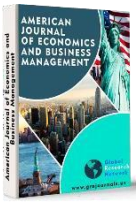

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Article

Analysis of Methods For Calculating Performance Indicators of Innovation Development

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Abstract: This article is devoted to the analysis of the methods of calculation of efficiency indicators of innovative development. In the course of this analysis, the main methodologies used to evaluate innovative development and their advantages and limitations in their application were considered. The importance of integration of economic, social and technological factors in the calculation of indicators was also emphasized. The importance of cooperation between scientific and technical potential, state policy and business sector in increasing the efficiency of innovative activity is highlighted.

Keywords: Innovative Development, Performance Indicators, Evaluation Methodologies, Scientific And Technical Potential, Economic Factors, State Policy, Technological Integration, Innovative Activity

1. Introduction

Today, innovative development is considered an important factor for the sustainable development of the world economy and society. In the era of globalization and digital technologies, countries are developing strategies based on innovative approaches to increase their economic, social and technological potential. In this context, identifying and analyzing the performance indicators of innovative development has become one of the priority topics in today's research.

Various methodological approaches and indicators are used to evaluate the effectiveness of innovative activities. Among them, approaches that take into account economic, social and technological factors have a special place. Through these approaches, an in-depth analysis of the processes of innovation development, implementation and benefiting is created.

This study is aimed at studying modern methods of evaluating innovative development and ways to increase their effectiveness. This is important for the development of scientific and technical potential and sustainable economic growth.

The result of creation of new and modified products in medium and short-term periods of production activity is characterized by economic efficiency of innovations in enterprises. Therefore, the question of evaluation of innovative activity is important.

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Analysis of literature on the topic

Research on the evaluation of the effectiveness of innovative development has been carried out by many scientists at the international and local levels. These studies are aimed at studying the impact of innovation on economic growth, competitiveness and technological development and improving performance indicators.Any innovation project must meet all resource and time constraints. The innovation and investment policy of all entities of the cluster, as well as the efficiency criteria established for innovative activities, are determined. [1] Russian scientists Kuzyk, B.N., Yakovets Yu.V. "Effectiveness of basic innovations should be understood in a broader sense of the word.

The economic efficiency of an innovative project is characterized by a system of economic indicators that reflect the ratio of costs and results related to the project. The following are used as the main indicators of the results of innovative activity: the volume of innovative products and the share of innovative products.[2] In this regard, static and dynamic indicators are used. Russian scientists Kuzyk,.B.N., Yu.V. Yakovets believe that it is possible to increase the rate of productivity growth only on the basis of basic and improved innovations. It supports the growth of the declining situation and the quality of life and civilization of the entire world population is the function of the implementation of the innovative project.

VL Popov, A. Bovin, LE Cherednikova all proposed to divide the set of criteria and indicators for evaluating the effectiveness of innovation management into two: qualitative and quantitative. Key innovations should be evaluated both quantitatively and qualitatively. Quantification should be done using potential and system properties. For this, we can use the following indicators: innovation commercialization potential and innovation leverage.

Innovation leverage is considered as an increase in the efficiency of innovative activity in relation to costs, which causes an increase in the relevant range. In this case, the ratio of fixed and variable costs does not change. The minimum value of innovative leverage should be greater than -1, the optimal - 1.3.

2. Materials and Methods

The following methodological approaches are widely used in research on methods of calculating efficiency indicators of innovative development. Collection of economic, technological and social indicators related to innovation using the method of statistical analysis (for example, the share of GDP in the technological sector, the number of patents, innovative project investments). Using the method of descriptive statistics, it is possible to describe the general state of indicators of innovative development. Regression models are used to study the relationship between innovation development and economic growth through econometric modeling. For example, the impact of technological development investments on economic growth can be evaluated. Analyzing innovation in relation to several socio-economic factors through multivariate analysis. Investigating regional or cross-country differences in innovation development using comparative analysis. For example, technological development in developing countries can be compared with the situation in developed countries. These methods serve to comprehensively analyze the effectiveness of innovative development and develop specific recommendations.

3. Results

The results of research carried out within the topic of methods of calculating the efficiency of innovative development are described as follows:

Economic efficiency of innovative development.

Innovation is one of the most important drivers of economic growth, and technological innovations have a positive effect on GDP (Gross Domestic Product) growth. The share of exports of digital technologies and high-tech products in the local

economy has increased. According to local studies, public-private partnerships are important for financing innovative development.

Regional differences.

The level of innovative development varies significantly between regions. For example, the rate of introduction of technological innovations varies between the city of Tashkent and other regions. The main difficulty in introducing innovations in rural areas is related to insufficient infrastructure and limited financial resources.

The role of education and training.

The lack of highly qualified specialists for innovative development is noted as an important problem. The implementation of digital technologies requires the improvement of the education system, which creates a solid knowledge base to support innovation.

Application of foreign experience.

The experience of foreign countries, in particular, the active participation of the state in countries such as South Korea and Singapore, played an important role in accelerating innovative development. Technological startups are actively developing in these countries with the help of innovative infrastructure and tax incentives.

Performance evaluation methods.

Complex evaluation methods combining economic and technological indicators are used to determine efficiency. Statistical analysis and econometric models were used to monitor the results of the introduction of digital technologies and innovations. Based on these results, the following recommendations can be made. Improvement of innovative infrastructure, including establishment of technological centers in rural areas. Improving the effectiveness of state programs for financing innovations. In the higher education system, it is necessary to pay attention to the training of personnel in subjects aimed at the development of innovations. These studies based on statistical data and analytical materials serve as a scientific basis for increasing the efficiency of innovative development.

Table 1. Evaluation system of innovation performance

Overall efficiency of innovative activity	$O_{ру} = \Phi_{рп}\left(ОП_{з.м.р.у.} * Э_{з}\right) O_{ру} -$ general efficiency of innovative activity; $\Phi_{рп} -$ innovation project implementation function; $ОП_{з.м.р.у.}$ - volume of sales of knowledge, goods, works and services; $Э_{з}$ -cost savings.
Innovation Commercialization Potential (ITS)	*1.* **ITS1= Ka/Oiti**, Here – the number of patents; – Volume of scientific research works by types.$Ka\ Oiti$ *2.* $ITS2 = Ry/Ziti$,Here are the royalty sums; general costs of scientific research.$Ry - Ziti -$ *3.* , where the proceeds from the one-time sale of ITIs; Ziti - one-time costs of scientific research$ITS2 = Vy/ZitiBy -$
Indicators determining the share of activity of innovative clusters	1.. - Growth of new types of activity; Number of new activities; total number of activities by type.$YaTF = YaFS/UFSYaTFYaFS - UFS =$ 2. Growth of new professions; - amount of new professions in clusters; UK- Sum of all occupations.$YaK = KlYaK/UK.YaK - KlYaK$ 3. Share of innovative departments. The number of new sections during the analysis period; Total number of KlI-Cluster participants.$IBu = TDYa/KlI.IBu - TDYa -$

Quality Indicators Innovation Leverage (IL)	1. $IL1 = \Delta B/\Delta Z$ ΔB=increase in revenue from the sale of goods; ΔZ=innovation cost growth. 2. $IL2 = \Delta P/\Delta Z$. ΔP= increase in profits after the introduction of the innovation; an increase in the costs of introducing innovations.$\Delta Z =$
System of relative indicators	1. $EI = \Delta Pya/\Delta Ps$. the share of profit in sales revenue; increase in profit in the sale of new types of products; increase in total profit; $YeI - \Delta Pya = \Delta Ps =$ 2. $YeIya = \Delta Pu/\Delta P$. YeIya = increase in the share of profit from the sale of refurbished goods. ΔPu is the profit from the sale of new goods and services. ΔP-total profit.
Absolute indicators of the innovative system:	1. $EZ = \sum Zi - \sum Zf$. – Cost savings; -planned costs for production and innovative goods. - actual expenses.$EZ \sum Zi \sum Zf$ 2. $\Delta Pu = \Delta Pb - \Delta Pt$. - profit growth. increase in profit from the sale of refurbished goods. profit growth through cost savings.$\Delta Pu \Delta Pb - \Delta Pt$ –
Marginal efficiency	$Ee = \Delta Vin/\Delta Zin$ where - the increase in revenue from the sale of an additional unit of innovative product;ΔVin ΔZin- an increase in production costs as a result of the sale of additional units of innovative products; E is the marginal increase in income compared to the cost of producing and selling an additional unit of innovative product (Marginal income).$e -$

The effectiveness of innovation improvement is characterized by the following relative and absolute indicators. The system of relative indicators includes the following equations:

- the share of profit in sales revenue is expressed by the ratio of the increase in profit in the sale of new types of products to the increase in total profit;
- the increase in the share of profit from the sale of renewed goods is expressed by the ratio of the increase in the profit from the sale of new goods and services to the total profit.

Absolute indicators of the innovative system:

- cost savings - the sum of the planned costs for production and innovative goods is determined in relation to the actual costs
- Marginal profit growth is expressed as the ratio of the increase in profit from the sale of renewed goods to the increase in profit from saving costs.

The following indicators are offered to evaluate organizational innovation: share of company goals, innovative activity, percentage of achieved goals, changes in organizational scope - reorganization, reconstruction, renovation, transformation, reengineering.[4]

In addition to evaluation, innovative activities and management efficiency should be analyzed by types of innovations within the network innovation structure. Creation and sale of innovative products according to the stages of the innovation process within the cluster involved various types of organizations, from universities, and represented by sales and marketing organizations. Therefore, it is important to systematically analyze the effectiveness of innovation management. With a cluster approach to management, it is necessary to analyze the entire innovation space along the entire trajectory of creation and diffusion of all types of innovations.

As an achievement with the help of modern economic knowledge, management efficiency can be increased. A certain cost level to control, manage or achieve good results results by ensuring minimum costs. Management also depends on the efficiency of the managed facility, which the facility management system ensures operational efficiency.

With this approach, innovation management is a necessity related to requirements such as systematicity, control, efficiency of innovation. The effectiveness of innovation management represents the ability to meet demand, and also ensures the effectiveness of the innovation process. The lack of an effective innovation management system is one of the main reasons for the commercial failure of innovations. For effective control, it is necessary to analyze the indicators of generation and diffusion trajectories based on the management system. Determining successful innovation methods in strategic management is one of the most important issues of enterprise activity. The methods should correspond to the objectives of the analyzed activity. Most important goals and, accordingly, success criteria are traditionally profit, income, profitability. The effectiveness of innovation management in clusters is determined by financial indicators, which include general and limiting values. Innovation profitability index and other commonly recognized performance indicators are of great importance. It is expressed by the ratio of the increase in income from the sale of innovative products to the increase in the costs of its production and sale according to formulas with calculated marginal efficiency.

$$\mathrm{E}e = \Delta Vin/\Delta\, Zin$$

where - the increase in revenue from the sale of an additional unit of innovative product;ΔVin

$\Delta\, Zin$- an increase in production costs as a result of the sale of additional units of innovative products;

E is the marginal increase in income compared to the cost of producing and selling an additional unit of innovative product (Marginal income).e −

It is necessary to apply a system of methods that allow the use of profit-oriented methods in the evaluation of the efficiency of innovative activities. It is appropriate to take into account the dynamics of the innovation cycle. Here are the following indicators:

- the value of the organization engaged in production and implementation of innovations
- increasing the value of the organization engaged in the production and sale of innovations
- net operating profit received from the sale of innovative products
- the average natural value of capital required by investors or the rate of return
- the amount of capital invested in the production of innovative products.

A significant difference of the proposed approach is not only focused on profit, but also on providing constant or growing potential for innovative activities, increasing market share in the value of cluster enterprises (creating value for shareholders), creating and implementing innovations, improving the quality of existing products, indicators of increasing the value of the company, such as attracting new capital to enter markets or create new ones, more job opportunities, are included in the most popular ratings in the world.

An innovative approach to this performance evaluation method is being developed step by step. Innovative products are formed through both equity and debt, so this composition affects the efficiency of capital innovation. In addition, an important feature of innovation is that in many cases it can also be sold as a whole, as separate subsystems and even as elements. Where the cost of an innovative product (innovation package) does not necessarily correspond to the sum of the costs of its components due to the risk effect inherent in complex systems.

The cost of innovation is determined by the costs of its creation and reproduction, implementation. "Intangible" assets (warranty, insurance, licenses, good customer relations and other unregistered assets, including brand value, company name (goodwill)) are added to the valuation price.

Because the clusters include various research organizations and universities that conduct practical research. Their work is mainly characterized by the efficiency of

managing the complex and fundamental research process. Innovative ideas and developments that have reached commercialization are taken into account not by financial and cost indicators, but by quality indicators and quantity of research work.

Effectiveness of management in the field of innovation depends on intellectual property and scientific knowledge. Infrastructure, including university infrastructure, from legal and economic relations arising in research institutes, universities, formation of patent policy and product protection is research and creative works, intellectual property within organizations. The second method of evaluating the efficiency of innovations is based on the theory of value. The effectiveness of innovative activities is considered in terms of current and one-time costs - through the method of cost minimization or optimization.

Analysis of the main components using costs for innovative activities requires the selection of two types:

- research and development (without amortization), fixed assets and capital expenditures related to expenses for machines, equipment, devices, etc., introduction of product and process innovations, training of personnel for marketing research;
- costs of obtaining rights to patents, licenses for the use of inventions, industrial samples, utility models.

Then, the average values of the results of the innovative activity for the groups formed by the costs of the innovative activity are calculated. (The so-called "piecewise continuous regression" method).

The calculations allow to determine in which case the indicators of innovative activity will be the best:

- acquisition of new technologies from outside
- or relatively high costs for independent research;

The third way of evaluating innovation efficiency is indicators based on the idea of utility: the consumer value of innovation as a property, the ability to satisfy the need for new technologies, goods, and markets.

Customer satisfaction usually results from customer-to-customer information transfer, maintaining and expanding the customer base.

A fourth way of evaluating the efficiency of innovation comes from the comparative or supply and demand theory of the market. Instead of the friction function (or competition function), you can use an analytical expression for the supply and demand functions. It reflects the features of market and market economy established in classical and neoclassical theories. This, in turn, allows the application of expected value planning, forecasting and modeling techniques.

In addition, the effective management of innovations also depends on external factors, which, first of all, it is necessary to create a clear methodology and necessary conditions for the transfer of technologies and intellectual property from the university and academic science to production and society in general.

Evaluation of the effectiveness of each type of innovation is required at each stage of the innovation process. Thus, real values can be supplemented by the power of effective innovation activities. The fifth method is to change the modeling method or dynamic settings. The analysis of the entire trajectory of generation and diffusion implies a technological approach to the evaluation of the effectiveness of all types of innovations within the framework of cluster structures.

In order to ensure efficiency at all stages, it is necessary to take into account the innovative processes that are of particular importance in the innovative structures of the network. The ineffectiveness of the innovative activity of any element of the research and production cluster leads, at least, to the loss of competitive advantages and the loss of "Competition over time". Without efficiency, the entire trajectory of creation and distribution of innovations in cluster structures, the rapid formation and rapid development of the national innovation system are impossible.

Qualitative research methods have been used by world scientists to classify the efficiency factors of innovative clusters, because this approach is more flexible to understand complex socio-economic phenomena. This study is based on an interpretive approach and is based on the construction of dynamic system models to determine the positive and negative effects of industrial cluster performance factors.

The dynamic system model of 4 groups of efficiency factors of innovation clusters is built on the basis of the following factors: workforce, technology, financial (investment) and marketing. Dynamic system models are built, representing the influence of each of the mentioned factors on the clusters. The built models helped to study the dynamic influence of factors on the efficiency of industrial clusters and to determine their characteristics, and helped to set strategic goals that would increase the efficiency of clusters and ensure global competitive advantage.

The method of constructing dynamic system models is mostly used in solving management problems. Control systems contain many variables that are known to belong to a series and are assumed to be related to each other in non-linear models. A dynamic system is a methodology and mathematical modeling technique for formulating, understanding and discussing complex issues and problems. Originally developed in the 1950s to help corporate managers improve their understanding of industrial processes, dynamic systems models are now widely used for policy analysis and design in the public and private sectors. Dynamical system is a well-known aspect of systems theory, which is considered as a way to understand complex dynamic behavior. The basis of the method is the structure of any system, the interconnected relationships between its components, the relationships that change over time, and the models that combine components that reflect the management process.

Dynamic system modeling processes consist of the following stages:

1) setting of problems
2) understanding the problems and describing the system
3) model development
4) identifying interdependencies
5) determining the best system.

The classification of 4 groups of factors that affect the effective management of industrial clusters is as follows:

1) workforce factor: the formation and development of an industrial cluster is related to the skilled personnel and workforce operating in each industry branch. For example, labor resources, the system and speed of personnel training, the number of qualified personnel, etc. affect the formation, development and efficiency of an industrial cluster.
2) technological factors: the main factors such as the technological state of the industry, the spread of technology, knowledge resources, the technological level and competitiveness of entrepreneurship determine the efficiency of the clusters.
3) financial (investment) factors: this includes factors such as the investment fund, the banking institution's lending system, the ability to attract capital, and fixed assets.
4) market factors: these factors include the degree of concentration of the industry, the completeness of related and supporting industries, the specialization of suppliers, market potential, marketing strategies, and the relationship between supply and demand.

4. Conclusion

The analysis of the methods of calculating the efficiency indicators of innovative development showed that innovations are an integral part of economic, social and technological development, and their correct measurement and evaluation are important for optimizing development strategies. The global innovation index, the number of

patents, investment in technological innovations, and indicators that improve national production efficiency are the key performance indicators.

The use of digital technologies and econometric methods makes it possible to evaluate the impact of innovative activities on various fields. In particular, analyzes based on big data and artificial intelligence reveal the possibilities of real-time monitoring of results and long-term forecasting.

Development of digital platforms for evaluating the effectiveness of innovative development at the national and regional level and introducing global standards into them. Using artificial intelligence and big data analysis in monitoring innovative projects. Add indicators such as patents, the degree of commercialization of innovations, and investment in technological development to the measurement system. Increasing the efficiency of local projects through the development of innovation centers and technology parks.

Expand cooperation between educational institutions and industrial enterprises to support innovative development. Studying the experience of developed countries on innovative development and adaptation to local conditions. These proposals help to ensure the effectiveness of strategic measures aimed at increasing the efficiency of innovative development.

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