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THE OPTIMIZATION METHODS OF MODERNIZATION PROCESSES REGARDING THE LARGEST TECHNICAL INTEGRATED SYSTEMS

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Abstract:
This article describes an optimization model of Surface-To-Air Missile System like a technical integrated system. The theoretical model of optimization describing the basic relationships between the Life Cycle Cost of the system and the frecquency 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 The financial crisis has forced extension of system operation even if it is obsolete.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 Intgrated Tehnical System); SAMS (Surface-to-Air Missile System); LCC (Life Cycle Cost); Cb(t) (unit acquisition cost related to the operating time) Cm(t) (Cumulative cost for preventive maintenance during the operating time); Cr(t) (Average unit cost for Repairs)*

1. Introduction

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

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 ... n can be determined by the formula:

$$\mathbf{S} = \sum \mathbf{S_i K_i}$$

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.

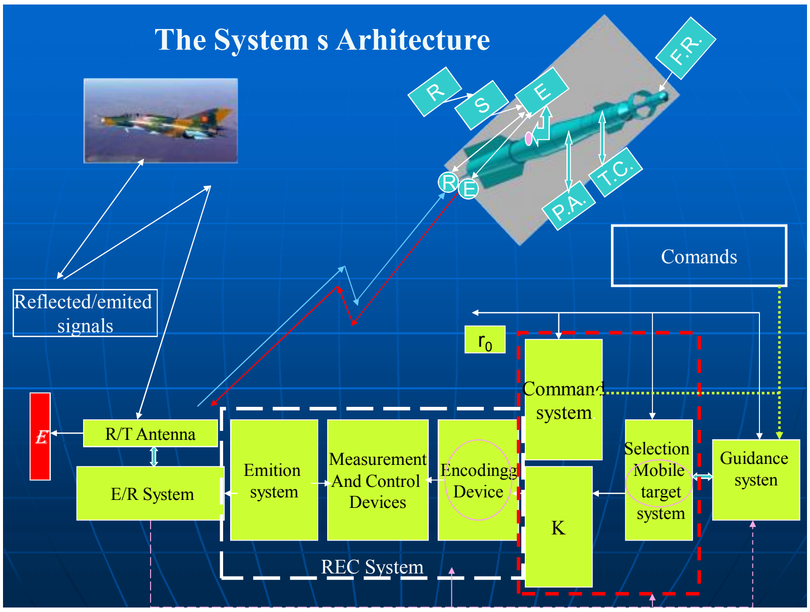

Figure 1 A simplified diagram missile system

Experience realization and exploitation of modern integrated military systems is a complex activity which demonstrates that the organizational and technical point of view and also the financial one. This adds a longer time - from 2 to 5 years or more depending on complexity (see fig.2).

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

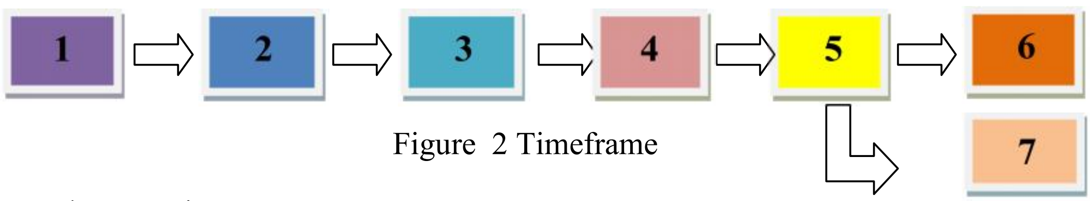

Figure 2 Timeframe

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 gives 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 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:

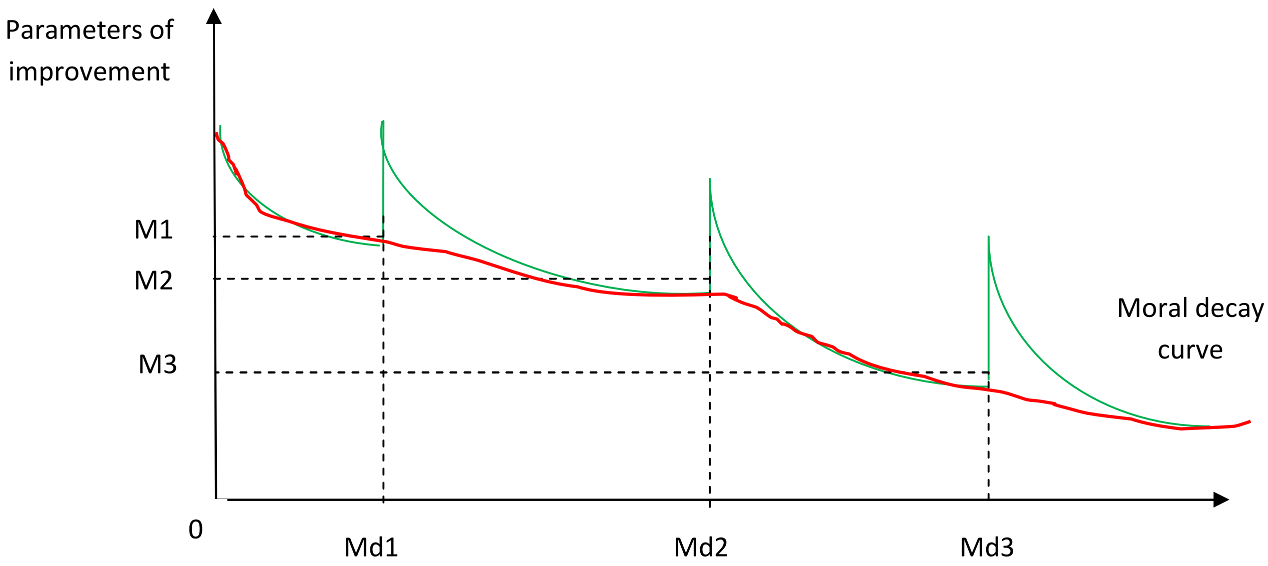

Figure 3. The upgrades related to moral decay points during the time

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

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

In these limiting conditions:

$$G_1(x_1,\ldots\ldots,x_n,y_1,\ldots\ldots\ldots..Y_m,z_1,\ldots\ldots\ldots,z_k),\ [<,=,>]G_i^{(o)}$$

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

....

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

Where: C (x_1, ... x_n,, z_k) are total expenditure for the operation of the system

G_1,G_2 ,G_s ,………,criteria of system operation

$G_i^{(o)}$ $G_2^{(0)}$,…….,$G_s^{(0)}$,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 The high precision measurement of a device increases the cost of technical maintenance of the system The coefficient quality is estimated by operational training in order to fulfill functions at any time. The coefficient of operational training the assumption of uniform distribution of is given by:

$K_{op\,/}$= lim ∫P(t)dt
For the stationary operation:
K_{op}=M[t_f]/M[t_f]+M[t_n],
In this formula:
M [tf] is the mean value (mathematical expectation) of the operating range of the object without disturbances
M [Tn] - mean the time the objects broken between two consecutive operative state.

2. Analysis 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 tehnical-economic data are not complete.

2.1 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 equitelateral hyperbola. As we can see the value of this function decreases with extending of operating time.

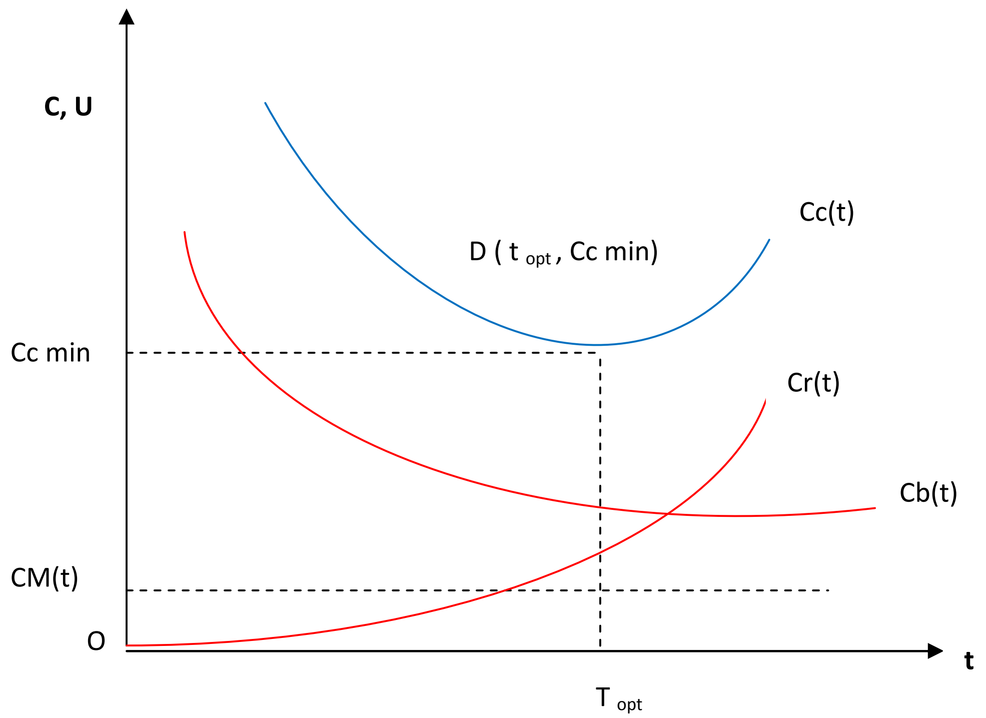

Figure 4

2.2 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.

2.3 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.

3. Conclusions

In the end we ca 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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