Technical - economic models of business management in the processes of agricultural production

Oleksandr Brovarets[1], Yuriy Chovnyuk[2]

Ph.D., associate professor[1], Corresponding Member of the Academy of Engineering Sciences
[1]Kiev Cooperative Institute of Business and Law; e-mail:
Ph.D., associate professor[2], professor of International Human Resources Academy
[2]National University of Bio-resources and Nature Management of Ukraine

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Abstract. The task of controlling the development of the technical-economic system of agricultural production (TESAP) as the only cross-functional business process is carried out. The methodological approach to its solution is proposed, based on the use of marketing research methods and construction of a complex of interrelated models of market-oriented technological options for the development of TESAP and financial schemes of realization. Different ways of interaction of the optimization and simulation models in the complex are considered.

Key words: modeling, methods, management, business processes, development, technical and economic systems, agricultural production.

FORMULATION OF THE PROBLEM

Modern economic conditions of Ukraine dictate the necessity of structural adjustment of production (both industrial and agricultural) and realization of investment programs of enterprises of various industrial orientation (affiliation). The requirements for quality management are increasing, which necessitates the development, generalization and use of modern methods of strategic management and financial and economic analysis of the effectiveness of planned investment measures in the development, reconstruction and modernization of technical and economic systems of agricultural production (TESAP) in practical activity.

The definition and implementation of the TESAP development strategies are among the extremely complex, labor-intensive and difficultly formalized works, which at the present time are not being implemented at the proper level at the domestic agricultural enterprises. Today, these enterprises should be considered as "open" technical and economic systems of agricultural production, the success of which is primarily determined by how well they are attached to their external economic, scientific, technical, socio-political and other environment, taking into account the current state and available internal capabilities. Methodology, procedures and practice of planning and management at various levels of the Ukrainian economy, which largely retained the features of the administrative-command system, does not fully comply with the principles and practical conditions of the newest economic mechanisms and, as a consequence, do not meet modern requirements.

The widespread methodological mistake that occurs when managing the development of TESAP is that certain aspects of development are considered and solved as partial problems (development of the production and technical base, the formation of an investment program, intensification of agricultural production, etc.) that significantly reduces efficiency, leads to inconsistencies, and often to the impracticability of the management decisions that are taken.

ANALYSIS OF RECENT PUBLICATIONS AND RESEARCHES ON THE TOPIC

In works [1-9], in order to increase the efficiency and coordination of managerial decisions, the development of techno-economic systems of industrial production is considered as the only cross-functional business center, which covers the analysis of the market environment of the system, the formation, coordination and optimization of technological development options and financially-economic schemes for their implementation. However, for TESAP, such an approach is not feasible. Therefore, this study is devoted to the solution of this problem and, moreover, it takes into account the specificity of the functioning of modern TESAP.

THE PURPOSE OF THIS STUDY

Is to substantiate the method and model of optimization of the management of the business process of TESAP, which would allow to obtain the maximum profit both from the use of available resources and from the satisfied existing (potential) demand for the product (services) that is produced. It should be noted that a well-planned, systemized and systematic market research is a prerequisite for adopting effective market-oriented management decisions regarding the development of modern TESAPs.

PRESENTATION OF THE MAIN CONTENT OF THE STUDY

Fig. 1 shows a schematic version of a planned and systematic market research.

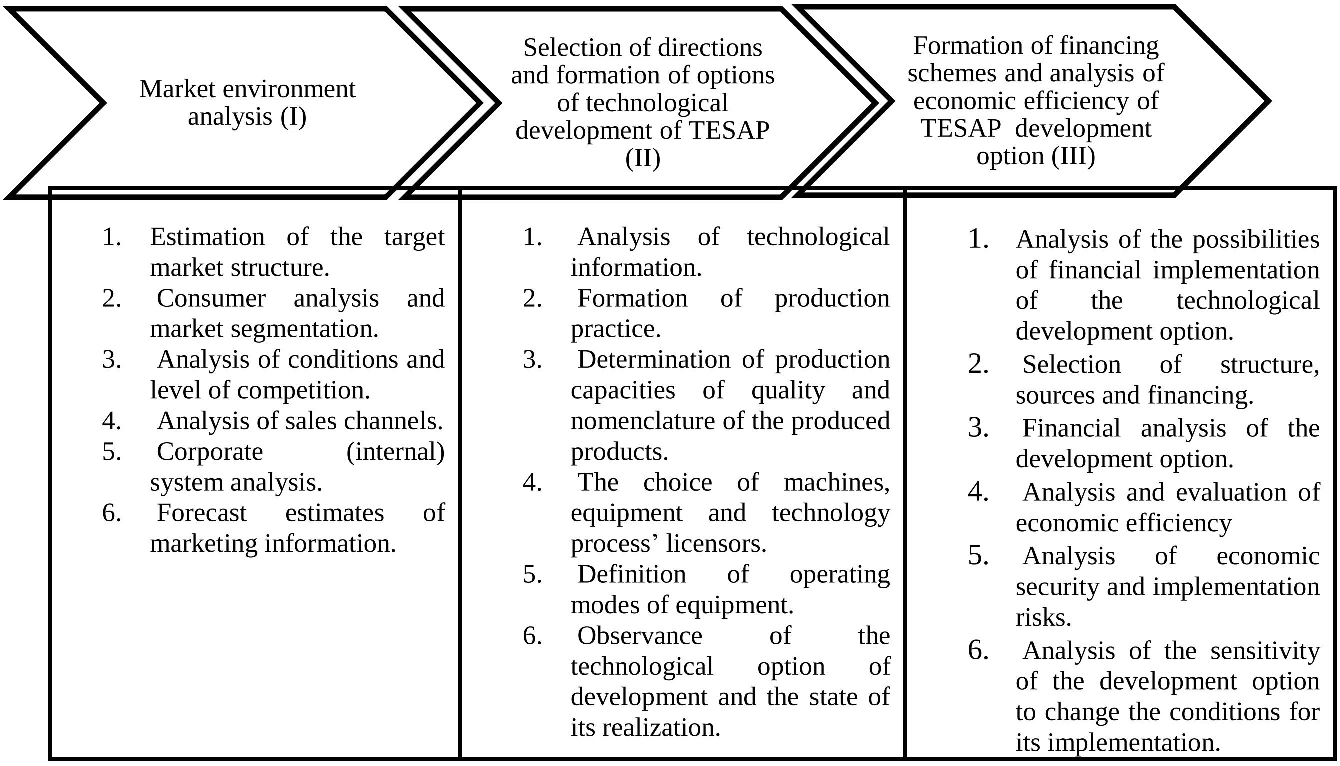

Fig. 1. Scheduled and systematic market research (agricultural products / services).

In the first stage of marketing research it is necessary to determine the structure of the target market and evaluate the degree of its monopolization. For the quantitative assessment of the degree of monopolization of the market (including agricultural products / services), the index of Herfindahl-Hirschman HHI [2] is often used:

$$HHI = \sum_{i=1}^{n} S_i^2 \;, \; S_i \in [0,1], \qquad (1)$$

where: n – the number of sellers on the market (agricultural products / services), S_i - the part (share) of the market occupied by the *i*-th seller. The greater the inequality of the parts (shares) of the market, the closer the HHI value is to one ($HHI \to 1$).

At the next stage, the necessary segmentation of the market (for products, consumers, geographically, etc.) is carried out.

The main quantitative characteristics of the target segment are the volume of market demand and the capacity of the market itself. The volume of market demand $R(t)$ (expressed in real or value terms) determines the potential volume of purchase of (agricultural) products, localized in time and space terms. Capacity of the market $Q(t)$ characterizes the maximum possible demand. Thus, at any given time, the volume of market demand constitutes a part (share) of market capacity. The difference between them $\Delta_{QR}(t)$ characterizes the potential perspective of the investigated market (see Fig. 2).

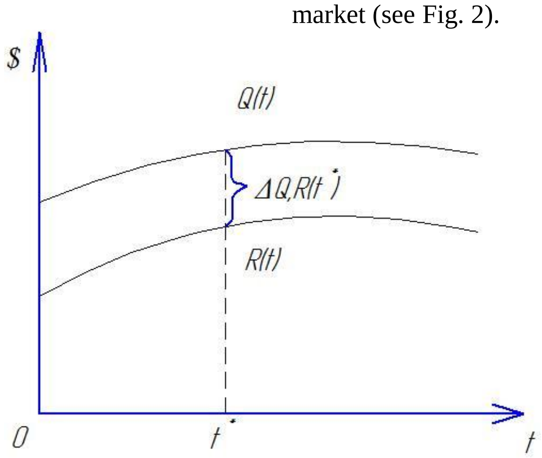

Fig. 2. Potential perspective of the investigated market of sales (agricultural products)

The volume of demand and the capacity of the market (goods / services) are dynamic functions, depending on many factors: market structures, competition from other enterprises, price elasticity of demand, rates of consumption change, distribution channels, etc.

In world practice there is a wide range of methods for forecasting the market, most of which use a rather complicated mathematical apparatus and require the availability of a large amount of diverse information, the collection and processing of which is not always possible [3, 4]. In practice, simplified methods are usually used:

1) simple extrapolation method (determination of stands and their parameters);

2) method of consumption level (the level of direct consumption of a particular product of agricultural production is determined);

3) the method of end (consumption) use (all possible variants of the use of products are determined, the coefficient of its use in the consuming industries is calculated, the level of production in these industries is forecasted, the consumption forecast is made), etc.

The most widespread methods are based on the principles of regression-correlation analysis. Correlation analysis is used to find the level of interdependence between different sizes and characteristics of the market. The method of regression analysis is used to find the average of some variable that characterizes the market under study, depending on the value of the second variable by comparing and solving the level of regression. If the value of the desired variable is dependent on the values of several parameters, then the multi-factor regression equation is formed.

An important stage in market research (Figure 1) is an analysis of the conditions of competition in the selected market segment and their impact on the magnitude of the potential market niche, which is considered by TESAP in its development. At this stage, expert methods of qualitative analysis of the situation play an important role, but some formalized means of decision support are also used. Thus, for example, the possible share (fraction) of specific products (services) of agricultural production of TESAP in the market (specific weight in percentage of total demand or market capacity) at the moment is determined taking into account the competitiveness of products, comparison of the enterprise with the competing, the ratio of supply and demand, and other factors. Approximately this share can be determined by the formula:

$$\delta^t = \frac{100\%}{\left(\frac{\sum_{j=1}^{J} a_j^t}{\alpha^t} + 1\right) \cdot \frac{m^t}{k^t}} \; ; \; m^t = \frac{n^t}{c^t} \; , \qquad (2)$$

where: δ^t – the share of specific products of agricultural production in the market,

J – number of competitors, $\alpha_j \in [0,1]$ – competitiveness index of the enterprise j ;

$\alpha \in [0,1]$ – indicator of competitiveness of the investigated enterprise;

n^t, c^t – supply and demand for agricultural products (services) sold, respectively;

$k^t \in [0,1]$ – relative competitiveness of products (services), which is produced, all at the time *t*.

In determining the potential sales volume of the products being produced by the TESAP under investigation, the methods of game theory (game models of Cournot, Stackkelberg, Forchheimer et al. [2]) are widely used in the selected market segments under the conditions of competition. Let's consider the basic idea of these methods on the example of the simplest model of Cournot in the conditions of a duopoly (on the investigated segment of the market two firms compete). Each firm determines its level of sales (production) q_1 and q_2, respectively. Market price - the linear function of the sectoral volume of production:

$$P(Q) = a - b \cdot Q \; , \qquad (3)$$

where: $Q = q_1 + q_2$.

The profit Π_1 of the firm 1 is the difference between total income $P(Q) \cdot q_1$ and total expenses equal to the product of constant average costs "*C*" on the volume of production q_1:

$$\Pi_1 = (a - b \cdot Q) \cdot q_1 - c \cdot q_1 \qquad (4)$$

Since the price also depends on the volume of output by firm 2, as well as on its own production, firm 1 can not determine the level of sales (production) that maximizes profits without the assumption of how the firm 2 will react. The Cournot model is based on the assumption , that each firm proceeds from a constant volume of release by another firm. In this case, the firm 1 maximizes its profit, differentiating Π_1 to q_1 and equating the obtained expression to zero (the condition for the existence of the maximum function of profit of the first order):

$$\frac{d\Pi_1}{dq_1} = P(Q) + \left(\frac{dP}{dQ}\right) \cdot q_1 - c = a - 2 \cdot b \cdot q_1 - b \cdot q_2 - c = 0 \qquad (5)$$

Converting this equation, you can get a function that indicates the maximizing profit level of sales (production) of firm 1 with the object of sales (production) of firm 2:

$$q_1 = \frac{(a-c)}{2 \cdot b} - \frac{1}{2} \cdot q_2 \; . \qquad (6)$$

This equation is a function of the reaction or the reaction curve, because it registers maximizing the profit of the firm 1 and response to the decisions of the firm 2 (see Fig. 3). Firm 2 solves the exact same problem and has its own reaction function:

$$q_2 = \frac{(a-c)}{2 \cdot b} - \frac{1}{2} \cdot q_1 \, . \qquad (7)$$

The solution that corresponds to the equilibrium (Fig. 3), that is, the solution to the problem of maximizing the profit of each firm, which does not leave any of them an incentive to change the volume of sales (production) of agricultural production, lies at the intersection of two reaction curves. It was found by the substitution of the expression for the function of the reaction of firm 1 and is solved in the following way:

$$q_1 = \frac{(a-c)}{3 \cdot b}. \quad (8)$$

Similar considerations apply when determining the volume of sales (production) of agricultural production and in more generalized models that reflect a more complex market structure (oligopoly, dominant firm, etc.).

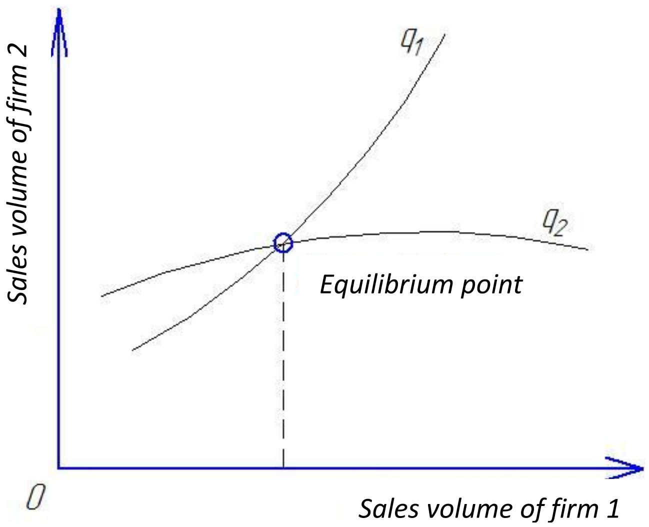

Fig. 3. Equilibrium solution (8) - a graphic representation

The results of forecasting the level of demand for manufactured products (services), the characteristics of the relevant market segments, the conditions of competition and other factors of market research largely determine the rational production program of TESAP, the necessary material, technological and labor resources, that is, allow us to formulate a market-oriented version of technological development TESAP. Taking into account that the regulator of marketing research is targeted information and analyzed at the preliminary stage of the preparation of the TESAP variant (see Figure 1), in this paper the main attention is paid to the methodology, models and methods for the formation of technologically and financially-agreed TESAP development projects. It takes into account market needs and the mutual influence of technological and financial and economic indicators of the project.

In general, the considered management problem can be formalized as follows: to construct an operator μ, which provides a set of possible solutions that characterize variants of TESAP development, the choice of such development, which belongs to a set of admissible solutions and delivers an extremum to some given target function.

Let's Z be a solution that defines the variant of TESAP development, characterized by a set of technological X (composition and type of equipment, topology of its connection, mode of operation, nomenclature and structure of production, etc.) and financial and economic (object of investment, direct material costs, flow of net payments, internal rate of return, period of full payback, etc.) indicators; Ω – a set of technological characteristics of the TESAP development option; Θ – a set of financial and economic characteristics of the TESAP development option; F – target function (a certain rule of decision estimation); $extr\_F$ - criterion of optimality (a certain rule of comparison of decisions). Then the general task can be formalized as follows:

$$\mu : \left\{ Z \overset{def}{=} [X(\Omega), Y(\Omega)] \right\} \xrightarrow{\mu} \left\{ Z^* / Z^* \in R \equiv R_\Omega \times R_\Theta ; F\left(Z^*, \Omega, \Theta\right) = extrF \right\}, \quad (9)$$

where: R – the area of possible (admissible) solutions,

R_Ω and R_Θ – the set of constraints and conditions of technological and financial-economic nature, respectively. If R- is a formalized set, F- a formalized rule, and $extrF \in \{\max, \min\}$, then the operator μ can be constructed as a solution to the problem of mathematical programming.

However, in practice, the domain of admissible decisions can be defined both analytically and algorithm ically defined dependencies, especially in the part of financial and economic constraints. In connection with the latter, the construction of an operator μ is usually a rather complicated task and requires creation of complex structures based on the use of mathematical modeling methods. One of the main directions of development and construction of complexes of interconnected models in which each model corresponds to its specific tasks, and the final decision is reached in the process of transformation and transfer of information between models on the basis of the organization of iterative procedures for their interaction [5].

The establishment of such an approach in solving the problems of management of the development of TESAP type (9) involves the breakdown of the general task into two interrelated regulations that characterize the process of development in the technological ("technological model") and financial and economic ("financial-economic model") points of view.

Analytically, by (9) the general statement of the problem of the formation of an optimal technological variation of development can be formalized as follows:

$$\mu_\Omega : \left\{ X \overset{def}{=} \left[X(\omega_1,..\omega_n), / \omega_i \in \Omega; i = \left(\overline{1,n}\right) \right] \right\} \xrightarrow{\mu_\Omega} \left\{ X^* / X^* \in R_\Omega; F\left(X^*, \Omega\right) = extrF_\Omega \right\} \quad (10)$$

In practice, due to the significant determinism of the technological options for the development of TESAP and their characters, the operator μ_Ω, which provides the best solution for the purposeful function, represents a solution to the problem of mathematical programming of large dimension. Depending on the specifics of a specific task, the target function and restrictions may include: the nomenclature, structure and quality of the manufactured product; volume of processed raw materials; production of commodity products as a whole or by its individual types (in physical or cost terms); aggregate quality indicators of the production process (the depth of processing of raw materials, the degree of loading of key capacities, etc.); direct material expenses in general or by types; degree of pollution of the environment and other characteristics of the TESAP development option. The method of solving problems of type (10) is quite well-developed methods and algorithms of mathematical programming, implemented in specialized (taking into account the specifics of production and technological activity) application software packages on modern computing platforms.

Given the solution X^* of the problem (10), the general resolution of the problem of the formation of an optimal financial and economic variant of the development of TESAP (i.e., the choice of the optimal in terms of financial and economic indicators of the financing scheme of the technological variant of development) can be formalized in the form of "financial-economic" model:

$$\mu_\Theta : \left\{ Y \overset{def}{=} \left[Y\left(Y^*, \Theta_1,...\Theta_n\right), \Theta_j \in \Theta; j = \left(\overline{1,n}\right) \right] \right\} \xrightarrow{\mu_\Theta} \left\{ Y^* / Y^* \in R_\Theta\left(X^*\right); F_\Theta\left(Y^*, X^*, \Theta\right) = extrF_\Theta \right\} \quad (11)$$

In practice, in the solution to the next degree of algorithmic character in determining the range of admissible values R_Θ, the construction of an operator μ_Θ can include both the solution of the corresponding optimization problem and the implementation of a series of simulation experiments that provide the formation of a set of necessary financial and economic indicators of the technological development option X^*, which is implemented in accordance with some scheme of financing. Depending on the specifics of a specific task of type (11), the target function and limitations may include: the flow of net payments, the internal rate of return, the period of full payback, the level of profitability (assets, sales, etc.), liquidity (current, absolute etc.) and other characteristics. In contrast to the problem of type (10), the solution of the problem type (11), along with the use of mathematical programming tools, generally involves the development and use of specialized simulation models of cash flows (arising in the process of implementation of the TESAP technological development option), taking into account discounting [6].

Conceptual principles, methodological approach and general scheme of building a complex of interconnected models of management of the development of complex TESAP, developed on the basis of the above ideology, are reflected in Fig. 4

In the first stage (see Fig. 4) it is proposed to solve the problem of choosing the optimal technological variant of TESAP development within the existing limits of the technological group (block 1). In the process of modeling it turns out the existence of a solution to the problem (block 2).

If the solution of the task does not exist (i.e. $\notin \mu_\Omega$), then the existence of the possibilities (rules) of use *q* and *h* of the set of technological characteristics of the variant of development Ω and the area of restrictions R_Ω, respectively (block 3), is checked. If the correction options of Ω and R_Ω are exhausted, then the solution to the task does not exist (block 4) and it is necessary at a higher level of management to review the requirements to the development goals and conditions for its implementation. If the adjustment is possible, then *q* and *h* of the sets Ω' and R'_Ω (block 5) are updated as new outputs to block 1 and a new "internal" cycle of the task solving is carried out. In practice, the adjustment usually involves narrowing the set of characteristics that are taken into account, and relaxing limiting the requirements within acceptable limits. If there is a solution to the problem of optimization of the technological variant of the development of TESAP (i.e. $\in \mu_\Omega$), then the optimal solution X^* comes as a source data in block 6, where the problem of choosing the optimal scheme for financing the current version of technological development of TESAP within the limits of existing restrictions of the financial and economic group is solved. In the process of modeling, the existence of a solution to a task (block 7) is revealed. If the decision of the task does not exist (i.e. $\notin \mu_\Theta$), then the fact of existence of the adjustment possibilities (rules)of *p* and *f* of the set of considered financial-economic and characteristics of the variant of development Θ and the area of limitations R_Θ of this TESAP, respectively (block 8), is checked. If the adjustment is possible, then the rules *p* and *f* adjusted for the set Θ' and R'_Θ (block 9) are received as the output data in block 6, a new "internal" cycle of solving the problem of determining the optimal TESAP financing scheme is implemented. If the correction options of Θ and R_Θ are exhausted, then the possibility of an adjustment of Ω and R_Ω is checked and if a positive answer is given, a new "external" cycle of solving a task is carried out. If there is a solution to the optimization problem of the financing scheme (i.e. $\in \mu_\Theta$), then based on the solution Y^* and previously obtained X^* the solution to the general problem Z^* is formed (block 10).

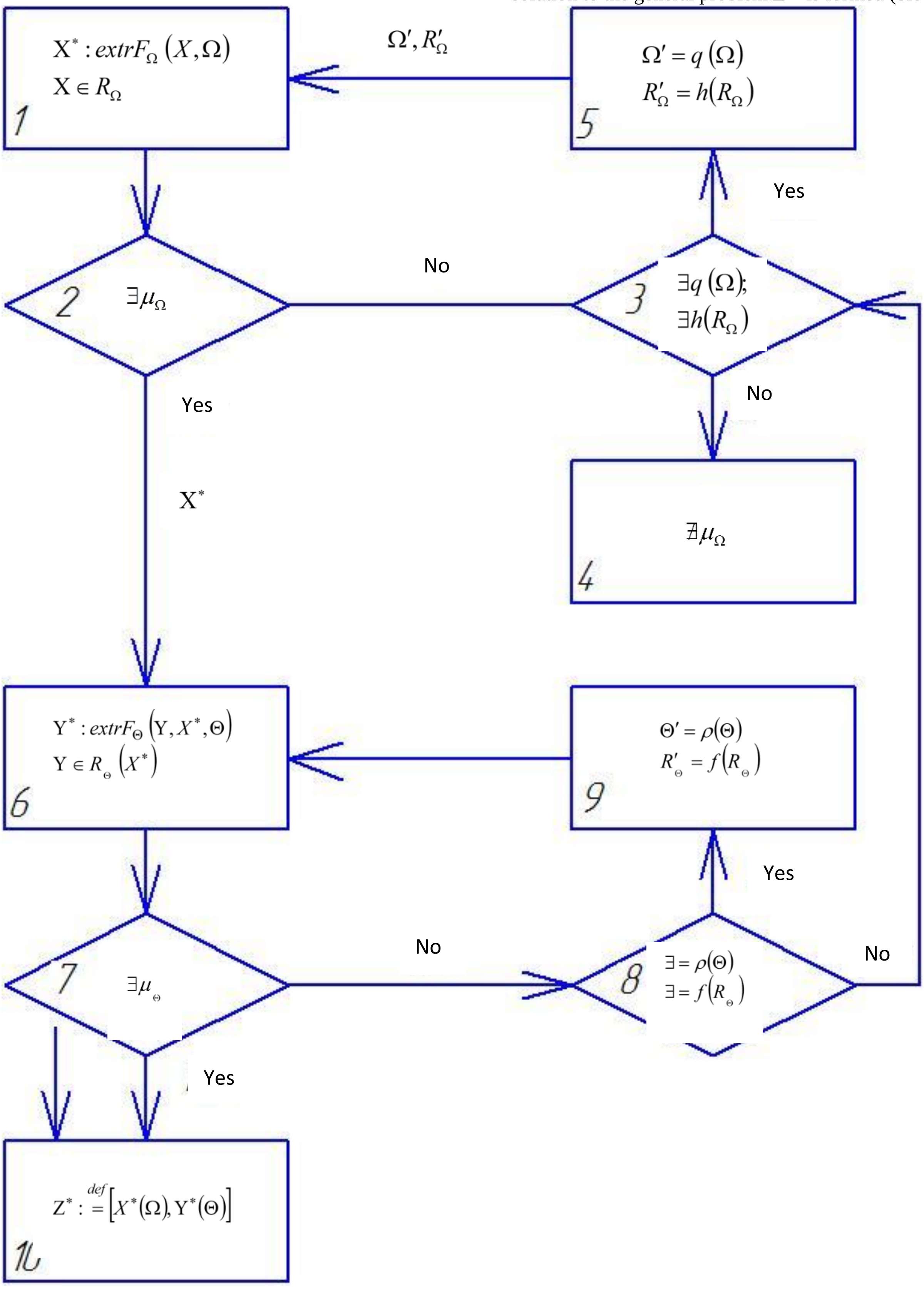

Fig. 4. General scheme of construction of a complex of interrelated models of management of the development of complex TESAP

Because of the existence of cross-functionality of the business development process within the models (10) and (11) used in the calculations, the latter may differ significantly in composition, structure, target orientation and interaction procedures. These features should be taken into account when designing and choosing the ways to formalize the TESAP development process. The most expedient approach is based on the development of a "library" of basic elements of models (10) and (11).

The basic elements of the models include a set of formal constraints and optimality criteria that have a library organization, from which specific models of different sizes and structures can be formed. The library principle of organization allows to systematically expand the composition of models, quickly change their structure, formalize and solve the tasks of management of development of different content and purpose [7].

It should be noted that the definition of the necessary and sufficient composition of the "library" of the model elements is an independent task, the solution of which is based on the selection and approval of the limited requirements (criteria, constraints), which directly proceed from the main objective of the development of TESAP and are critical to its achievements (the so-called "critical success factors" of Critical Success Factors [1]). Thus, the basic elements of the technological model of TESAP development usually include critical factors that are related to the power and production technology, market requirements, product quality, economic conditions, etc. Productive power P can be estimated as for the TESAP as a whole:

$$P_1 = x_e \cdot \sum_{j \in J_e} \sum_{i \in I_j^l} Z_i^{je}, \; e \in L, \qquad (12)$$

so for some "key" manufacturing establishment:

$$P_2 = x_e \cdot \sum_{i \in I_j^l} Z_i^{je}, \; e \in L, \; j \in J_e, \qquad (13)$$

where: Z_i^{je} – the input material flow of i -th type of j -th establishment at e -variant of the development of this TESAP;

X_e – Boolean change equal to 1, if the variant of development and 0-th of the opposite case is chosen;

J_e – a plurality of plants of production with e-th variant of its development;

I_J^e – the set of input material flows of the j-th establishment in the e-version.

The production technology of this TESAP is described by the flow and balance dependencies of the type:

$$U_m^{jl} \cdot x_l = \left\{ h_{q_m}^{jl} \cdot \sum_{i \in I_i^l} z_i^{jl} \right\} \cdot x_l, \; m \in M_j^l, \; l \in L, \; j \in I_l, \; q \in Q_j^l \qquad (14)$$

where: U_m^{jl} – the output material flow of m-th type from j-th establishment at work in l-th option;

$h_{q_m}^{jl}$ – the coefficient of selection of m-th component on j-th establishment during its work in q-th mode in the l-th option;

M_j^l – the set of output material flows from j-th establishment in the l-th option;

Q_j^l – a plurality of modes of operation of j-th establishment in the l-th option of development; Then:

$$\left\{ \sum_{i \in I_j^l} z_i^{jl} \right\} \cdot x_l = \left\{ \sum_{m \in M_j^l} U_m^{jl} + \alpha_j^l \right\} \cdot x_l, \; l \in L, \; j \in I_l \qquad (15)$$

where: α_j^l – the cost of the production process of this TESAP on j-th establishment in the l-th option.

Market restrictions on the production of one or another agricultural product (services) can be characterized as the integral (absolute) values of the specified production of one or another product / service:

$$P_3 = x_l \cdot \sum_{j \in J_l} \sum_{m \in M_j^l} d_{mk}^{jl} \cdot u_m^{jl}, \; l \in L, \qquad (16)$$

and the magnitude of the deviation of the volume of production of k-th type Δ_k^l of product from the requirements of the market of collection:

$$\Delta_k^l = 1 - \frac{x_l}{G_k^*} \cdot \sum_{j \in J_l} \sum_{m \in M_j^l} d_{mk}^{jl} \cdot u_m^{jl}, \; l \in L, \; k \in K \qquad (17)$$

where: d_{mk}^{jl} - the share of the component of m-th type, which is produced by the j-th establishment, which goes to the production of the k-th product by l-th option;

G_k^* – the forecasted value of market demand for products of the k-th type.

Certification limitations on the value of certain quality indices of products are described by dependencies of the type:

$$P_4 = x_l \cdot \sum_{j \in J_l} \sum_{m \in M_j^l} A_k^l \cdot C_{mk}^{sl} \cdot d_{mk}^{jl}, \; l \in L, \; s \in S \qquad (18)$$

where: C_{mk}^{sl} - the value of s-th quality indicator in the m-th component of the k-th product manufactured by TESAP on the l-th option;

S – a set of quality indicators;

A_k^l – a matrix of correction coefficients of quality indicators in the production of k-th product that is produced by the l-th option.

The critical success factors formalized in the form of the basic elements of the financial and economic model of the development of the TESAP are primarily Net Present Value (NPV), the Internal Rate of Return (IRR) in Internal Return on Payback Period (PB). Net discounted income is calculated as the amount of discount net flows of net payments (the difference between inflows and outflows of funds or between income and expense of funds) on the accepted horizon of calculation:

$$NPV_k = \sum_{t=0_l}^{I} \left[\frac{1}{1+\delta}\right]^t \cdot C_{kt}(x_l^*) \cdot y_k \,,\; C_{kt}(x_l^*) = R_{kt}(X_l^*) - D_{kt}(X_l^x) \quad (19)$$

where: T – the horizon of calculation;

δ – discount factor;

$C_{kt}(x_l^*)$ - the flow of net payments, which arises in the t-th period during the implementation of the selected l-th option of TESAP technological development plan financed by the k-th financial scheme;

y_k - Boolean change, which is equal to 1, which is chosen y_k - th scheme of financing;

$R_{kt}(X_l^*)$ – financial results, which are achieved at the t-th time during the implementation of the l-th selected option of technological development of TESAP, which is financed by the l-th financial scheme;

$D_{kt}(X_l^x)$ – the costs incurred.

The internal rate of return represents the value of the discount factor, at which the value of discounting effects equals discounted investment and is defined as the root of the level:

$$\sum_{t=0}^{T}\left[\frac{R_{kt}(X_l^*) - \overline{D}_{kt}(X_l^*)}{(1+\delta)^t}\right] \cdot y_k = \sum_{t=0}^{T}\frac{G_t(X_l^*)}{(1+\delta)^t} \Rightarrow \delta^* = IRR_k \quad (20)$$

where: $\overline{D}_{kt}(X_l^x)$ – the costs incurred in the t-th period in the implementation of the selected l-th option of technological development, funded by the k-th financial scheme (not including investments);

$G_t(x_l^*)$ – volume of capital investments, carried out in the t-th period.

The period of full payback characterizes the minimum interval (from the beginning of the project implementation), for smaller ones, the integral effect becomes and in the future remains non-negative (≥0) and is determined from the following ratio:

$$\min\left\{\sum_{t=0}^{T}\frac{D_{kt}\left(X_l^*\right)}{(1+\delta)^t} \cdot y_k \le \sum_{t=0}^{T}\frac{R_{kt}(X_l^*)}{(1+\delta)^t} \cdot y_k\right\} \Rightarrow T^* = PB_k \quad (21)$$

Depending on the target orientation, the design stage and the specifics of the solvable task of development of TESAP, in practice, different ways of constructing a set of models (Fig. 4) can be realized, which differ from each other by the combination of models, the level of detail and procedures for generating solution options, verification of rules for necessary conditions and restrictions and also the ways of adjusting models in the process of integration (Figure 5).

The method of constructing a set of models, presented in Fig. 5, a, it is expedient to use in the preliminary stage of research, when the task of optimization of technological development of TESAP is quite well structured, and the financial and economic component of development is taken into account at the level of production costs and some generalized assessment, for example, marginal income. The best solution can be found in the iterative mode by directional adjustment of the optimization model based on the results obtained during the integration process.

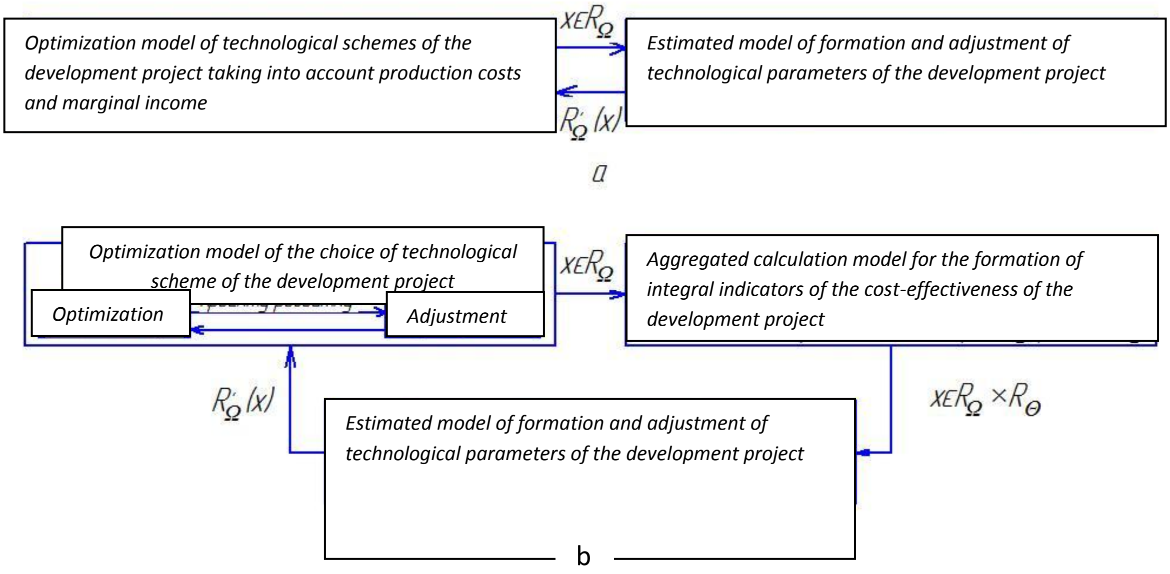

Fig. 5. Ways of constructing a complex of models TESAP: a); b).

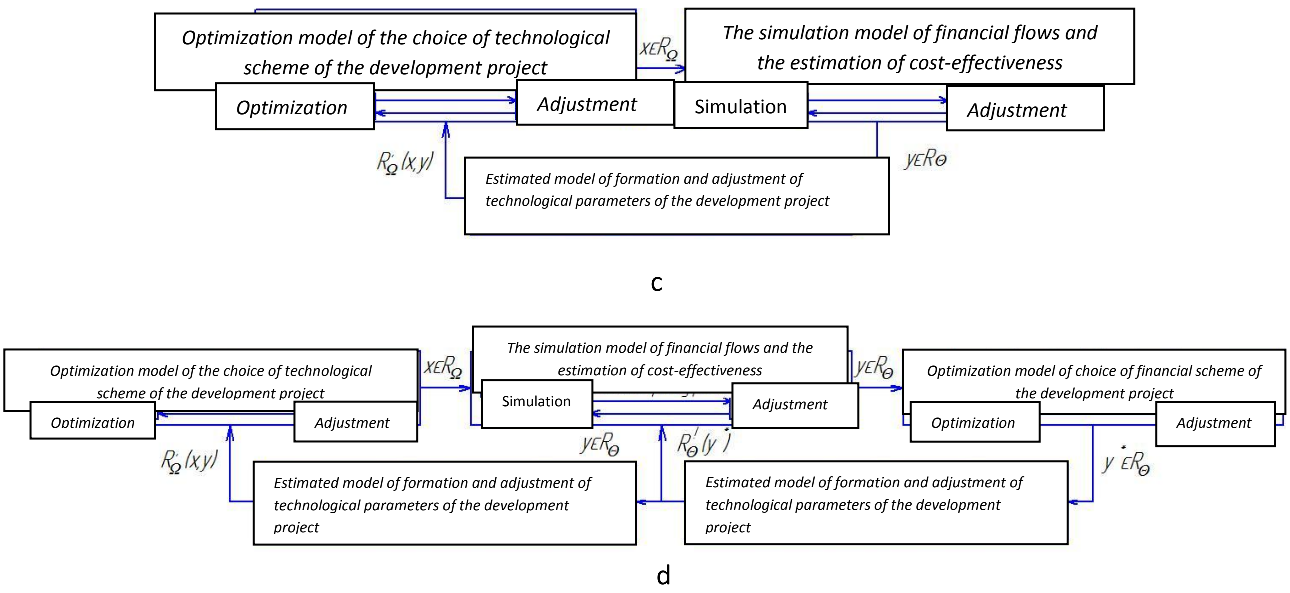

Fig. 5. Ways of constructing a complex of model of TESAP: c); d).

Such an approach to the solution of the TESAP task can be effectively used to determine the totality of alternative perspective projects of development of the investigated TESAP. However, a decision on choosing and implementing the best option for the TESAP development project requires a more in-depth study and analysis of its financial and economic performance. The depth of this research in practice usually depends on the degree of detail and the object of the known information, as well as on the time limits of the analysis.

If the research is to be carried out in a short time and only approximate estimates of the financial and economic characteristics of the project are known, then, together with the mathematical model of technological development of TESAP, it is proposed to use an aggregated financial-economic model. Due to the approximate nature of the source data, such a model is usually formalized in an analytical form, and the complex of interconnected models has the form shown in Fig. 5, b.

If it is necessary to conduct a sufficiently detailed study of both technological and financial and economic indicators of the project in question, then (due to the algorithmic nature of the detailed description of the financial and economic characteristics) it is necessary to construct an adequate simulation model of financial flows and to analyze the sensitivity of the values of the integral indicators of the project's effectiveness in terms of changing its conditions of realization. The method of constructing a set of interconnected models for this, the most frequently occurring in practice case, is given in Fig. 5 c.

The scheme of the most complete, but at the same time the most labor-intensive and rarely implemented in practice research, which covers the optimization of both technological and financial-economic decisions related to the implementation of the project, is given in Fig. 5 d. This method of constructing a set of models is a combination and generalization of the methods "b" and "c". At the first stage, a cycle of optimization calculations is carried out to determine the best (in some given sense) technological scheme for the development of the investigated TESAP. For the chosen technological scheme, using the simulation model flows of cash and financial and economic indicators of the project are formed, which correspond to possible schemes of its financing. Then, with the help of an optimization model, the choice of the best (in some given sense) of the financial scheme of the project implementation is carried out. At the same time in the process of optimization calculations and simulation experiments can be adjusted as an optimization model of technological development of TESAP, as well as a simulation model of financial flows.

Regardless of the adopted method of construction (see Fig. 5), complexes of business process management models of TESAP development should be developed taking into account the accepted technology of strategic planning and are an integral part of the decision-making system and should be oriented towards the use of modern computer technologies.

In connection with this, an important role plays the issue of their program implementation, the organization of computational schemes, the choice of composition and structure of software tools, taking into account the specifics of the investigated TESAP. Examples of such approaches in the oil and gas industry are the works [8, 9].

CONCLUSIONS

Using the optimal results and complex approaches to the problem, when managing business processes of TESAP development, will allow reducing substantially the terms, improving the quality and validity of the management decisions that are being made.

REFERENCES

1. **Robson M. A., Ullah P. 1996.** Practical guide to business process re-engineering. London: Gower Publishing Std. Vol. 78, No. 10, 821-831.
2. **Scherer F.M., Ross D. 1990.** Industrial market structure and economic performance. – Boston, USA: Hongliton Mifflin Co., Vol. 21, No 4, 16-26.
3. **Erlich A**. 1996. Technical analysis of commodity and financial markets. – Moscow: INFRA – M. Vol. 12, No 1, 26-37.
4. MacConnel L. Brew S. 1993. Ekonopis: Principles, problems and politics. – M .: Manager. Vol. 13, No 6, 63-74.
5. **Karibskiy A.V**., **Tsvirkun A.D., Shishorin Yu.R., 1989.** Modeling the development of the structure of large-scale production and transport systems. I, II. Automatics and telemechanics. – №2. 139 - 154.
6. **Karibskiy A.V., Shishorin Yu.R. 1996.** Business plan: financial and economic analysis and performance criteria. (Methods of analysis and evaluation). Preprint. – Moscow: Institute for Control Sciences, Vol. 14, No 2, 36-44.
7. **Karibskiy A.V.**, **1991.** Managing the development of large-scale system. Mathematics and Computers in Simulation. – No. 2. 287-293.
8. **Shestakov N.V**. Use of computer modeling methods in the investment planning of petrochemical. Abstracts of the International Scientific and Practical Conference "Management of large systems." - M.I.PU, 1991. 391.
9. **Karibskiy A.V., 1998.** Information technologies and features of financial and economic analysis of large investment projects in the oil industry. World of Communication. № 7-8. 72-77.
10. **Parkhomenko E.I., 1989.** Geoelectrical properties of minerals and rocks at high pressures and exploitation / E.I. Parkhomenko. – M. Nauka. 198.
11. **Basniyev K.S., 1993.** Underground hydromechanics. M .: Nedra. 416.
12. **Aleksandrov P.N., 2000.** Effective electromagnetic parameters of the capillary system of electrical conductivity of rocks. Fizika Zemli. № 2. 87 - 94.
13. **Fedorov F.I., 1976.** The theory of gyrotropy. – Mins: Nauka i tekhnika. – 456.
14. **Tretyakov S.A. 1994**. Electrodynamics of continuous media: chiral, isotropic and some anisotropic materials. Radiotekhnika i eletronika. – Vol. 39. 1457-1470.
15. **Kong A.I., 1986**. Electromagnetic wates theory. N.Y.: Wiley. 400.
16. **Sihvola A.H., Lindell I.V, 1991.** Microw. And optical Technol. Leters. – V.4, No. 8. 295.
17. **Tellegen B.D.H., 1948.** Philips Res. Rep. – Vol.3. 81.
18. **Saadoun M.M.I., Ebgheta N.** 1992. Microw and optical Technol. Lett. – V.5, No. 4. 184.
19. **Lindell I.V., Viitanen A.I., 1992**. IEEE Trans. – V. AP – 40, No. 1. 91.
20. **Tretyakov S.A. Oksanen M.I., 1992.** Electromagn. Wates and application. — V.6, No. 10. 1393.