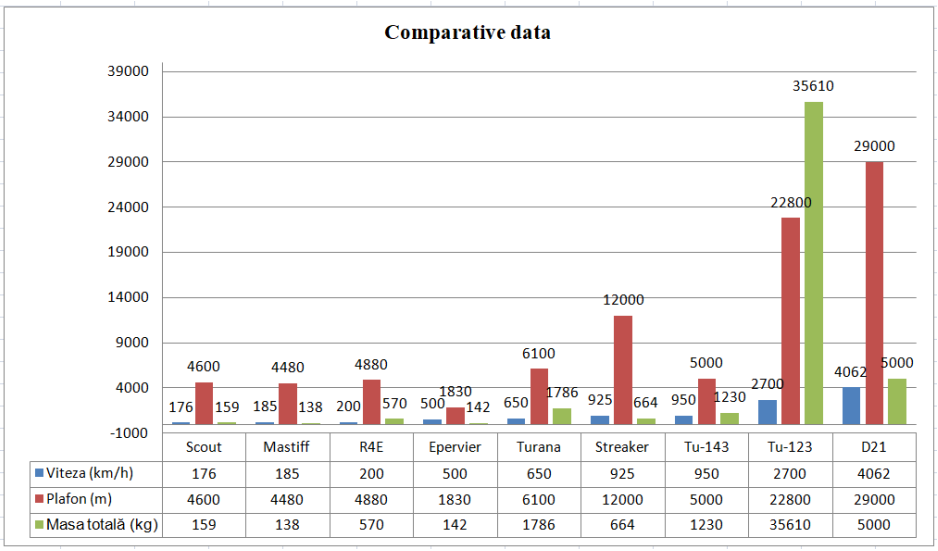


(a) (b)

FIG. 3.2. UAV 3D geometry, (a). FMA IA-59 , (b). Lockheed D21

3.2.Comparative performances

For a comparative highlight of the flight performance of unmanned aircraft during the 1970s, we present the graph in Fig. 3.3. Comparable performance is observed for unmanned reconnaissance aircraft (Tu-123 vs D21).



	Scout	Mastiff	R4E	Epervier	Turana	Streaker	Tu-143	Tu-123	D21
Viteza (km/h)	176	185	200	500	650	925	950	2700	4062
Plafon (m)	4600	4480	4880	1830	6100	12000	5000	22800	29000
Masa totală (kg)	159	138	570	142	1786	664	1230	35610	5000

FIG. 3.3. UAV comparative data for 1970-1980

CONCLUSIONS

The development of the UAV field after the 1970s produced a conceptual change in the architecture and operation of unmanned aerial systems on board which led to technological development directions that generated new capabilities (speed, autonomy, data processing speed, system reliability) and attributes of UAS (persistence, penetrability, integration, versatility), [6, 7]. After the end of the Vietnam War in 1975, digital technologies were used extensively due to cheap processors and software development.

Future bibliographic research efforts will focus on summarizing and essentializing information on relevant landmarks in the field of UAS for historical intervals after the 2000s.

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