Modeling the Decision-Making Process in Project Management of Innovative Diffusion of Socio-Economic Systems

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Abstract
This section presents conceptual foundations of modeling the management innovative diffusion of socio-economic systems, embodied in the form of a meaningful abstract model with a certain structure of interconnected concepts, highlighting the properties of its elements and the relationships between them that are important to achieve the goal of modeling. Models of distribution of innovations by means of which it is possible to carry out forecasting of innovative diffusions of social and economic systems by performance of forecast calculations in the planning period are considered. The SWOT-analysis of the given models of forecasting of innovative diffusions of social and economic systems on criteria "Strengths / Weaknesses and Opportunities / Threats" is carried out. A model of risk-free production strategy for decision-making at the enterprise has been developed.

Keywords 1
Innovative diffusion, project, project management, conceptual bases of modeling of management of innovative diffusion of social and economic systems, abstract model, conditions of functioning of innovative diffusion.

1. Introduction

In today's harsh business environment to maintain or ensure the competitiveness of socio-economic systems, it is necessary to constantly improve existing models and methods, search for new opportunities and solutions for their management by forming a system of initial theoretical positions as conceptual foundations of management modeling, implementation of new developments. approaches, i.e. the range of everything that will help to distinguish each system from each other and allow it to be unique at both national and global levels.

In the context of the global financial and economic crisis, which has affected systems at different levels, investment and innovation, the role of which is constantly increasing, can contribute to their survival.

Innovation and investment model of economic development allows to increase the efficiency of production processes by directing investment in achieving the results of scientific and technological progress, embodied in the latest knowledge that can be directed to the sphere of production and provide the social sphere. In other words, we cannot talk about any innovations without significant investments.

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2. Analysis of recent research and publication

Many economists have studied socio-economic systems in the field of innovation and investment, who recommend the concept of "innovation and investment" to understand the mechanical combination of investment and innovation, which can make a profit or achieve a social effect.

There are several scientists who have made a significant contribution to the management of socio-economic systems development projects and the justification of the feasibility of using modelling in the diffusion of managerial innovations of socio-economic systems: Peter Drucker, Michael Porter, Clayton Christensen, Amartya Sen, Muhammad Yunus Yang J., Macharis C., Turcksin L., Lebeau K., Damian D., Finkelstein A., Bushuyev S., Havrylenko E.and others.

It is very important to develop such innovations that can be gradually implemented and gain recognition as a result of the unity of interconnected institutions, groups, organizations, communities, which, interacting, provide material and intangible needs and interests of people [1], ie in social systems. This process is called innovative diffusion. Projects related to the diffusion of innovations in socio-economic systems refer to initiatives aimed at introducing new technologies, products, or services into a particular community or market segment. These projects typically involve a set of activities aimed at creating awareness, promoting adoption, and integrating new innovations into existing systems. The main characteristics of such projects are: innovation, feasibility, scalability, and cooperation between different stakeholders, including innovators, users, and service providers, to ensure a smooth and successful diffusion process.

To effectively manage this process, it is necessary to offer conceptual bases for modeling the management of innovative diffusion of socio-economic systems, embodied in the form of a meaningful abstract model with a certain structure of interconnected concepts, highlighting the properties of its elements and relationships between them.

The purpose of the article is to develop a model of the decision-making process in the management of projects of innovative diffusion of socio-economic systems.

3. Presentation of the key material

The abstract model of managing the innovative diffusion of socio-economic systems, in our opinion, can have a structure of three interrelated elements, each of which can be characterized by a number of partial parameters (Fig. 1):

1. initial data for the development of innovation, which will determine the possibility of innovation to acquire the status of diffusion;
2. conditions for the functioning of innovative diffusion, defined by the boundaries of the legal field of an individual country;
3. applicability in socio-economic systems, which is determined by the separation of the composition of certain parameters that allow to manage the innovative diffusion of socio-economic systems.

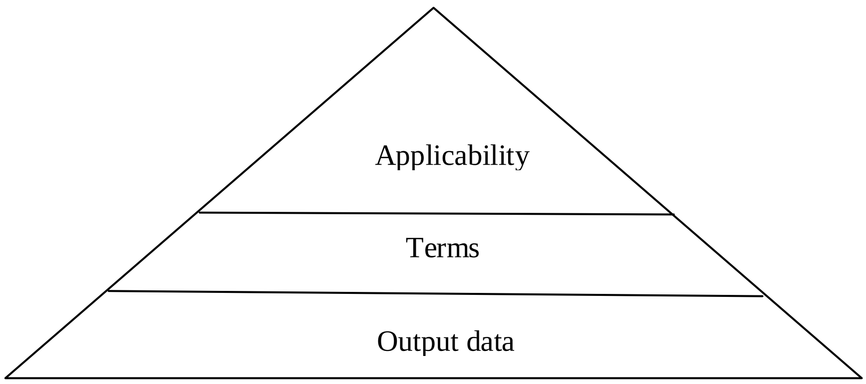

Figure 1: Conceptual bases of modeling management of innovative diffusion of social and economic systems

To answer the question "what innovation can be diffusion" it is necessary to understand what diffusion is and what initial data it is necessary to have for its formation. That is, consider the first element of the abstract model.

The concept of "diffusion" was first proposed by the American sociologist Everett Rogers. In his work, he formulated a definition that gained its further viability among other economists: "diffusion is a communication process through which innovation is transmitted through certain channels over time between members of the social system" [2]. In our opinion, it is not clear enough what channels are meant, what period of time should be taken as a basis, which participants and under what conditions interact with each other. One thing is clear, E. Rogers' theory aims to find an explanation for the ability of new ideas and technologies to spread to different cultures. The initial data in this case, in our opinion, can be financial resources for the development of innovation, qualified employees who understand the conditions of functioning of various social systems.

Currently, the diffusion of innovations is quite common and deserves the attention of both domestic and foreign economists. Yes, the author Prorovsky AG [3] proposes to distinguish between the concepts of "dissemination of innovation" and "diffusion of innovation" and to equate the definition of "diffusion of innovation" and "technology transfer". Thus, the dissemination of innovations, he understands "the information process, the form and speed of which depend on the power of communication channels, the peculiarities of the perception of information by economic entities, their ability to use this information in practice" [3].

In our opinion, the form and speed of the ongoing process must take place in a regulated legal field, ie be performed in accordance with the laws of the country or countries of innovation. Diffusion of innovation, according to Prorovsky AG - is "the process by which innovation is transmitted through communication channels between members of the social system over time ... That is, it is the spread of already mastered and used innovation in new conditions or places of use. Technology transfer is nothing more than a diffusion of innovation. International technology transfer is a diffusion of innovation, when the producer and consumer of innovation are in different countries "[3]. From this definition it becomes clear that for successful implementation of innovation must be tested at least once in a particular business entity, which with its positive experience of using innovation is able to transfer it to another user on a commercial basis. it is the spread of an already mastered and used innovation in new conditions or places of use. Technology transfer is nothing more than a diffusion of innovation. International technology transfer is a diffusion of innovation when the producer and consumer of innovation are in different countries "[3]. From this definition it becomes clear that for successful implementation of innovation must be tested at least once in a particular business entity, which with its positive experience of using innovation is able to transfer it to another user on a commercial basis. it is the spread of an already mastered and used innovation in new conditions or places of use.

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Almost similar interpretation of diffusion is given by scientist Sungurov A.. Diffusion is “an important part of the innovation process. This is the spread of already mastered and used innovation in new conditions or applications. As a result of diffusion, the number of both producers and consumers increases, and their qualitative characteristics change. The continuity of new processes is determined by the speed and limits of diffusion of innovations in a market economy "[4]. A distinctive feature of this definition is the selection of the result of diffusion and its impact on the qualitative characteristics of business entities.

Thus, innovative diffusion is recommended to be understood as a communication process by which innovations that have already found their positive test in one business entity are transferred on a commercial basis for a certain period for development to other actors or other participants in the social system. operate in other conditions or places.

Summarizing the research, we present the initial data for the development of innovation, which will determine the possibility of innovation to acquire the status of diffusion:

1. the essence of innovation - an idea, practical activity or object that is perceived as something new by an individual or other unit of adaptation;
2. means of communication, means of transmitting messages from one individual to another;
3. time of implementation relative speed with which innovation is adapted by members of the social system;
4. members of the social system are many interconnected units that work together to solve problems to achieve a common goal.

The results of the synergy effect that can be obtained with the help of these elements are able to identify only the real consumers of innovation: companies as users of new technology or ordinary buyers of new products. The process of recognizing innovation is the adaptation of innovation. Finding optimal relationships and interrelationships between diffusion elements is the art of modeling the decision-making process.

It is necessary to distinguish the concept of diffusion, taking into account the result of its implementation: commercial or non-commercial. When it comes to making a profit, it is obvious that innovation diffusion is a mechanism for the development of a technological system based on the adoption of developed and one-time innovations in certain industries by others.

In the absence of a commercialized component, it is necessary to use the term "diffusion of scientific and technical knowledge" as fundamental knowledge. Used when it is impossible to make a profit. It can be the object of industrial espionage or the object of international scientific exchange within various scientific schools.

To clearly understand the conditions for the functioning of innovative diffusion of socio-economic systems, it is necessary to understand the modern regulatory framework governing the conduct of scientific, technical and innovative activities in Ukraine. In Ukraine, a number of laws, Presidential decrees, by-laws in the form of Government resolutions, orders of central executive bodies have been developed and put into effect about 200 documents.

First, the innovation legislation of Ukraine is based on rights, which are covered in the Constitution of Ukraine. Thus, each entity has the right to carry out legal activities, including innovation. Restrictions on business activities, as well as a list of activities in which entrepreneurship is prohibited, are set Constitution and the Civil Code of Ukraine.

Obviously, the development of an innovative product and innovative production is the next way to implement the diffusion of innovations.

Priority innovation project - an innovative project implemented within the priority areas of innovation. We believe that the products of such a project will be easily embodied in the process of diffusion of innovation.

Innovative developments always go hand in hand with scientific and scientific-technical expertise. That is why it is necessary to note the existence of a legal field on this issue, namely the Law of Ukraine "On Scientific and Scientific-Technical Expertise", which is a very important point in the development of innovations.

It is very important in innovation to determine its priority areas. This is regulated by the Law of Ukraine "On priority areas of innovation in Ukraine". Obviously, the areas of innovation are those aimed at ensuring the economic security of the state, creating high-tech competitive environmentally friendly products, providing high quality services and increasing the export potential of the state with effective use of domestic and world scientific and technological achievements. Despite the positive perception of the number and completeness of the presented areas, it is not clear how they will be able to meet the material and intangible needs and interests of people.

When implementing innovations by participants in the social system located in different countries, it is necessary to understand the legal framework that can protect each of the participants in the process of diffusion of innovations. In Ukraine, the Law of Ukraine "On state regulation of activities in the field of technology transfer". The positive point is the existence of Article 5 "International cooperation in the field of technology transfer provides", which provides not only the conclusion of international agreements of Ukraine on scientific, technical and technological cooperation with many countries, but also attracting investment in science and technology of Ukraine.

Ukraine of international standards, technology transfer in the framework of scientific, technical and production cooperation and investment cooperation, ensuring the participation of domestic enterprises, institutions and organizations in international exhibitions and fairs of high-tech products and technologies and participation in the development of domestic segments of international information and communication systems and technology transfer.

The conducted researches of the normative-legal base allow to state that our country has a considerable necessary basis for development of innovations, realization innovative diffusions and formation of forecasting models innovative diffusion. That is why, at this stage, it is advisable to explore existing models.

Regarding the third element of the abstract model "applicability in socio-economic systems, determined by the separation of certain parameters that control the innovative diffusion of socio-economic systems" - the only parameter for different socio-economic systems "may be the parameter" performance ".

Other parameters depend on the specifics of a particular socio-economic system and need to be clarified at the time of transition of innovative diffusion from one system to another. Despite the existing nature of diffusion, it is necessary to clearly understand the models by which it is possible to operate in the management of the diffusion of innovations of socio-economic systems.

E. Rogers' follower is the American marketer Frank Bass with his model "Bass Diffusion Model" [16]. Currently, several models of innovation dissemination are known [17] with the help of which it is possible to forecast innovative diffusions of socio-economic systems by performing forecast calculations in the planning period:

1. Linear model of innovation dissemination.
2. Diffuse model of Rogers' innovation dynamics.
3. Territorial model of innovation dynamics of Hegerstrand.
4. A new model of innovation dynamics.

Consider in more detail the models for predicting innovative diffusions of socio-economic systems. A linear model of the spread of innovation in the organization was proposed by E. Rogers. The main postulate of the presented model is the provision of decision-making on the planned and actual forecasting of innovative diffusion. Therefore, their forecasting, ie the implementation of this model for forecasting innovative diffusions of socio-economic systems directly depends on the level of centralization and formalization of a particular system.

If the decision-making process is carried out at the top level of the management hierarchy, ie we have a situation of concentration or centralization of management at this level, the planned decision to predict innovative diffusion is made very quickly. It is quite difficult to implement the planned measures in fact. This is due to the need to restructure the organizational structure of the enterprise for forecasting, determining coordination and regulation between structural units that perform actual work. Consider the diffuse model of Rogers' innovation dynamics.

Rogers studied the levels of acceptance of various innovations. He found that most of the graphs of innovation acceptance by members of society resemble a standard curve corresponding to the normal distribution, divided into five segments: innovators; early followers; formerly the majority; later the majority; lagging behind. Predicting the reaction of members of society in a particular socio-economic system to innovation diffusion will determine the possibility of influencing the degree of recognition of the latest innovation.

3. Territorial model of innovation dynamics of Hegerstrand.

The central point of this model is the consideration of socio-economic phenomena in rural Sweden as a diffusion process that can be modeled by the Monte Carlo method. The essence of the method is as follows: the process is described by a mathematical model using a generator of random variables, the model is calculated many times, based on the obtained data, the probabilistic characteristics of this process are calculated.

A feature of diffusion mechanisms, according to Hegerstrand, are the intensity and effectiveness of personal contacts. This direction was called by them "geography of time". The results of research showed how much time must be spent in a particular place to solve a problem.

4. A new model of innovation dynamics. This model combines elements of the models of Rogers and Hegerstrand. The results of the model depend on the starting point for predicting and implementing diffusion. Allows you to calculate the optimal strategy for adapting innovative knowledge for specific groups of territorial formations.

We present a SWOT-analysis of the above models for forecasting innovative diffusions of socio-economic systems according to the criteria of "Strengths / Weaknesses and Opportunities / Threats" in tables 1-4.

Table 1

Strengths / Weaknesses and Opportunities / Threats Linear models of innovation dissemination

1. Strengths	2. Weaknesses
1.1 Five generations of linear models of innovation dissemination. 1.2 The presence of an organizational approach to solving the problem. 1.3 Third-fifth generation models have an open network of interactions.	2.1 The first generation of linear models have a theoretical approach to solving the problem 2.2 The second generation of linear models have a practical approach to solving the problem
3. Opportunities	**4. Threats**
3.1 Ability to respond quickly to the model under the influence of public institutions and / or business entities. 3.2 Decisions made in the first and second generation of models are evolutionary	4.1 Lack of ability to find revolutionary solutions in the first and second generation models. 4.2 First and second generation models have a closed (closed) network of interactions. 4.3 Third-fifth generation models have a complex implementation scheme, which can lead to incredibly high costs, both time and financial 4.4 Models of the third-fifth generations contain a complex hierarchy of tasks that can significantly extend their term implementation and will make it impossible to use for the implementation of practical tasks

Table 2

Strengths / Weaknesses and Opportunities / Threats Rogers' Diffuse Model of Innovation Dynamics

1. Strengths	2. Weaknesses
1.1 Description of both network and continuous process of innovation dissemination. 1.2 The possibility of rapid adaptation of the model by all interested participants in the social system. 1.3 Investigates the process of transferring innovative knowledge from innovator to consumer	2.1 The model does not describe the process of innovation transition from one contact group to another, does not decipher the complexity of barriers to interaction between them 2.2 Delayed transfer of information between contact groups
3. Opportunities	**4. Threats**
3.1 Possibility of quick adaptation within contact groups	4.1 A significant number of unknown variables, which complicates decision-making processes and affects the correctness of the calculation of the final result of the innovation. 4.2 The quality of the contact group affects the effectiveness of innovation

Table 3

Strengths / Weaknesses and Opportunities / Threats of the Hegerstrand Territorial Model of Innovation Dynamics

1. Strengths	2. Weaknesses
1.1 The process of dissemination of innovation is carried out both vertically and horizontally. 1.2 Use of parametric data in models	2.1 Different rate of diffusion of indicators, due to the decisions of the contact group 2.2 The distance between contact groups affects the quality of decisions made
3. Opportunities	**4. Threats**
3.1 Effective use of innovations for contact groups within a close territorial location	4.1 Insufficient completeness of data can affect the quality of final decisions

Table 4

Strengths / Weaknesses and Opportunities / Threats of the New Model of Innovation Dynamics

1. Strengths	2. Weaknesses
1.1 The speed of innovation can be influenced by the development of both social and spatial network of relations. 1.2 The process of diffusion of innovations is a multilevel system. 1.3 The model allows to calculate the optimal strategy of adaptation of innovative knowledge for a specific group of territorial entities.	2.1 Insufficient funding for innovation slows down the spread of innovation. 2.2 Different rate of propagation in different contact groups
3. Opportunities	**4. Threats**
3.1 Takes into account the shortcomings of linear and diffuse models 3.2 The process of spatial dissemination of innovations can take place within a hierarchical system (from larger entities to smaller ones). 3.3 The process of spatial dissemination of innovations can range from large cities to small ones.	4.1 Impossibility to predict the revolutionary nature of the innovation process 4.2 Dependence on the innovation potential of the territory 4.3 Influence of communication possibilities of the information field on the speed of communications between territorial contact groups.

We will take into account the conclusions made in the study and present the results of the application of models of mathematical programming in strategic planning.

The concept of the effectiveness of management decisions on innovative diffusions of socio-economic systems to some extent coincides with the concept of efficiency of production activities of the organization. The effectiveness of management decisions - is the resource effectiveness obtained after the preparation or implementation of management decisions in the organization. Resources can be finances, materials, personnel, labor organization, etc.

The process of socio-economic development is a consequence of the emergence and diffusion of innovations. Innovation is understood as new, relatively stable elements of social, economic, political and other nature. Examples of innovations are technological improvements, new sources of raw materials and energy, new materials, goods, services, "new ideas", etc.

One of the current problems of enterprise management is the problem of decision-making on the choice of production strategy. Each manufacturer seeks to develop such an innovative production strategy, in which no matter how the external and internal conditions of management change, the company would receive the optimal profit. In this case, it is proposed to develop a risk-free strategy for production in conditions of risk and uncertainty. Economic and mathematical methods of modeling play a special role in improving the efficiency of production management.

Mathematical modeling has long been a necessary management tool. In this regard, there are economic and mathematical models of different levels. For example, there are top-level models (macroeconomic models), the next step is territorial or sectoral models. Next are models of associations and models of enterprises. And then there are models of existing elements of enterprises. Levels of economic - mathematical models are presented in Figure 2.

Thus, to classify economic and mathematical models according to a very large number of both individual and mixed criteria. With the development of methods of economic and mathematical modeling, the problem of classification of applied models is constantly becoming more complicated.

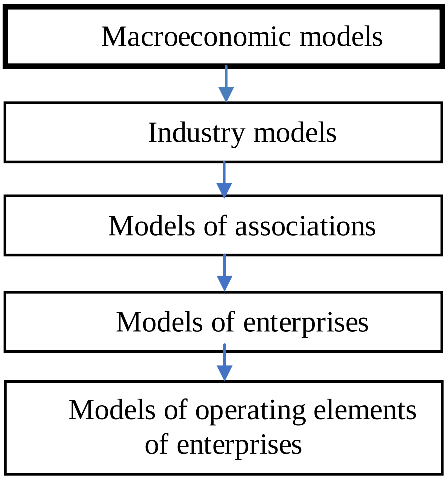

Figure 2: Levels of economic and mathematical models

Along with the emergence of new types of models (especially mixed types) and new features of their classifications, the process of integration of models of different types into more complex model structures. The same type of models can be applied to different socio-economic systems. At the same time, the same system can be studied using models of different classes and types.

This fact raises the question of the quality of models and simulations. From the point of view of optimal planning, the most effective are the models of optimal programming, which allow the most complete use of information technology and consider several options for solving the problem at the same time. The model of strategic planning includes many components that have slightly different purposes. Planning is based on information about economic activity. Economic activity is described by several models, including accounting models of basic accounting objects.

The purpose of production process models is to accumulate operational information useful for the current operation of production, sales or other divisions of the enterprise, as well as to collect and summarize data for further use in current and future planning models. The problem of choosing management decisions in terms of different awareness of the state of the environment, ie a set of external factors that affect the functioning of the organization, is to address the following two issues: choice of decision criteria; defining a functioning strategy that ensures the best implementation of the selected criterion.

Depending on the degree of awareness of the state of the environment, there are the following conditions for decision-making: certainty, when the state of the environment is strictly established (determined), i.e. the probability of this state is almost equal to one; risk, when the (known) distribution of probabilities of possible states of the environment is given; uncertainty, i.e. the distribution of probabilities of environmental conditions is unknown.

The problem of choosing from a possible "portfolio of orders" the most profitable in certain conditions is to solve the problem of decision-making in terms of certainty.

In the process of optimal planning, a system of interrelated indicators is formed, which allow to make the most correct decision from the possible options.

To make the optimal solution of any economic problem, it is necessary to build its economic and mathematical model, the structure includes a system of constraints, the objective function, the criterion of optimality and the solution (optimal plan). Models of mathematical programming allow to write down the problem of optimal control, i.e. it is necessary to find non-negative values of output volumes xj≥0, j∈{$\overline{1,n}$ }, which give the maximum of the objective function.

The formulated problem is equivalent to the linear programming problem (LLP):

$$\max_{\bar{x}} \bar{k} \cdot \bar{x};$$
$$A \cdot \bar{x} \leq \bar{b}; \tag{1}$$
$$\bar{x} \geq 0,$$

where$\bar{x}$ = (x1,…, xn) - vector of output;

$\bar{k}$ = (k1, ..., kn) - vector of coefficients of the objective function,

$A_i = \begin{pmatrix} t_1,\dots,t_n \\ S_{i1},\dots,S_{in} \end{pmatrix}$ - matrix of technical and economic coefficients that characterize the production of products j ∈ {$\overline{1,n}$ };

$\bar{b}$ = (b1, b2) - vector of constraint constants.

Given the complete certainty of the i-th state of the environment, the optimal release program $\bar{x}^{(i)} = (x_1^{(i)},\dots,x_n^{(i)})$ is determined by solving the problem of linear programming (ZLP).

$$\max_{x} \bar{k}_i \bar{X};\ \ A_i \bar{X} \leq \bar{b}_i;\ \ \bar{X} \geq 0;\ \ \forall_i \in \{1,2\},$$

The given linear programming problem, which has only two limitations, can be solved by the graph-analytical method using a dual problem, the algorithm of which is as follows:

1. The objective function of the dual problem is formed as a scalar product of the vector of constraint constants $\bar{b}_j$ initial (direct) problem and vector of new variables $\bar{y} = y_1, y_2$, the dimension of which corresponds to the number of constraints of the direct problem:

$$G_i(\bar{y}) = \bar{b}_i \bar{y}. \tag{2}$$

2. The criterion of optimality is set diametrically opposite to the criterion of the direct problem $\min_{\bar{y}} \bar{b}_i \bar{y}$.

3. The system of constraints of the dual problem is obtained as follows: a given matrix A_i multiply to the left by the vector of new variables $\bar{y}$as a vector of constraint constants we take the vector of coefficients $\bar{k}_i$ of the objective function of the direct problem, and the sign of the inequality is changed to the opposite: $\bar{y}A_i \geq \bar{k}_i$.

The obtained dual linear programming problem

$\min_{\bar{y}} \bar{b}_i \bar{y}; \bar{y}A_i \geq \bar{k}_i;$

$\bar{y} \geq 0;\ \ \forall i \in \{1,2\},$

which can be given in the following expanded form:

$\min_{\bar{y}} (b_1 y_1 + b_{i2} y_2);$

$t_j y_1 + S_{ij} y_2 \geq k_{ij}, \qquad j = \overline{1,n};$

$y_1 \geq 0;\ \ y_2 \geq 0;\ \ \forall i \in \{1,2\},$

solve by graph-analytical method.

It is known that the solution of any linear programming problem, if it exists, is always obtained at least in one of the vertices of the range of admissible values. So, the solution$\bar{y}^{(i)} = y_1^{(i)}, y_2^{(i)};\ \forall i \in \{1,2\}$ of the considered dual linear programming problem will be obtained at least in one of the vertices of the boundary of the domain of admissible values of the vector $\bar{y} = y_1, y_2$ with coordinates $(y_1^{(k)}, y_2^{(k)})$, where $k \in \{A, B, C, D\}$.

Next, calculate the value of the objective function of the dual problem:

$$G_i(\bar{y}) = b_i y_i + b_{i2} y_2.$$

At the points of the boundary of the range of permissible values

$$G_i(\bar{y}^{(k)}) = b_1 y_1^{(k)} + b_{i2} y_2^{(k)}$$

according to the set criterion of optimality we choose the minimum:

$$\min_{k} \{G_i(\bar{y}^{(k)})\}.$$

Coordinates of points

$$y_1^{(i)} = y_1^{(k)};\ \ y_2^{(i)} = y_2^{(k)},$$

in which the objective function

$$G_i(y) = b_1 y_1 + b_{i2} y_2$$

acquires the least value

$$\min_k \{b_1 y_1^{(k)} + b_{i2} y_2^{(k)}\},$$

will be the desired solution to the formulated dual problem of linear programming.

To verify the correctness of the solution found, we can use the following duality theorem: let the vector $\bar{x}^{(i)} = (x_1^{(i)}, \dots, x_n^{(i)})$ is the solution of the linear programming problem if and only if such an admissible vector exists $\bar{y}^{(i)} = (y_1^{(i)}, y_2^{(i)})$ dual problem, that the values of the objective functions of both problems on these vectors are equal to each other.

At each i-th price level $\overline{Ц}_i = (Ц_{i1}, \dots, Ц_{i2}, C_{Mi}, d_i),\ i \in \{1,2\}$, solving the problem of linear programming

$\max_x \bar{k}_i \bar{x};\quad A_i \bar{x} \le \bar{b}_i;\quad \bar{x} \ge 0,$

it is possible to receive the corresponding optimum programs of release of products

$$\bar{x}^{(i)} = (x_1^{(i)}, \dots, x_n^{(i)}),\ i \in \{1,2\},$$

providing for each i-th state of the environment the maximum profits, which correspond to the two optimal strategies for production:

$\bar{x}^{(1)} = (x_1^{(1)}, \dots, x_n^{(1)});$

$\bar{x}^{(2)} = (x_1^{(2)}, \dots, x_n^{(2)}).$

It is necessary to determine the optimal strategy for production

$\bar{x}^{(*)} = (x_1^{(*)}, \dots, x_n^{(*)}),$

which provides the maximum guaranteed profit in conditions of uncertainty of the external environment. This problem can be solved using the theory of possible (strategic) games, for which it is necessary to make a matrix of possible profits

$$P = (P_{ki})_{\substack{k=1,2,\\ i=1,2,}}$$

which is shown in the form of table 1.

Table 5

Matrix of possible profits

Release program k	Price level i	
	$Ц_1$	$Ц_2$
$\bar{x}^{(1)}$	P_{11}	P_{12}
$\bar{x}^{(2)}$	P_{21}	P_{22}

It is necessary to find such a partial allocation of resources $0 \le p_i \le 1 (i = 1,2)$ between pure production strategies $\bar{x}^{(i)} (i = 1, 2)$, at which regardless of the possible price level $Ц \in \{Ц_1, Ц_2\}$ the guaranteed profit will be maximum. If we assume that the company's profits are proportional to the volume of production, and those, in turn, are proportional to the allocated resources, then to solve this problem should use a matrix game, i.e., to determine the price of the game (γ) and the optimal strategy that provides it:

$$\bar{X}^* = \rho_1 \bar{x}^{(1)} + \rho_2 \bar{x}^{(2)}, \tag{3}$$

where

$$p_1 + p_2 = 1.$$

To solve this problem it is necessary to determine the bottom (α) and top (β) game price limits:

$$\alpha = \max_i \min_j P_{ij};$$
$$\beta = \min_i \max_j P_{ij}.$$

In the case of equality of the lower and upper limits of the price of the game, which corresponds to the presence of a saddle point in the considered matrix game, the price of the game (γ) - guaranteed maximum result - is determined by one of the pure strategies $\bar{x}^{(i)} \in \{\bar{x}^{(1)}, \ \bar{x}^{(2)}\}$, which allows you to get the maximum result in the worst possible cases:

$$\gamma = \max_i \min_j P_{ij}$$

With $\bar{x}^* = \rho_i \bar{x}^{(i)}$, $\sum_{i=1}^{2} \rho_i = 1$.

If the lower and upper limits of the game price are not equal to each other $(\alpha < \beta)$, then to obtain the maximum guaranteed result, the ratios must be met

$$\rho_1 P_{11} + \rho_2 P_{21} = \gamma, \quad \rho_1 P_{21} + \rho_2 P_{22} = \gamma, \quad p_1 + p_2 = 1,$$

which are a system of three linear equations with three unknowns ρ1, ρ2, γ. The solution is found $0 \le \rho_i \le 1, i = 1,2$ interpreted as a partial distribution of production resources between the optimal net production strategies $\bar{x}^{(i)}$, $i = 1,2$, which determines the mixed strategy of production:

$$\bar{x}^* = \rho_1 \bar{x}^{(1)} + \rho_2 \bar{x}^{(2)} \text{ in volumes } \bar{x}_j^* = \textstyle\sum_i^2 p_i x_j^{(i)}; \ j = \overline{1, n},$$

which guarantee a profit of

$$\gamma = \rho_1 P_{11} + \rho_2 P_{21} = \rho_1 P_{21} + \rho_2 P_{22} \qquad (4)$$

regardless of the state of the environment.

Thus, we obtain a risk-free production strategy

$$\bar{x}_1^* = p_1 x_1^{(1)} + p_2 x_1^{(2)};$$
$$\bar{x}_2^* = p_1 x_2^{(1)} + p_2 x_2^{(2)};$$
$$\dots \quad \dots \quad \dots \quad \dots$$
$$\bar{x}_n^* = p_1 x_n^{(1)} + p_2 x_n^{(2)},$$

which provides the greatest guaranteed profit in the conditions of uncertainty of the prices for resources and finished goods.

The model of planning the activity of the enterprise as an open technical and economic system in conditions of risk and uncertainty generated by market relations is presented, which will help in making decisions to the head of any enterprise, as the efficiency of management decisions is resource efficiency obtained after development and implementation of management decisions.

The introduction of economic and mathematical modeling in the activities of the enterprise is associated with the need to streamline and appropriate processing of large arrays of source information. In addition, the construction of models and calculation based on them of different forecast options looks quite time-consuming from a technical point of view, the procedure.

Modern computer technologies for collecting and processing information in combination with appropriate software allow you to automate the technical side of economic and mathematical modeling and forecasting of economic processes. With the development of computer technology in the practice of economic activity of enterprises are increasingly used a variety of ready-made computer models, which are designed to solve various problems of an applied nature. This simulation is called computer simulation.

Thus, the quality of management decisions is one of the main factors of efficiency of enterprises and depends on a large number of subjective and objective factors that require the development of methods of preparation and management decisions in a market economy, as this problem is very complex and multifaceted. since it is not always possible to accurately assess the results of a decision, there is often a large gap between decision-making processes and the ability to analyze their effectiveness.

4. Research findings and conclusions

Thus, the article presents the conceptual foundations of modelling the decision-making process in the management of projects of innovation diffusion of socio-economic systems, which is embodied in the form of a meaningful abstract model with a certain structure of interrelated concepts, allocation of properties of its elements and links between them, which are important for achieving the goal of modelling.

The article considers models of management of projects of dissemination of innovations, with the help of which it is possible to forecast innovative diffusions of socio-economic systems by performing forecast calculations in the planning period. A SWOT-analysis of the presented models for forecasting innovative diffusions of socio-economic systems by the criteria of "Strengths/Weaknesses and Opportunities/Threats" has been carried out. A model of a risk-free production strategy for decision-making at an enterprise has been developed. With proper management, the developed model can become an innovative diffusion of other socio-economic systems, which will be the focus of our further research.

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