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METHODOLOGICAL BASIS OF ECONOMIC EVALUATION OF INTERACTION SYSTEMS IN INNOVATIVE PROCESSES

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Purpose. The article is devoted to the problem of forming a methodological basis for conducting an economic evaluation of interaction in innovation processes.

Design/methodology/approach. Semantic analysis, comparative analysis and systematization method were used to conduct the methodological substantiation of the economic evaluation base; the method of grouping, structural-logical modeling has been used in the development of indicators for evaluating the interaction processes. An abstract-logical method has been used to formulate conclusions and theoretical generalization of the results of the conducted study.

Findings. The research of many Ukrainian and foreign scientists is devoted to the definition of problems of evaluation of innovative activity indicators, indicators of innovative activity development and establishment of joint activity processes in innovative processes, and the requirements for evaluation of innovative activity are regulated in regulatory documents.

The aim of economic evaluation of the interaction system in innovative processes is a comprehensive analysis of the effectiveness of the interaction system and its impact on the most important indicators of innovative development of a region, determination of expediency and optimal variants of interaction system formation, prompt adjustment of parameters of interaction processes and ensuring development of interaction systems in the region.

The main tasks of economic evaluation of interaction systems in the innovative processes of the region are: identification, analysis and evaluation of risk factors for joint implementation of the innovative processes in the innovative environment of the region; identifying opportunities and threats to the environment; determination of probabilities of conflict of interests of participants of the interaction system and their preventive elimination; evaluation of indicators of results and efficiency of participation in the interaction system.

It has been substantiated that economic evaluation of interaction systems in innovative processes of the region requires five consecutive stages: setting evaluation goals in accordance with the goals of interaction system formation, developing a system of criteria and indicators for control (standards), coordination of evaluation criteria and bringing them to the participants, evaluation of the functioning of interaction systems in accordance with the defined criteria and indicators, comparison of performance with standards and development, if necessary, of corrective measures.

Subjects of economic evaluation of interaction systems in innovative processes should be direct participants of the innovative process, indirect participants of the innovative process, mediate participants, each of which is characterized by its own goals and tasks for evaluating the interaction system.

Practical implications. The developed evaluation base should be used in the general concept of innovation evaluation. Quantitative indicators of evaluation of the interaction system are the efficiency and results of the innovative process (stage); qualitative indicators include the usefulness of interaction, the cost of interaction, the value of interaction.

Originality/value. Based on the study of methodological provisions for the evaluation of innovative processes in scientific publications and forms of statistical reporting, the main components of the methodological basis of economic evaluation of interaction systems in innovative processes of the region have been revealed. Components of the methodological basis of evaluation of interaction processes include: evaluation principles, evaluation functions, subjects and objects, evaluation stages. The aim and main tasks of economic evaluation of the interaction system in the innovative processes of the region have been substantiated.

Developed methodological basis should be used to form a methodological approach to economic evaluation of interaction systems in innovative processes of the region, which should include monitoring of the processes of establishment, implementation and execution of joint activities of participants in the innovative process of the region by substantiated directions and indicators.

Key words: evaluation; objects; indicators; innovation; interaction; innovative process.

Paper type: Research paper.

Formulation of the problem

The problem of evaluation in innovative processes becomes especially important in modern conditions in connection with the development of models of open innovations, based on the priority of interaction development. The establishment and development of various forms of interaction between market stakeholders remains an important issue for the national economy.

According to the World Bank, the local private sector in Ukraine is neither a leading technology supplier, nor a source of demand for the results of innovative processes. They do not conduct activities that would create demand for R&D from universities [1].

Analysis of the statistics also testifies to this fact. In particular, in the *domestic market* in 2020 compared to 2019 there was a decrease in the number of technologies transferred to the business environment of Ukraine (by 19.2 %), while the amount received from the transfer of funds increased (by 16.1 %), the share in total volumes (by 3.3 percentage points) and the average cost of one technology (by 43.6 %). In the *foreign* market the following indicators have decreased: the number of transferred technologies (by 12 units or 21.2 %), the amount received from the transfer of funds (by 3.7 times), the share in total volumes (by 3.3 percentage points) and the average the cost of one technology (by 2.9 times), which indicates a slowdown in technology transfer due to high competition in foreign markets, which led to a significant reduction in revenue with a slight reduction in transferred technologies [2].

Among the answers to the question of what Ukrainian business representatives do not have enough of to invest money in Ukrainian R&D, respondents most often mentioned such factor as the lack of information about Ukrainian R&D. Respondents also focused on the incomprehensibility of R&D communication channels in the field of interest, unclear final cost of solutions, the need for implementation time, market research on the demand for innovative ideas of the company, proper R&D quality, the current level of R&D – these are prototypes and ready-made solutions and high value products are needed [3].

The factors mentioned by the representatives of the business environment are due to the low level of establishment of various forms of integration between different market participants during all stages of the innovative process. Adequate and timely monitoring of the processes and results of innovation development is the key to their effectiveness and to innovative development in the country as a whole.

Analysis of recent researches and publications

Given the importance of the outlined problem for the formation of the mechanism of interaction, identification of problems of evaluation of innovative activity indicators, indicators of innovative activity development and joint activities in innovative processes, many Ukrainian and foreign scientists have devoted their research to the topic, and the requirements for the evaluation of innovation are regulated in regulatory documents.

Thus, the evaluation of innovative processes can be carried out through a certain system of indicators in the forms of statistical reporting.

The following groups of indicators that describe some aspects of the implementation of the innovative process are outlined: "statistics of scientific and scientific-technical activities; patent statistics; bibliometric data on scientific publications; technological balance of payments, which characterizes the international transfer of technology" [4, p. 101].

The Ukrainian analogue of monitoring the innovative activity of enterprises of different types of activity is the observation by the form No. 1-NN – survey of innovative activity of the organization (enterprise) for the relevant two-year period. The survey program provides quantitative and qualitative data on innovation activity of enterprises in 11 main sections and is similar to the relevant European monitoring [5].

The implementation of public-private partnership, which is actively pursued in the innovative processes in Ukraine requires constant monitoring of the effectiveness of implementation and improvement of the existing Methodology for evaluating effectiveness [6] in connection with reviewing the challenges of globalization society and the development of knowledge economy practice.

Innovation monitoring in accordance with the requirements of the standard "Oslo Guide" is proposed in two aspects: narrowed and expanded formats. In a narrow format, innovation monitoring involves tracking the progress and results of a particular innovation project. In an expanded format, monitoring covers the tracking of "all areas, types or areas of scientific, technical and innovative activities, state innovation policy, the state of development of innovation structures (research centers, innovation firms, technology parks, etc.). Such monitoring is carried out at the level of the country as a whole, particular region, production or type of economic activity in accordance with the Classification of Types of Economic Activities "CTEA" (Ukrainian KVED/КВЕД)" [7].

However, according to domestic scientists, most indicators of macroeconomic assessment of the innovation process of industrial enterprises are mostly quantitative and almost do not correlate with cost indicators, allow analysis and evaluation of only one of the manifestations of innovation and development – innovative activity.

Examining the work of leading scientists on this vector, it should be noted that H. I. Lazutin identifies groups of indicators that describe some aspects of innovation [4, p. 103]; P. H. Pererva notes the need to develop scientific and methodological foundations for the creation and operation of a system for monitoring the innovation of industrial enterprises based on the use of indicators of innovation potential, a comprehensive solution to multi-source resource supply of innovative activity [8, p. 110]; I. Fiegenbaum, D. Podmetina, R. Teplov, E. Albats investigate the system of evaluation of the effectiveness of the interaction system through the use of the approach to the evaluation of open innovations [9, p. 90]; V. A. Morozov determines the effectiveness of the interaction process of different types of economies that make up the national economy [10, p. 7]; M. Dziallas, K. Blind have studied a set of indicators and factors during the implementation of the innovative process in research for 35 years at the national level and industry level [11, p. 12]; S. A. Romanyuk notes the need to develop procedures for coordination of programming and implementation of development policy, thus laying the foundations of multilevel governance, when subsidiarity in the definition of tasks on development issues is implemented [12, p. 11].

Generalizing the work, it can be stated that the most developed are the approaches to assessing the indicators of innovative activity and innovation as a result of innovative activity. It should also be noted that modern research focuses on the problems of determining the interaction indicators in the chain "developer – manufacturer – investor" [13, 14], sometimes involving consumers or the university, another

limitation of existing methodological approaches is the exclusive focus of evaluation of investment or economic indicators [15]. However, the issues of determining the indicators of interaction systems in the innovative processes of the region remain poorly studied, which does not ensure the proper quality of management and establishment of various forms of joint activities at the regional level.

Instead, the researched scientific sources do not have methodological provisions for assessing the state and development of interaction processes in innovative processes, and existing developments do not take into account the impact and importance of taking into account factors and processes of partnership to ensure efficiency and results of innovative processes.

Hypothesis formulation and goal setting

The hypothesis of the study is the statement that the processes of evaluation of interaction in innovation processes are partial processes of integrated evaluation of innovations. The purpose of the research is to develop methodological basis of economic evaluation of interaction systems in innovative processes. To achieve this purpose, it is necessary to identify and substantiate the subjects and objects of economic evaluation, to develop a system of indicators.

Research methodology

The fundamental concepts of the theory and methodology of innovation, general scientific methods, methodological approaches of theoretical innovation and strategic management have been used as the methodological basis of the presented work. The authors have carried out the study with the involvement of general and special principles and techniques of scientific knowledge in the field of strategic management of innovative development.

Semantic analysis, comparative analysis and systematization method were used to conduct the methodological substantiation of the economic evaluation base; the method of grouping, structural-logical modeling has been used in the development of indicators for evaluating the interaction processes. An abstract-logical method has been used to formulate conclusions and theoretical generalization of the results of the conducted study.

The use of this methodology is consistent with the requirements of **jel classification codes** for scientific and economic research.

The described methods have allowed to study the theoretical and applied principles of innovative development of regions, therefore they are consistent with the block O: Economic Development, Innovation, Technological Change, and Growth, O1: Economic Development, in the category O12: Microeconomic Analyses of Economic Development.

The proposed provisions and approaches are based on the study and generalization of fundamental principles of theory and practice of conducting of innovative processes, therefore the selected methods provide block O3: Innovation, Research and Development, Technological Change, Intellectual Property Rights, namely O31: **Innovation and Invention: Processes and Incentives**.

Substantiation of approaches and formulation of research conclusions has been performed by a set of methods in block D: Microeconomics, namely substantiation of management decisions on joint innovative actitivity D7: Analysis of Collective Decision-Making, D70: General.

Identifying and systematizing the factors of interaction in innovative processes allows business entities to ensure the use of development potential, so the methods used belong to block D2: Production and Organizations, D25: Intertemporal Firm Choice: Investment, Capacity, and Financing.

Main part

The task of the methodological basis of economic evaluation of interaction systems is the formation of elements that allow to determine the complex characteristics of:

- the results obtained on the basis of joint implementation of the stages of the innovative process,
- process parameters that provide the established results.

Mandatory elements of the methodological basis of economic evaluation of interaction systems in innovative processes are:

– aim of evaluation;

– evaluation tasks;

– subjects of evaluation;

– objects of evaluation.

It is expedient to clarify the place of processes of complex evaluation of interaction systems in innovative processes in the general system of innovation evaluation (Fig. 1).

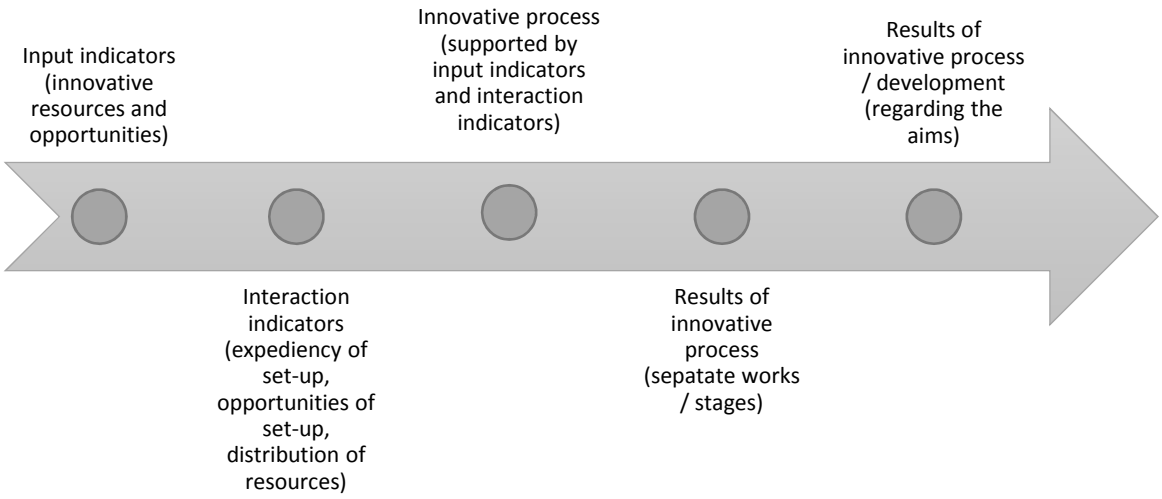

*Fig. 1. The place of indicators of interaction evaluation in the logical model of innovation evaluation**

** Developed by the authors with usage [16, p. 233].*

Traditionally, according to the results of research analysis, the aim of evaluating innovation is "complex analysis of the effectiveness of innovative activity, determining the feasibility and optimal ways of implementation of innovations, prompt adjustment of parameters of innovation projects and support of strategic innovation decisions" [17, p. 152].

The need to evaluate interaction systems in innovative processes is due to the following tasks: the need to monitor the implementation of particular works of the innovation process, performed jointly by participants or separately, achieving coherence and synchronization of efforts of participants in the innovation process; achieving coherence and synchronization of joint activities management; identification of contradictory tendencies and contradictions in joint activity; conducting a comparative analysis of indicators in space, spheres and time; constant monitoring of changes for active adaptation; providing a control system in connection with the ever-increasing complexity of the innovation process; ensuring the preservation of the property of the participant of the interaction system, efficient use of resources, compliance with regulatory (planned) indicators (cost, time, etc.) of the interaction; study of stimulators and distimulators of innovation development in the regional market.

Subjects of economic evaluation of interaction systems in innovative processes should be potential and actual participants, direct participants of the innovative process (employees of enterprises and associations, individual developers (scientists), indirect participants of the innovative process (collective and collegial bodies or individual participants in the innovative infrastructure), mediate participants (regional, departmental bodies, public organizations). All of these entities define the goals and objectives of the evaluation of interaction indicators.

The result of the study was the selection of the following objects of economic evaluation of interaction systems in innovative processes (Fig. 2):

- innovations;
- innovative process;
- interaction process.

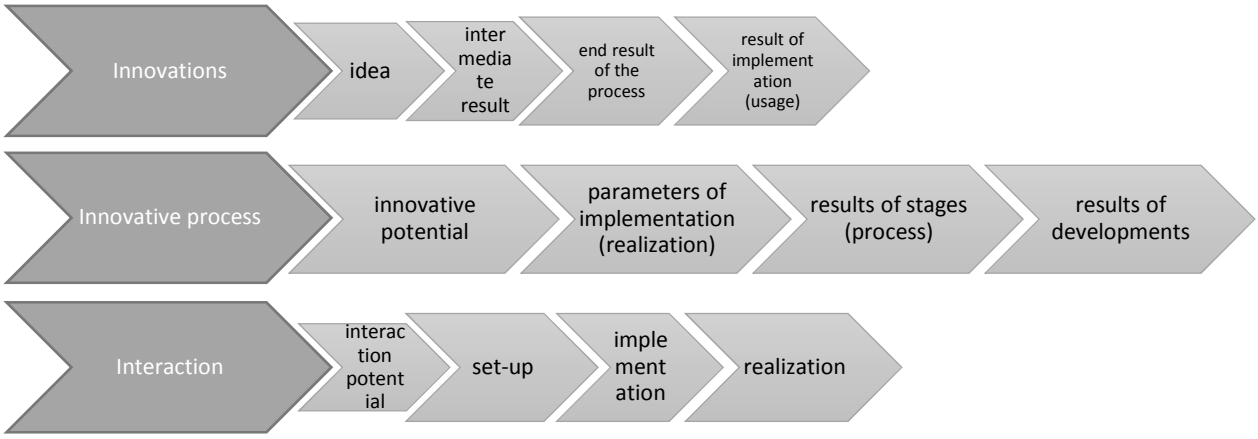

*Fig. 2. Objects of economic evaluation of interaction systems in innovative processes**

** Developed by the authors.*

The selected three evaluation objects are closely related, denote individual planes and determine the overall result of the evaluation of interaction systems in innovative processes.

Innovation as an object of evaluation can be defined on the levels of: a new idea (new knowledge), an intermediate result obtained after the innovation process, the end result of the innovation process in the form of a planned type of innovation or the result of implementation in practice on the market. Thus, we can generalize that the aim of evaluating innovation as a result of the innovative process is to measure by such indicators as: determining the level of novelty; expected areas of application and use of innovations; expected indicators of value for the consumer; level of new knowledge.

The innovation process can be assessed by a system of indicators of an innovation project or innovation program. According to the structuring of the innovative process, systems of indicators used to evaluate innovation projects can be identified [15, p. 118]. Indicators of evaluation of the innovation process should be considered separately for the current and final evaluation, so they should have different conditions and parameters of optimality.

It is also necessary to single out such an area of evaluation as the innovative potential of the participants in the process. The level of sufficiency of innovation potential is the initial indicator of substantiation for participation in the innovative process for each participant.

Indicators of the level of innovative development are generalizing complex indicators of economic evaluation, which determine the degree of achievement of planned goals and the level of competitiveness of the territory and its subjects.

The processes of interaction, as an object of economic evaluation, should involve the separation of the following three components (Fig. 3):

- set-up processes;
- implementation processes;
- realization processes.

The potential of interaction in this study is understood as a set of resources and conditions of the external and internal environment of the subjects, which determine the ability to integrate efforts in the innovative process.

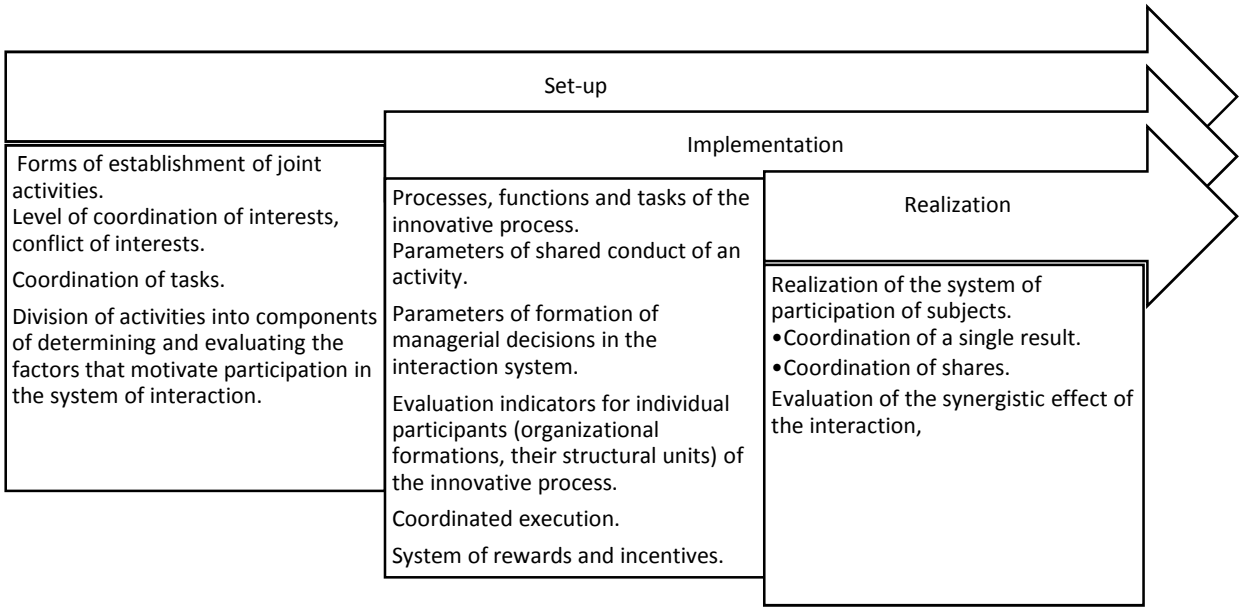

*Fig. 3. Interaction as an object of economic evaluation**

** Developed by the authors.*

To form the conceptual foundations of economic evaluation of interaction systems, the model of innovation logic is described in Fig. 1, is the basis for building a methodological basis for measuring the parameters of the interaction system. Measurements can reflect evidence of events, conditions, and behaviors that can be viewed as elements of an overall sequence of establishing and implementing interactions.

Critical analysis of the considered methodological approaches to the evaluation of innovative activity indicators and indicators of interaction in innovative processes became the basis for the development of conceptual foundations for economic evaluation of interaction systems (Table 1).

Table 1

Methodical basis of economic evaluation of interaction systems in innovative processes*

<table>
<tr><td rowspan="2">Principles</td><td colspan="5">Conceptual approaches</td></tr>
<tr><td colspan="3">Efficiency</td><td colspan="2">Results</td></tr>
<tr><td rowspan="2">Tasks</td><td colspan="5">Evaluation levels</td></tr>
<tr><td colspan="2">National</td><td colspan="2">Regional</td><td>Subject of the innovative process</td></tr>
<tr><td rowspan="3">Functions</td><td colspan="5">Evaluation objects</td></tr>
<tr><td>Set-up. Implementation of the innovative process</td><td>Execution of the innovative process</td><td>Interaction</td><td>Result of the innovative process</td><td>Result of the innovative development</td></tr>
<tr><td colspan="5">Evaluation methods</td></tr>
<tr><td colspan="3">dynamic</td><td colspan="2">static</td></tr>
</table>

** Developed by the authors.*

The methodological basis covers two levels of measurement: efficiency and results. It is obvious that the result indicators of the innovative process characterize the state of the process in a certain plane, but do not reflect the level and therefore have a different content than the efficiency indicators. Indicators of efficiency allow to determine "the qualitative degree of achieving the effect in the process of implementing innovative measures in accordance with the calculated quantitative indicators of the innovative process" [5].

Result indicator, without taking into account efficiency can lead to unreasonable decisions, because "any activity has a result that may not necessarily be positive" [20, p. 89]. Interaction is based on the implementation of actions that are agreed in time and space between the participants. Unity and coherence of interests, unity of goals of all participants, absence of conflicts of interest and regulation of interaction of participants are parameters of growth of efficiency of functioning of interaction system.

"The effect of relations can be characterized by the degree of rational uniformity (repeatability of actions), which reflects the order in the system of interaction. Factors such as the degree of coordination, flexibility and stability, heterogeneity and maneuverability, innovation and variability and some others determine the effectiveness of the interaction process of different types of economies that make up the national economy" [10, p. 89].

The formation of a system of indicators of interaction efficiency should be based on the model of open innovation, which involves the selection of indicators such as "volume of external knowledge involved, volume of technologies involved, indicators of breadth and depth of external information sources of innovative process, indicators of cooperation intensity in innovations" [9].

Based on the generalization of the above provisions of economic evaluation, we have formed thematic directions (Table 2), which should be considered to improve the accuracy and objectivity of innovation monitoring.

Table 2

Thematic directions of evaluation of innovations in the model of open innovations

Direction	Indicators
Efficiency of innovative process	Number of enterprises that have introduced product (technological) innovations. Number of enterprises that introduced new (improving) innovations. Number of new types of products. Number of new technological processes
Results of innovative process	Number of enterprises engaged in innovative activities. Cost of innovation. Number of innovative projects/programs
Innovative potential	The share of firms that use advanced, favorable or latest technologies. The share of firms employing highly qualified personnel, by level of education or by field of education
Interaction potential	The share of firms that have cooperated with other parties in innovative activities (by type of partner or location of partner). The share of firms indicating this type of partner as the most important. The share of firms engaged in initial licensing activities. The share of firms that have a contract to develop products or business processes for other firms or organizations. The share of firms that have discovered useful knowledge about innovations in products or business processes of other firms or organizations. The share of firms engaged in specific activities for the exchange of knowledge with HEE or PRI public research institutions. The share of firms reporting barriers to interaction with other parties in production or knowledge sharing
Interaction indicators	The share of enterprises which sell innovations to specific groups (other enterprises, the state). The share of firms selling products on international markets. The share of firms that received regional support for the development or use of innovations (by type of support). The share of firms reporting about selected positions as barriers (drivers) to innovation
Innovations as a result of innova-tive process	The share of turnover from product innovations and innovations in the market Number of new products (processes, services, products)
Economic and social results of innovative development	The level of competitiveness of activities (products). Sales market share. Customer loyalty. Business reputation

Note: formed by the author using [16, p. 224].

The system of indicators for evaluating the interaction system must meet the requirements of relevance, accuracy, reliability, timeliness, consistency and accessibility, so the interaction can be described by indicators of evaluation of the process of establishing joint activities or indicators of agreement on joint activities. To be useful, evaluation indicators must have several quality characteristics. In particular, as scientists point out [16, p. 217], "accurate, reliable and accessible indicators will be of limited value if delays in timeliness mean that they are not taken into account in policy discussions or decisions". Thus, the aim of economic evaluation of interaction systems in innovative processes in the region should be a comprehensive analysis of the effectiveness of the interaction system and its impact on key indicators of innovative development in the region, determining the feasibility and optimal options for the formation of interaction system, prompt adjustment of the parameters of interaction processes and ensuring the development of interaction systems in the region.

Conclusions

Indicators of development of the innovative process are now determined by indicators of the level of development of interaction, partnership, exchange of various objects (resources) for the implementation of the innovative process.

The hypothesis of the study is confirmed.

Adequate evaluation of indicators of cooperation will contribute to the formation of mechanisms for managing the innovative development of the region on the basis of methodological soundness.

The process of economic evaluation of interaction systems in innovative processes requires compliance with the dialectical unity of five successive stages:

1. Setting evaluation goals in accordance with the goals of forming a system of interaction.
2. Development of a system of criteria and indicators for control (standards).
3. Bringing and agreeing on evaluation criteria to participants.
4. Assessment of actual functioning in accordance with established criteria and indicators.
5. Comparison of results of activity with standards and development, if necessary, of corrective measures.

Thus, the methodological basis of economic evaluation of interaction in innovative processes in the development of open innovation models includes such elements as evaluation principles, evaluation tasks and functions, subjects and objects, evaluation stages. A substantiated conceptual approach to the evaluation of interaction systems in innovative processes, in contrast to the existing provisions for the evaluation of innovation, involves monitoring the processes of establishing, implementing and execution of joint activities of participants in innovative processes.

The main tasks of economic evaluation of interaction systems in innovative processes are the following:

- identification, analysis and evaluation in the external and internal environment of the region of those factors and phenomena that have a high probability of occurrence and can have a significant impact on the formation and implementation of joint execution of the innovative process in the region;
- disclosure of opportunities and threats for the combination of resources during the joint execution of the innovative process in the region;
- determination of probabilities of conflict of interests of participants of the regional system of interaction and their preventive elimination;
- evaluation of result and efficiency indicators: innovations for a certain period of time, efficiency and reliability of its management system, interaction, participation in the interaction system.

Quantitative indicators of evaluation of the interaction system are the efficiency and results of the innovative process (stage); qualitative indicators include the usefulness of interaction, the cost of interaction, the value of interaction.

Prospects for further research

After substantiation of conceptual bases and on the basis of generalization of existing methodological provisions of innovation evaluation it is necessary to form a methodical approach to economic evaluation of interaction systems in innovative processes of the region, which should include monitoring of the processes of establishment, implementation and execution of joint activities of participants in the innovative process of the region by substantiated directions and indicators.

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МЕТОДОЛОГІЧНИЙ БАЗИС ЕКОНОМІЧНОГО ОЦІНЮВАННЯ СИСТЕМ ВЗАЄМОДІЇ В ІННОВАЦІЙНИХ ПРОЦЕСАХ

Розглянуто проблему формування методичного базису для проведення економічного оцінювання взаємодії в інноваційних процесах. На основі дослідження методичних засад оцінювання інноваційних процесів у наукових публікаціях та формах статистичної звітності розкрито основні складові методичного базису економічного оцінювання систем взаємодії в інноваційних процесах регіону. Методичний базис містить обґрунтування таких елементів, як принципи оцінювання, завдання та функції оцінювання, суб'єкти та об'єкти, етапи оцінювання.

Мета економічного оцінювання системи взаємодії в інноваційних процесах – комплексний аналіз ефективності системи взаємодії та її впливу на найважливіші показники інноваційного розвитку певного суб'єкта або регіону. Основними завданнями економічного оцінювання систем взаємодії в інноваційних процесах регіону визначено: ідентифікацію, аналіз та оцінювання у інноваційному середовищі регіону чинників ризику спільного виконання інноваційного процесу; виявлення можливостей та загроз середовища; визначення ймовірностей конфлікту інтересів учасників системи взаємодії та превентивне їх усунення; оцінювання показників результативності та ефективності участі у системі взаємодії. Обґрунтовано, що економічне оцінювання систем взаємодії в інноваційних процесах регіону потребує дотримання діалектичної єдності п'яти послідовних етапів: встановлення цілей оцінювання відповідно до цілей формування системи взаємодії; розроблення системи критеріїв і показників для контролювання (стандартів); узгодження критеріїв оцінювання та доведення їх до учасників; оцінювання функціонування систем взаємодії згідно із визначеними критеріями і показниками; порівняння результатів діяльності зі стандартами і розроблення, у разі необхідності, коригувальних заходів.

Ключові слова: оцінювання; об'єкти; показники; інновація; взаємодія; інноваційний процес.