MODELING OF MANAGERIAL PROCESSES IN THE BASIC INDUSTRIAL STRUCTURES OF AIRCRAFT CONSTRUCTION

© 2009 A.A. Koptev, S.F. Tlustenko*

Keywords: dynamics of reorganization, threshold of sensitivity, investment efficiency, functions for a special purpose.

Analysis of production development according to the time of realization of its separate stages in condition of the limited sources of financing has been carried out. The efficiency of innovative activity on condition of its functioning within the limits of the stable state is provided.

The initial basis for the construction of a management system by process and modernization of the production during operation is the generalized graphic of the structure that is used for the description of the approach to modeling of interaction of its elements. The system of management regarded as the dissipative dynamic system, which models the process of realization, is used as the general approach to the realization of the project according to a set of criteria. Some periodic exchange of funds with the source of finance is common in such systems. Let us consider the system of project management (Fig 2.)

Sources of financing of investment activity implement investment into investment subsystem, which accumulates the funds of the basic sources up to some starting value. After that, it performs the distribution of investment into the active medium providing implementation of the necessary set of work taking into account the specificity of aircraft industry. Fig-

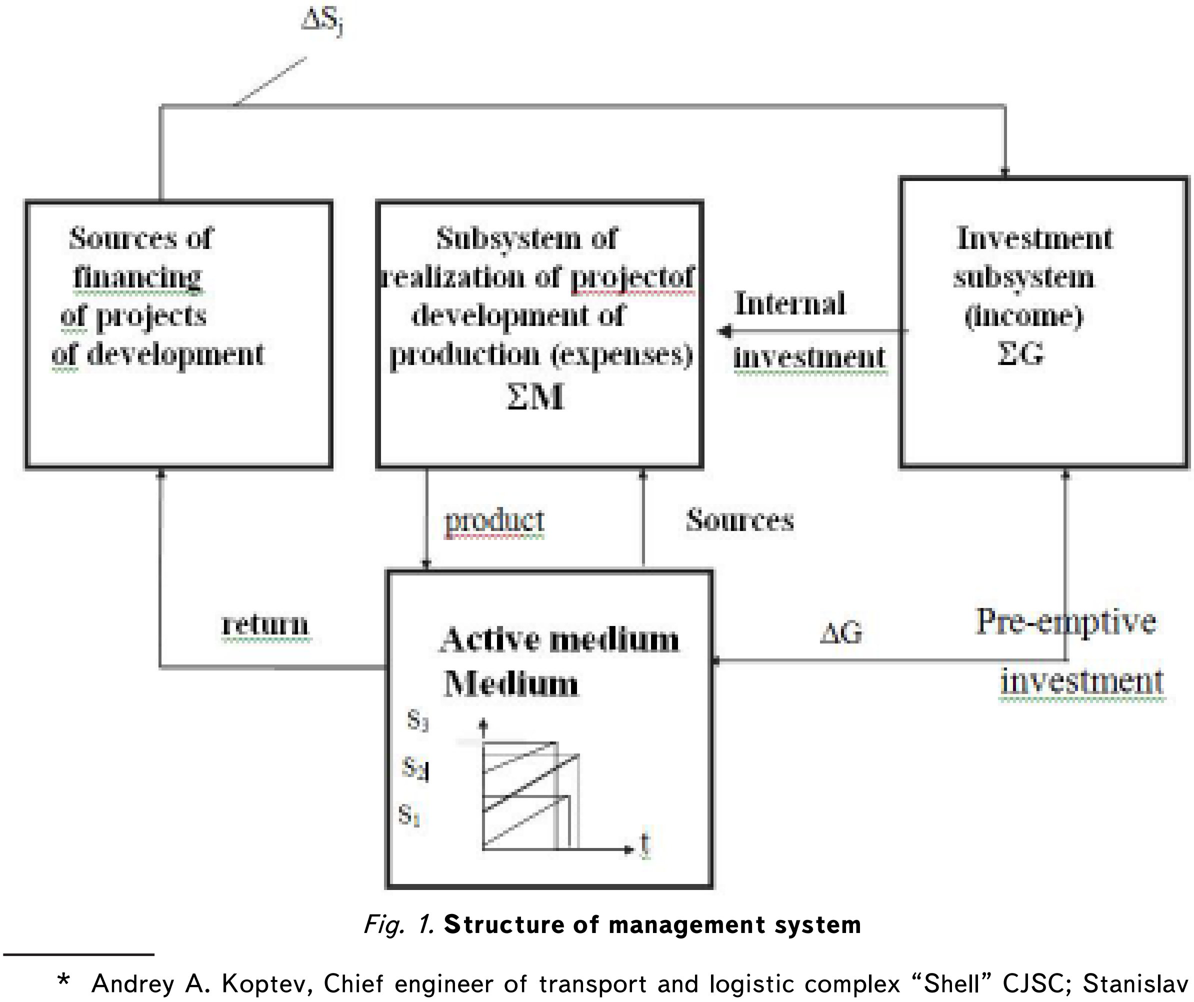

Fig. 1. **Structure of management system**

* Andrey A. Koptev, Chief engineer of transport and logistic complex "Shell" CJSC; Stanislav F. Tlustenko, associate Professor of Samara State Aerospace University named after S.P. Korolev. E-mail: titan250@mail.ru.

ure 1 shows how much the time of obtaining the desired result depends on the size of initial investment S_1, S_2 when the circulating capital from S1 and S2 levels triggers with different time intervals. The character of such dependence should be determined accurately enough. System of management should operate within the range of parameters S_1 and S_2.

Consequently, the dynamics of reorganization and the effective control of the system parameters are successfully implemented only in the case when it is in the managed misbalance state of development and possesses the degrees of freedom at all the levels. If we single out the size of circulating capital Sj, which is an integral parameter in our case, as the dominating factor, the situation will be characterized by the susceptibility threshold (Sj) of the system to the changes of the threshold given, as well as the rage (Sj) of admissible changes within the limits of its stable state. The ability of the system to reproduce its function will be determined by its capability to retain parameter Sj in the interval (Sj) that is (Sj).

Thus, when the amount of the means is sufficient in the resource subsystem and reaches some critical parameter Scr, the stage of distribution and realization of the work according to design-engineering documentation starts.

When the level drops to lower than S1 the investment system involving the sources of financing of innovation activity raises this level up to S2. It provides the reproduction of innovation function of the system. Figure 3 shows schematically the dynamics of this periodic, but violently nonlinear process.

As the general experience shows the problem of managing the process of development in the case of limited investment should be solved by means of "some separate processes of special activity" in the limits of decentralized structure of taking decisions. Such structure is able to estimate not only the results of realization of the chosen projects but the output of all intermediate levels of this process as well.

The parameters of efficiency depend on the purposes, operation conditions of production management system. These parameters may be represented by some network (or mathematical expression, which is the network equivalent) alongside with some separate requirements (characteristics of the general purpose). The parameters are external with respect to both the system and the network, which describes the system itself. Such network may contain just simple evidence of the connection between the separate parts of the system and the purpose function. Besides, it can determine the connection between the certain parameters of the system and the components of the efficiency parameter under the condition of sufficient study of the system and its operation conditions. In the first case, we may follow only the general influence of the system structure upon the parameter of efficiency. In the second case, it is possible to give the quantitative estimation of the parameters using the information on the structure and the system parameters.

Let us stop on the examination of the general influence of the structure on the parameters of efficiency.

Let us consider the characteristics of the structure efficiency of management system by means of production restructuring. The problem of simultaneous achievement of many goals with optimization of several output quantities, for

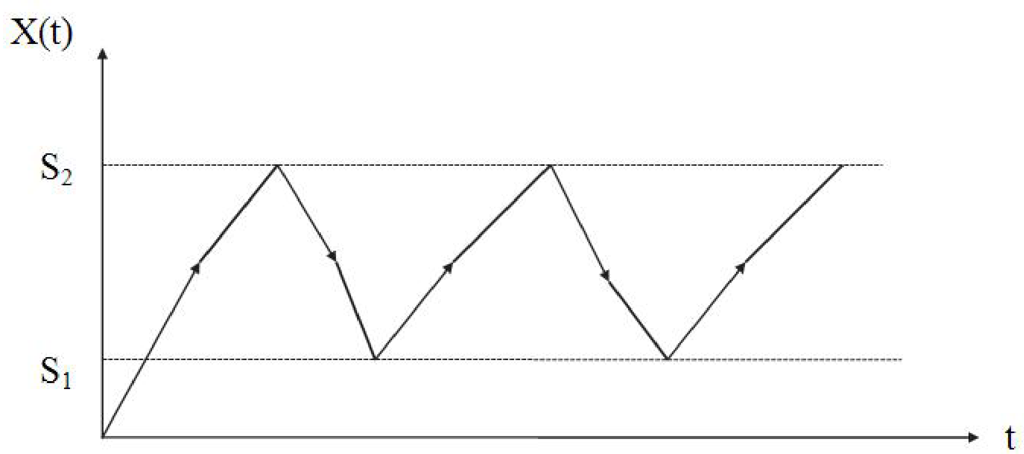

Fig. 2. **Periodic process of reproduction in the case of limited resources**

example, income and expenses, cost price of production, its quality level, etc. arises in the complex systems with hierarchical structure.

In the system that consists of a great number of subsystems, which are described by the following expressions:

$$\varphi_j = f_{ij}(x_1, \dots, x_m),$$

$$j = 1, 2, \dots, r, \quad (1)$$

where X_i is the controlled variables; ϕ_j is the output variables; the global special function depends on the local special functions determined through ϕ_j, as well as on the structure of the connections between the subsystems and on the type of ϕ_j functions.

Let the problem of management system be in obtaining maximum of expression Φ (G-M), where G is income and M is expenditure. Let us suppose that the system may control two variables x1 and x2, and we may see that

$$G = f_1(x_1, x_2), \ M = f_2(x_1, x_2), \quad (2)$$

$$\max \Phi\ (G - M) = \max_{(x_1, x_2)} [f_1(x_1, x_2) - f_2(x_1, x_2)]. \quad (3)$$

Let the output value of investment system be G, and output value of the subsystem of project realization is M, e.g. the parts of the system have their local objectives: to maximize G and to minimize M. Let us admit that it is managed in such a way that one part of the system may affect x1 and the second may affect x2. The following expression will be derived as the result of the work of each part of the system:

$$\max_{(x_1)} [f_1(x_1, x_2)],$$

$$\min_{(x_2)} [f_2(x_1, x_2)]. \quad (4)$$

To obtain the same effect as the global objective from the implementation of the local objectives (12), functions f1 and f2 should be the functions of one variable and the following proportion should be implemented:

$$\max_{(x)} [f_1(x) - f_2(x) = \max_{(x_1)}[f_1(x_1, x_2)] -$$

$$- \min_{(x_2)} [f_2(x_1, x_2)]. \quad (5)$$

Since it is rarely implemented, the difference

$$\max_{(x)} [f_1(x) - f_2(x)] - \{\max_{(x_1)}[f_1(x)] -$$

$$\min_{(x_2)} [f_1(x)]\} \quad (6)$$

may be regarded as the structural efficiency of the system. It is stipulated only by the system structure, which fulfills optimization of the local special functions.

There are two other types of structural efficiency. The first type is stipulated by some canals of connection inside the system, and the second one is stipulated by the process of finding solutions. If the systems optimize their local special functions but do not have any exact information on the variables controlled by the other subsystem, the efficiency is stipulated by the efficiency of the connection between the subsystems. Let us take x1 and x2 as the calculation value of variables x1 and x2. In that case, for the regarded system the efficiency stipulated by the connections is determined by the expression:

$$\{\max_{x_1} [f_1(x)] - \min_{x_2}[f_2(x)]\} - \{\max_{x_1} f_1(x_1, \hat{x}_2)] -$$

$$. \quad (7)$$

This measure of efficiency depends on mathematical properties of f1 and f2 functions and consequently depends on the structure of the system. The difference in structures determines greater or lesser sensitivity of the system to the poor connections between subsystems. System efficiency stipulated by its structure and connections of subsystems is determined by the expression:

$$-$$

$$. \quad (8)$$

Let us suppose that subsystems do not provide obtaining their precise maximum and minimum local special functions. Let us designate max* and min* of such values of local special functions that are obtained from subsystems operation. Then the expression

$$- \min^*_{(x_2)} [f_2(x)]\} \quad (9)$$

determines the efficiency connected with the process of finding solutions. The degree of influence of the process of finding solutions on the system efficiency also depends on mathematical properties of functions f1 and f2 and on the structure of the system.

It is possible to extend a number of characteristics of structural efficiency in the direction of the account of the structure of special function, as well as the account of uncertainty in setting this function and so on.

Technical and economic parameters of production are usually applied in practice as the functions of the goal. Determining technical and economic parameters represent considerable difficulties.

Algorithms of calculation of technical and economic parameters should include determination of efficiency, the general output of production, total idle time and idle stroke of each aggregate, specific charge of raw materials and half-finished products, as well as technological component of cost price by each kind of production. One of the peculiarities of aircraft production is the essential excess of resources at the initial production stages.

When implementing such analysis, it is necessary to determine the expenses at all the stages of technological process and the calculation of cost price of each intermediate phase of the work, i.e. the structure of the considered enterprise should be taken into account. Algorithm based on the payroll introduction of parameters is the most effective calculation algorithm of technical and economic parameters. For coding structural scheme of the process of realization of decisions, we will apply such coding lists whose components are the consequences of identifiers of the states of the schemes coded.

1. *Ustinov V.A.* Management of scientific and technical progress at the enterprise. M.: GAU named after S. Ordzhonikidze, 1991.

2. *Kristofidx D.* Graph theory. M.: World, 1978.

3. *Neusipakin K.A., Zabelskiy A.I.* Some aspects of theory of organization and prediction. M.: Signal, MPU, 2000.

4. *Twiss B.* Management of scientific and technical innovations. M.: Economics, 1989.

Received for publication on 08.04.2009