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THE OPTIMIZATION METHODS OF MODERNIZATION PROCESSES REGARDING TO THE LARGEST TECHNICAL INTEGRATES SYSTEMS

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Abstract: *This article describes an optimization model of Surface-To-Air Missile System like a technical integrates system. The theoretical model of optimization describing the basic relationships between the Life Cycle Cost of the system and the frequency of upgrades related to the moral decay, during the time. The financial crisis has forced extension of system operation even if it is obsolete. Thus have designed a new modernization*

Key words: *LITS (Large Integrated Technical System); SAMS (Surface-to-Air Missile System); LCC (Life Cycle Cost); $C_b(t)$ (unit acquisition cost related to the operating time) $C_m(t)$ (Cumulative cost for preventive maintenance during the operating time); $C_r(t)$ (Average unit cost for Repairs)*

1. INTRODUCTION

The approach of fundamental theme of Surface-to-Air Missile System (as a typical exemple of mobile with variable mass), the improvement of flight performances, dynamic stability, posibilityties of minimizing the guiding errors and the optimizing of upgradeing processes, can be found in the scientific activity of many other specialysts.



2. KEYWORDS:

Large Intgrated Tehnical System - LITS

Surface-to-Air Missile System - SAMS

Life Cycle Cost - LCC

Unit acquisition cost related to the operating time - $C_b(t)$

Cumulative cost for preventive maintenance during the operating time - $C_m(t)$

Average unit cost for Repairs - $C_r(t)$

The 21st Century presents itself like a temporal complex space defined by continuousness quantitative increasing and

qualitative changing, both contributing to the actual deployment process.

In this context intuition is not sufficient to assess the complexity of an integrated technical system; substantiating the notion itself is mandatory although it is very difficult.

The complexity of the system S consists of elements of complexity and, $i = 1, 2, 3 \dots n$ can be determined by the formula:

$$S = \sum S_i K_i$$

Where K_i is the number of i elements and type of the system. The first large technical systems were formed in the Air Defense area. Through a careful analysis of

the structure of control systems Surface-To - Air missiles from the perspective of automated systems, we can highlight their requirements and principles of operation required, in close connection with obtaining information about the parameters of movement of air targets.

Figure 1 shows a simplified diagram missile system in close contact with components that work with a purpose optimization criterion or several criteria for effectiveness.

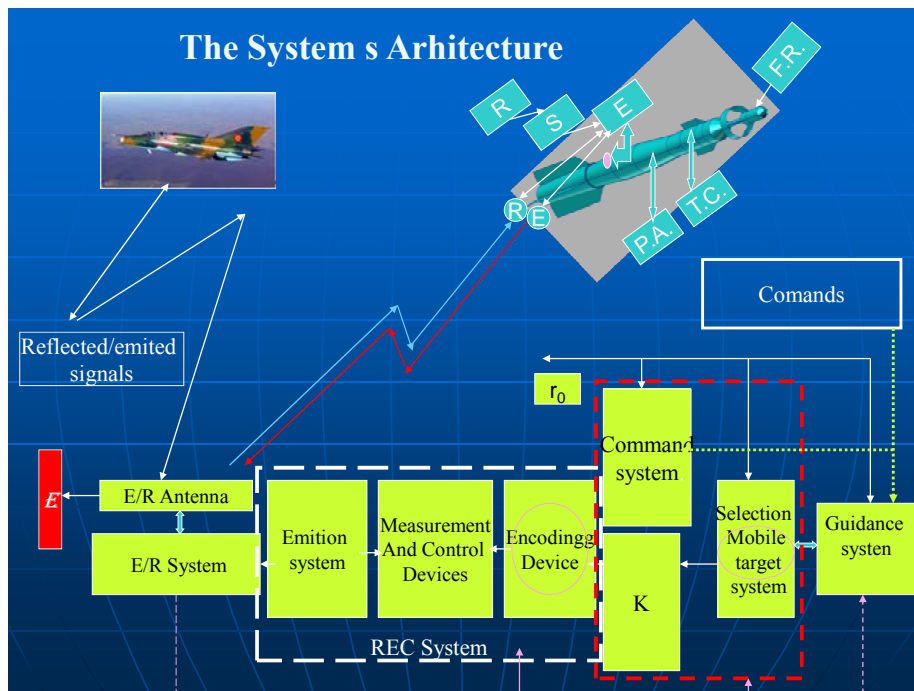


Fig. 1

Experience realization and exploitation of modern integrated military systems is a complex activity demonstrates that the organizational and technical point of view not least financially. This add for a long time -

from 2 to 5 years or more depending on complexity.

To determine more precisely the connections between elements of a technical system, we must define the following:

S1-matrix of connections between input and



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output
S2-matrix elements intraresi connections
between the elements of the system output
S3-matrix connecting the input vector in the
vector system out of the totality of elements
S4-matrix vector connecting the totality of
elements in the system output vector can

reunii the 4 matrix In a single

S =
Structural scheme of a large technical system
interconnections between the elements listed
above:

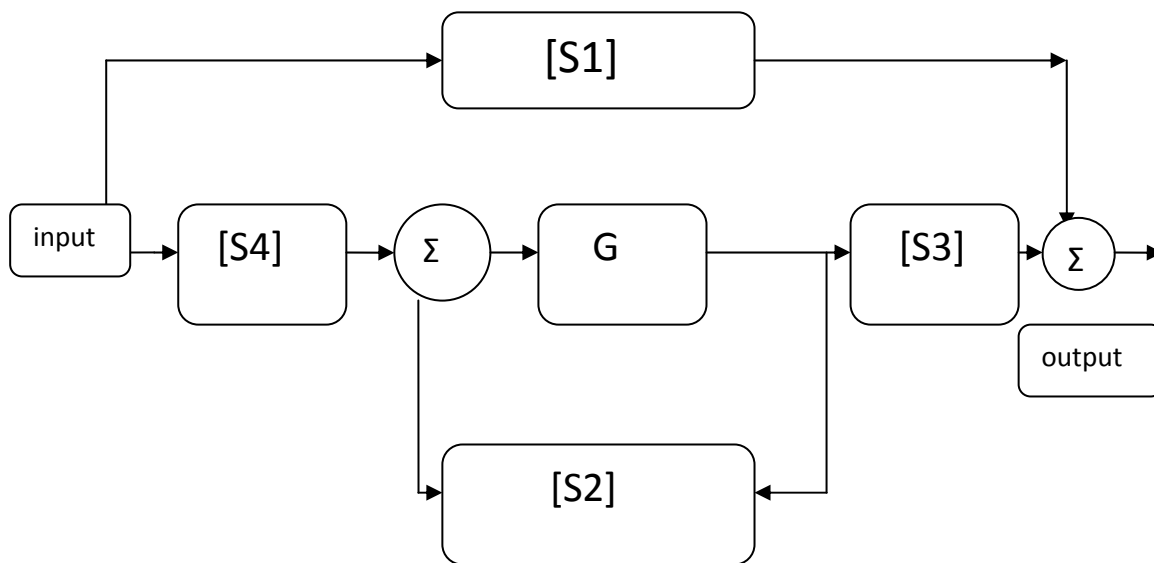


Fig. 2

Given the current economic crisis is becoming more evident prolonging service life correlated with the modernization subsystems.

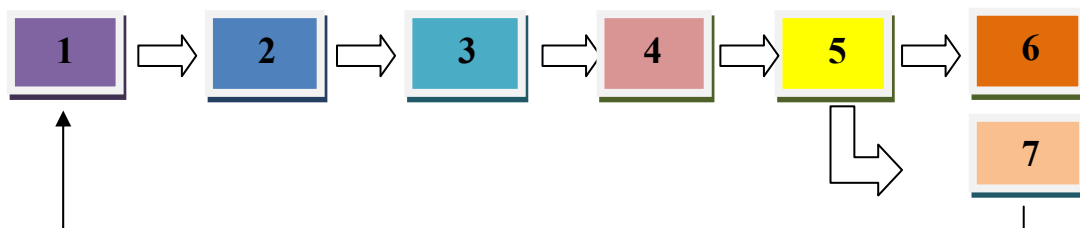


Fig. 3

- 1 - general conception
- 2 - system analysis
- 3 - projection
- 4 - achievement
- 5 - exploitation
- 6 - modernization
- 7 - extended service life

In large integrated systems, the effectiveness of such variant follows the structure and operation to ensure fulfillment of the mission with minimal costs.

The general form of the criterion of efficiency is the minimization of costs:

$$\min C = \min M [\sum C_i] E > E_{dat}$$

where C is the minimum cost of system;

C_i is the cost of part I of the system consists of I elements;

E_{dat} is the size efficiency is required.

The approach give a formulation of the inverse problem of the criterion of effectiveness.

In this case seeking to obtain a maximum effect given that the costs are limiting factors

$$\text{Accordingly: } M [\sum C_i] < M_{dat}$$

where M_{dat} is average expenditure.

Lately Surface –To- Air Missile system has undergone a series of upgrades that have focused mainly: - improving breakthrough characteristics of radar stations especially for interference with the signals reflected from fixed targets

- TV-introduction regime for air target detection correlated with reduced time to prepare their rockets.

- to improve the jamming protection subsystems

Modernization at these missions face but is strongly influenced by obsolescence according to the graph:

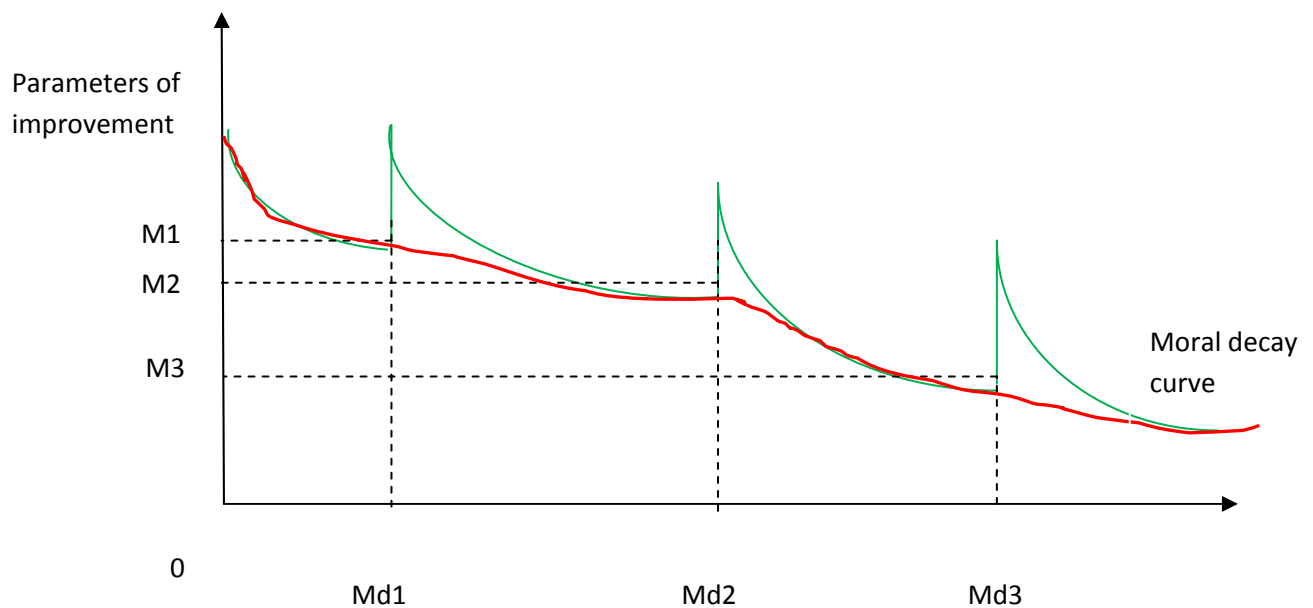


Fig. 4



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Figure 3 (The upgrades related to moral decay points during the time)

Operating expenses take into account the period of operation and maintenance refer to staff and maintenance, repair, transport and storage.

The quantitative assessment of operating costs to economic efficiency using the standardized coefficient K_{ec} - increasing the accumulation time of year according to early accumulation size:

$$K_{ec} = C_i - C_{i-1} / C_{i-1}$$

C_i, C_{i-1} are spending in the late years i and $i-1$. Costs incurred in different periods of time operating the process be made at the same moment of time according to the formula:

$$C_i = C_i^n (1 + K_{ec})^i$$

C_i^n - expenses at beginning of period

In practice it is possible that system has been consumed own set resource capacity but continues to be operative

Optimization requires proper choice of the means used for this purpose, the optimization of their characteristics and use strategy.

In the most general form, the problem can be formulated as follows:

Total expenditure for operation system C is a function that depends on the characteristics of operation and restoration x_1, \dots, x_n , the

characteristics of quality control means, y_1, \dots, y_n and features control strategy, z_1, \dots, z_n . as is intended that the operation was run with as low a cost, the cost C must minimized:

$$C = \min C(x_1, \dots, x_n, y_1, \dots, y_n, z_1, \dots, z_k)$$

In these limiting conditions:

$$G_1(x_1, \dots, x_n, y_1, \dots, y_m, z_1, \dots, z_k), [<, =, >] G_i^{(0)}$$

$$G_2(x_1, \dots, x_n, y_1, \dots, y_m, z_1, \dots, z_k), [<, =, >] G_2^{(0)}$$

.....

$$G_s(x_1, \dots, x_n, y_1, \dots, y_m, z_1, \dots, z_k), [<, =, >] G_s^{(0)}$$

Where $C(x_1, \dots, x_n, z_k)$ are total expenditure for the operation of the system

G_1, G_2, G_s, \dots , criteria of system operation

$G_i^{(0)}, G_2^{(0)}, \dots, G_s^{(0)}$, data values for these criteria

Operation of the system s evaluated with different general criteria such as:

- coefficient of operational status
- the likelihood of interruption-free operation

For the optimal control of authenticity, or found on these particular problems may arise optimization:

- determining the optimal set of system parameters to be controlled so that the

system to perform all financial operations and minimum material consumption

- establishing optimum accuracy for the elements that make up the operation knew sistemul. Este high precision measurement of a device increases the cost of technical maintenance sistemului. Calitatea coefficient is estimated by operational training in order to fulfill functions at any time. Coefficient of operational training the assumption of uniform distribution of is given by:

$$K_{op} = \lim \int P(t) dt$$

For the stationary operation:

$$K_{op} = M[t_f] / M[t_f] + M[t_n],$$

In this formula $M[t_f]$ is the mean value (mathematical expectation) of the operating range of the object without disturbances $M[t_n]$ - mean the time the objects broken between two consecutive operative state.

3. ANALYSYS OF THE OPTIMIZATION MODEL

A basic condition for application of the described optimization method is to have a suitable shape of the curve $Cc(t)$. An important condition for optimization is a sufficiently strong local minimum in point D (t_{opt}, Cc_{min}), which will enable relatively precise identification of a location of this point even if the tehcnical-economic data are not complete.

3.1. Average unit cost for acquisition of a subsystem

Function $Cb(t)$ expressing a dependency of average unit costs for acquisition of a subsystem upon the operatin time is defined by: $Cb(t) = Cb/t$.

Graphical representation of this function is an equilateral hyperbola. As we can see the value of this function decreases with extending of operating time.

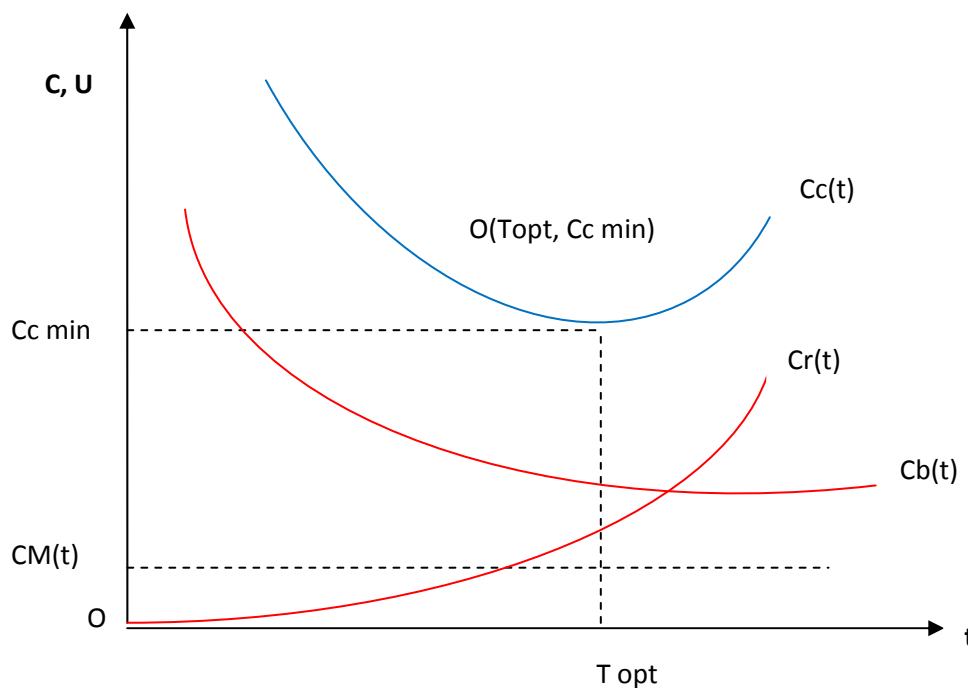


Figure 5



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3.2. Average Unit Cost for Preventive Maintenance

Function $CM(t)$ expresses the dependency of unit costs for preventive maintenance upon the operative time: $CM(t) = CM(t)/t$. Where $CM(t)$ is the sum of all costs connected with execution of subsystem preventive maintenance during the operating time t .

The extent of individual preventive maintenance actions does not substantially vary with operating time, this CM can be considered constant.

3.3. Average Unit Cost for Repairs of the Subsystem

A graph of the function $Cr(t)$ shown above intersects the co-ordinate origin and it increases within the whole scope of studied values of operating time of functions.

The notion of reparability **Narrow-R reprtezinta an imprint maintenance tehnica**. Ea defines a products ability to restore its operation allows duringn period of time, operating conditions, when in operation due to malfunctions occur Radiolocator intensities corresponding to a failure of subsystems are shown in the chart below

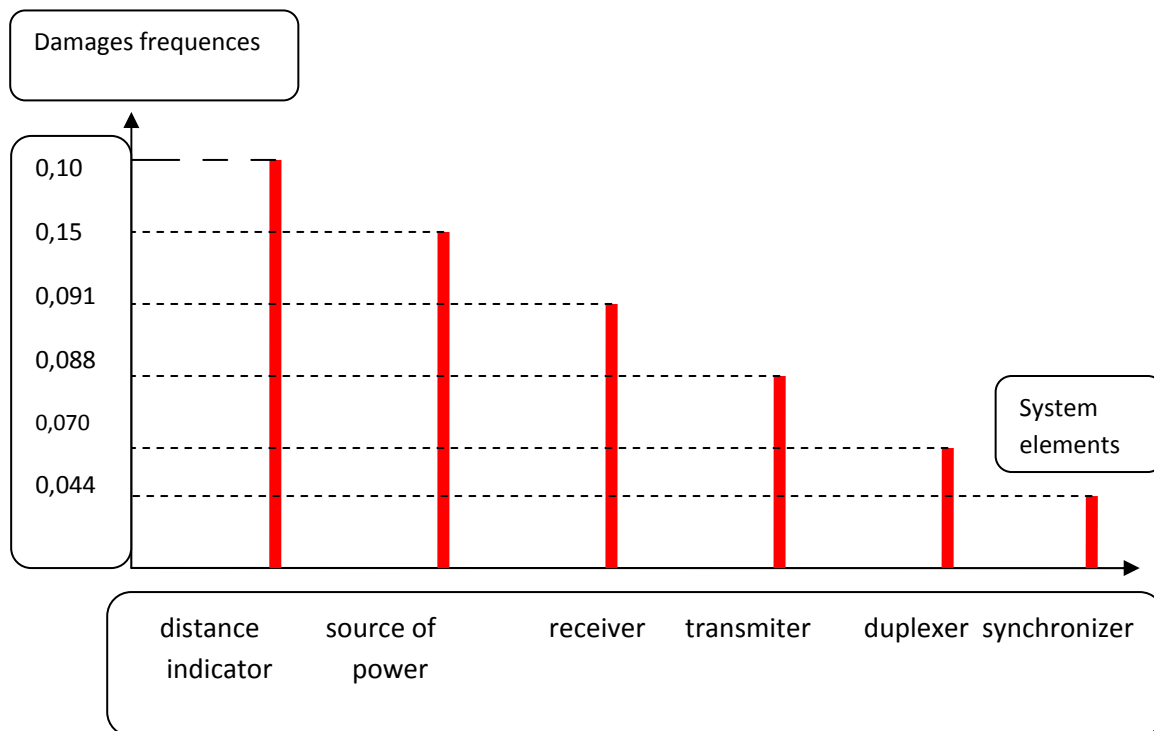


Fig. 6

- Develop an advertising system ... finding solutions for reducing time and as often as constructive alternatives analyzed satisfactorily no conditions imposed accountability. In this case the main ways to reduce separation time that the user has available are:
- Modularization of subsystems
- Automation of the search

4. CONCLUSIONS

In the end we can say that keeping the Surface-To -Air missiles in a perfect state of function can be realized with a new upgrades following:

- digitization of computer systems
- replacement system with a network transceiver phased array antennas which would lead to a compaction of the system

- replacement of liquid fuel, which would lead to increased maintenance

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