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IMPLEMENTATION OF AN ECONOMIC-MATHEMATICAL MODEL IN ORDER TO DETERMINE THE EFFECTIVENESS OF INVESTMENTS IN THE CHANGES FROM THE DEFENSE INDUSTRY

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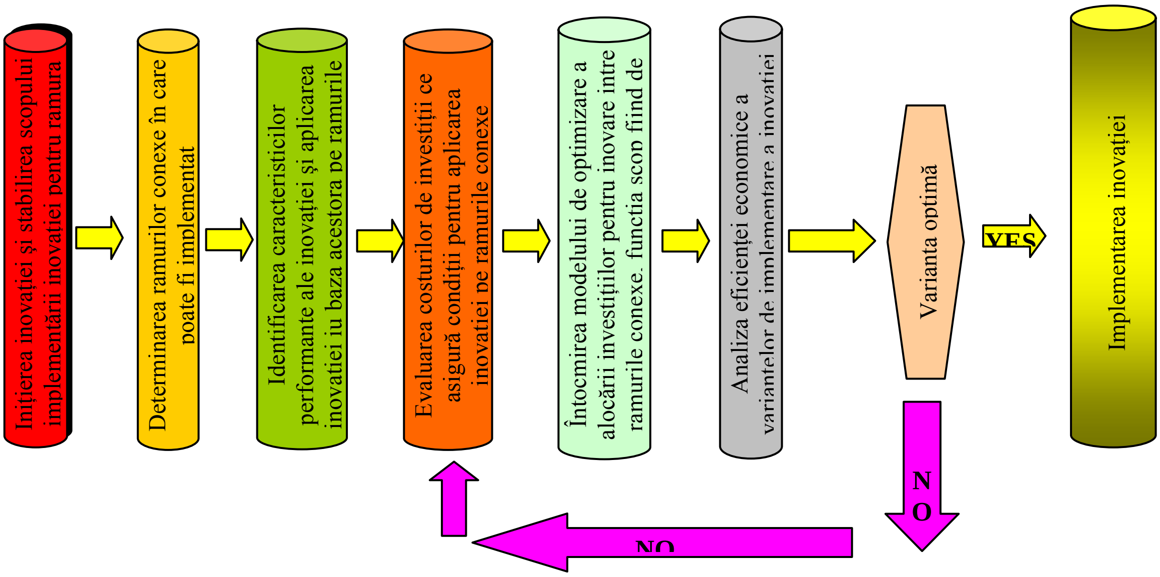
Abstract*: Technically, this method is a systemic process of analysis and economic management, resulting from the foundation of the method for determining the effectiveness of industry innovation through technological interdependence, but also from the content and time frame for achieving it. It is mainly based on taking decisions on the application and integration of innovation in the economic activity of the companies for estimating the costs necessary for the implementation of innovations, ie, placing the capital needed to create and integrate new products or technologies and of the economic consequences resulted in other branches, different from the basic use of the innovation.*

Since the control and maintaining of the problem in the imposed limits is only possible in the hypothesis that the implementation is targeting a small number of sectors, it is imperative to state that according to a specific legislation adapted to the defense industry (GEO nr.95/2002 with additions and amendments), of the many objectives set for the distribution of investments in this area, we believe that the design, implementation and development of technologies and advanced munitions, the development and acquisition of new equipment, including information, represent priorities.

Keywords*: economic mathematical model, innovations, arms industry, integration.*

Solving the systemic problem and increasing the studies on the evolution of economic processes is obtained by using the economic and mathematical methods. In this regard, in order to obtain an effective and comprehensive estimate of innovation, based on the drawing method for assessing the effectiveness of innovation that has been discussed previously, it is recommended an economic-mathematical algorithm used for the assessment of economic efficiency that is built as follows (Figure 1).



Source: Developed by author

Figure 1. Steps taken in assessing the effectiveness of innovations in the national economy

Under assessment of efficiency in each stage of the review before taking final decision, there is a permanent identification of all the ways to find the optimum solution to make the most suitable decision on the application of innovations within the national economy.

From the brief method of technological interdependence between branches there can be outlined the organization of the algorithm of efficacy innovation [1] which is structured on the choice and application of optimal investment costs, including the solution adopted for the use of innovation. This is structured in three stages, as follows:

a. The stage of introducing technical improvement to the new field of activity - it includes selecting it and initiating the design decisions that specify the meaning of the expression of the areas of use for this innovation, but is closely following the finding and applying of the most suitable decision. Also at the start of the creation of the effectiveness management system, an important point is the basis for decision on the application of innovation, by specifying the goals for the main industry.

Exemplifying, they can be: the improvement of the production and services organization, the increase of productivity, limiting all the costs and guaranteing the superior value of the products, reducing the raw material and electricity consumption, etc.

b. The evaluation stage, focuses on studying the best parameters of innovation, because after that, the main directions of application set by the original decision will be included in the innovation. In this phase the are investigated and highlighted the important technical parameters of innovation, the investment costs necessary to use innovation are determined as well as the circumstances that set the stage with the highest value of innovative product effectiveness. The high quality technical parameters of innovation and their adequate support on the market should constitute the essential starting point for accomplishing economic efficiency increase.

c. The synthesis stage, involves the development of the rational processes that produce the desired effect, namely the distribution of stock investment to achieve innovation in various sectors of the economy. In this stage, the designated possibilities can become applicable in practical solutions. There are also being searched the most suitable ways for checking and for the practical application of innovation and compliant project implementation activities, these being accomplished under conditions of return in terms of investment efforts. Hence, the decisions regarding the application of innovation are based in a high percentage on the quantity of goods allocated that are indispensable for the application to economic news in all the other branches. In such circumstances, to ensure an appropriate relationship between costs that are needed for ensuring the use of innovation and all the results obtained, it seems appropriate to express the guidelines for the implementation of innovations, which depend on the development of the application innovation.

Likewise, the manner in which the investment envisaged for the implementation of innovations are designed specifically by industry and innovation that can be integrated, is, along with identifying the circumstances and benefits of various options for implementation, the first and essential aspect in assessing the economic efficiency of innovation, having intense implications on the effectiveness of future innovations. Thus, we find that the economic efficiency of investment plans in innovation is subject to a large extent to the availability of resources and to the manner in which these are distributed. Being a part of economic efficiency, we consider that the distribution of investment resources that can be divided on sectors must be focused on the growth of those which raise the most concern for economic and social development and whose general assessment to justify all expenditure incurred in the final. Usually, the variety of problems relating to investment supports several possible solutions, which causes to the same extent also many different results.

For the vast variety of solutions, there is always one, sometimes more, which is chosen as the most useful, because of the better result expected and achieved and that essentially represents the level of obtaining the objective associated with the most effective solution, ie the optimal solution. Today, with the economic agents the most sensitive issues arising in the international management process are those related to optimization [2]. Obtaining and solving optimal solutions for resource allocation can be performed through various mathematical processes. The set of specific economic systems and the management of their many problems have created a variety of economic-mathematical representations, called models [3].

The study of these problems with the help of a mathematical model allows determining the appropriate variations, participating directly to the increase of economic efficiency and hence the efficiency of economic branches of the existing operators. In the most appropriate distribution of the needed resources, an important role plays the optimization calculations of the allocation of investment that administer the linear mathematical programming [4]. Therefore, linear programming plays an extremely important part both in the theory and in economic practice. The economic theory has gained from the interdisciplinary approach that allowed deep research examining the maximum efficiency of complex systems, it accepted the intrusion of new concepts of the economic optimum, improved the methods of learning and knowledge and the economic practice has gained a very useful tool of economic analysis and strengthening decisions.

All mathematical programming models and especially their subclass, linear programming models are also dealing with issues of prediction, in which both the optimized objective and the requirements imposed by the problem are expressed by linear functions. Thus, the implementation of linear programming can be also used in our case, that of the appropriate distribution of investments by which we attempt to address the problem effectively. Their variety is determined mainly by the structure of the "subject" studied, by the examination purpose and information available. Often, due to the large proportions, the diversity of processes and events taking place in the industry and the management of their offices, due to the fact that they are carried out gradually in stages specific to the production process, solving by traditional means the various problems that the trader faces becomes insufficient, for which it is resorted constantly to their solving by reformulation as linear programming problems.

In these circumstances, various mathematical linear programming problems, recognized as issues of improvement, occurr in the setting of variables that have the role to check a specific algebraic restrictions system and thus positively or negatively affect an initial function called objective. It is the goal toward which the system tends to be improved to reach the highest possible standard. Only in this way it will positively and really influence the specific social and economic reality.

Restrictions to which we have referred and which are controlled by predetermined variables, mean, in fact, limits imposed by the issues of optimizing the initial situation and the improvement of these variables.

Therefore, the mathematical programming in the field is to determine the costs necessary for the introduction and transfer of technological innovation in both basic and the complementary branches [5]. Assessment of total costs includes both direct and the subsequent costs necessary for the efficient generalized implementation of innovation, because this relationship is reciprocal: the existing costs for introducing innovation in the key field generates a series of new costs to transfer the same technology in complementary fields dependent or determined by field basis.

Programming will have to undergo several stages. The first stage aims at the basic field. The problem will be designed by setting the determinant terms related to the basic field, respectively the costs and benefits resulting from the implementation of innovation, only then being settled the costs for technology transfer in complementary areas. Next there follows the most difficult stage, that of designing mathematically the problem that will translate into a computer model. All these efforts aim at implementing a computer program to allow the assessment of all the costs and benefits arising from the introduction of innovation, thereby achieving, by saving time and labor, the optimal variant of investment [6].

In the following we will exemplify this by designing a problem aimed at introducing new technological processes. This aims to streamline production units belonging to different areas, but which influence each other. We establish that the amounts allocated to innovation in all areas of industry k, branches R1, R2 ,...., RK is the Sum.

Consider true costs of the basic fields

$$R_i, i = \overline{1,k} \tag{1}$$

as known and equal, each with s_i, and the benefit obtained from 1 u.m. investment, each of the branches, from the application and use of innovations, equals *pi*. As a result of the creation of other products or the start of operating the technology used for the first time, there arises the need for additional investment, aiming to ensure conditions for spreading the innovations. In order to supplement this, there is required an amount of investment to ensure the implementation of s_c related innovations in the activities of other sectors (industry) *A1, A2, ..., An*. When the expected benefits for 1 u.m. related investment in the industry *Aj* is worth *PIJ* um, and *xij* is related investment allocated in the industry

$$j, (j = \overline{1,n}), \tag{2}$$

product *pij xij*, expresses the benefit in the industry

$$A_i (i = \overline{1,n}), \tag{3}$$

from the investments related to implementation of the distributed new technology.

Therefore, the total benefit of innovation applied will represent the result of adding the product

$$\sum_{i=1}^{k} p_i s_i \,, \tag{4}$$

which is benefit in the main branches of application of the innovations and product

$$\sum_{i=1}^{k}\sum_{j=1}^{n} p_{ij}x_{ij} \tag{5}$$

and which is the benefit achieved from the implementation of the innovations in the branches attached to each main branch. Thus,

$$P_{total} = \sum_{i=1}^{k} p_i s_i + \sum_{i=1}^{k}\sum_{j=1}^{n} p_{ij}x_{ij} \ . \tag{6}$$

What emerges, issues discussions on how to ensure the greatest efficiency of the related investments in industries in which the new technology is to be implemented, so that the resulting benefit from this active participation is very high. The circumstances determine the fact that the direct investments specified in the application of the new technology in the main branch and their effectiveness are known independent of the innovative application.

In these circumstances, you know the constitutive element

$$\sum_{i=1}^{k} p_i s_i \tag{7}$$

of the total income (*Ptotal*), the problem analyzed being limited to the calculation

$$\max Z = \sum_{i=1}^{k}\sum_{j=1}^{n} p_{ij}x_{ij} \tag{8}$$

which constitutes the target destination expression that depends on the innovative plan, which determines the highest benefit.

The set of limitations on which the implementation of innovation depends, is limited to the investment stocks that are available and are established in order to carry out these activities. In order not to overlook the limitations we have to consider the investment costs necessary to implement innovation in every branch. These imposed limitations are:

a. Determining all costs necessary for the application of innovation:

$$\sum_{i=1}^{k}\sum_{j=1}^{n} x_{ij} \le S_c \tag{9}$$

b. Restrictions on the total amount allocated to the related investments established for the implementation of the new technology in the neighboring branches of the basic industry R_i, in such a way that the investment does not go over the limit that was established prior to the implementation of the new technology in the basic industry:

$$\sum_{j=1}^{n} x_{ij} \le s_i (i = \overline{1,k}) \tag{10}$$

c. The planning of the minimum related investments required for the related branches to ensure the use of the innovations that have already been integrated into the main branches:

$$\sum_{j=1}^{n} x_{ij} \ge x_{ij\,\min} (i = \overline{1,k}; j = \overline{1,n}) \tag{11}$$

d. This condition implies that the fundamental variables can not be negative, as it is necessary to fulfill the requirement in the previous paragraph, ie to meet the minimum investment, as follows:

$$x_{ij} \ge 0, (i = \overline{1,k}; j = \overline{1,n}) \tag{12}$$

Obviously, what is sought both by introducing the new technology in the primary sector and the secondary sectors is achieving as large profits as possible with minimum investments, meaning the efficient use of the sectors to be modernized. That this is the very goal of the programming based on the analyzed mathematical problem, namely achieving an optimal investment, as we show below:

$$\max \ Z = \sum_{i=1}^{k} \sum_{j=1}^{n} p_{ij} x_{ij}$$

$$\begin{cases} (1) \sum_{i=1}^{k} \sum_{j=1}^{n} x_{ij} \leq S_c ; \\ (2) \sum_{j=1}^{n} x_{ij} \leq s_i (i = \overline{1,k}); \\ (3) \sum_{j=1}^{n} x_{ij} \geq x_{ij} (i = \overline{1,k}; j = \overline{1,n}); \\ (4) x_{ij} \geq 0, (i = \overline{1,k}; j = \overline{1,n}) \end{cases} \quad (13)$$

Given the general rules for linear programming, the formula that will reflect the proposed efficient mathematical problem is given of the below:

As a result of these formulas we find the factors affecting the investments required for introducing the new technology process in the related sectors and which determine a maximum value for z, so that

$$P_{total} = \sum_{i=1}^{k} p_i s_i + \sum_{i=1}^{k} \sum_{j=1}^{n} p_{ij} x_{ij} . \quad (14)$$

The problem exposed took into consideration all the economic consequences determined by the way in which investments were made, except for the length of time in which they take place and then they are covered.

Concluding, we consider that in this mathematical model, the primary investment is instantaneous and the implementation of the latest technology in the related sectors is subsequent to its full implementation. When the period in which the investment in related sectors is higher, the limitations also change and the original function must be recalculated and updated. Updates are made by the coefficient a^{t-1}, where the update factor $a = (1 + i)^{-1}$.

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