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THE CONCEPT AND ANALYSIS OF INNOVATION AND R&D

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Abstract

The article reveals the concept of "innovation" in the economy. Relevance is due to the increasing importance of new technologies in all areas of the economy. The meaning of the term is not fully disclosed in regulatory documents and educational literature. In this regard, there are discrepancies in the understanding of innovations by users and this leads to problems in the legal and production activities of enterprises. The article describes the concept of "research and development" in the context of the concept of "innovation". The relationship of innovation and research is described. Evaluation of innovation plays an important role for the development of enterprises. The article proposes indicators for the analysis of innovative activities of the enterprise. There are indicators in physical terms (absolute and relative) and indicators in value terms (absolute and relative). Formulas for calculating indicators are given. The system of indicators developed in the article will allow us to conclude that the implementation of innovative projects in enterprises is justified**.** The article has practical and theoretical significance in the field of innovation**.**

Keywords: Innovations, economy, experimental development, analysis, indicators.

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1. Introduction

This article is relevant because the era of globalization and the financial and economic crisis affects the formation of innovative sectors of national economies. In recent years, there has been an active transition of many countries to an innovative type of economy, the hallmark of which is the increase in GDP because of the production of high-tech products and new business technologies.

Russia recognizes the innovative path of economic development as a top state priority. Several documents have been produced at the federal level: «Strategy for the innovative development of the Russian Federation for the period until 2020», «Strategy for scientific and technological development of Russia until 2035» and «Economic Security Strategy of Russia until 2030». The implementation of the projects is aimed at increasing the share of innovative products in the total volume of industrial products, increasing the export of high-tech Russian-made goods, increasing Russia's share in the global markets for high-tech products (Government of RF., 2020).

2. Problem Statement

The relevance of the topic raises the question of what is innovation and activity in the field of scientific research and experimental development (R&D), as well as what indicators should be used to analyze the innovative activity of an organization.

3. Research Questions

The economic literature has a large number of approaches to the definition of innovation. Russian law does not provide a clear definition of R&D, which contributes to disagreements in the understanding of a number of legislative acts.

“Innovation” is one of the first definitions of the content and specifics of innovative transformations in society, which was formed in the 19th century. It was associated with changes caused by spontaneous interactions of different cultures. At the beginning of the 20th century, this term began to be used in economic science and meant that economic growth and development depend not only on investments in labor and capital assets, but also on investments in new production technologies (Kazantsev, 2017).

> The emergence of the term “innovation” in the application to the economy dates from this area to the beginning of the twentieth century. Economists understood innovation as the embodiment of a scientific discovery in a particular technology or product. Such an understanding of the term in our time has become the most common in the direction of modern innovations in the field of economics and material production. An innovation may be called the “final result of introducing an innovation to change the management object and obtain an economic, social, environmental, scientific, technical or other effect. (Fedorchenko, 2015, p. 76)

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Based on international standards, the concept of "innovation" is the result of creative activity, which was embodied in the form of a new or improved product of activity introduced on the market, a new or improved technological process used in practice (Kazantsev, 2017).

The evolution of the term "innovation" can be called its interpretation as a powerful factor and an effective lever for the development and self-development of society and its individual areas of activity. With regard to legislation, the first definition of innovation was given in a letter from the Ministry of Finance of the RSFSR of May 14, 1991. No. 16 / 135B "On innovative (implementation) areas of activity" (Newsletter of the Ministry of Finance of Russia, 1991). It was defined as innovative (implementation) activity for the creation and use of an intellectual product, as well as bringing new original ideas to implementation in the form of finished goods on the market (organization of examinations, implementation and replication of inventions, know-how, scientific and technical developments, scientific works, discoveries, industrial designs, trademarks, conducting research, design, development, marketing research in order to create samples of new equipment and new technologies; patent licensing activities).

In Decree of the Goskomstat of the Russian Federation dated February 14, 1995 No. 16 "On the approval of the form of federal state statistical monitoring of small business" (measured dated December 7, 1995) it is stated that enterprises engaged in organizing the introduction and replication of inventions, "know-how", scientific and technical development , the creation of prototypes, testing, development and transfer of technologies and scientific and technical documentation, preparation of production, market research and other activities related to innovation process.

According to the Decree of the Government of the Russian Federation of July 24, 1998 No. 832 "On the Concept of Innovation Policy of the Russian Federation for 1998–2000" (Russian newspaper, 1998) (hereinafter referred to as the Concept), which defines the term "innovation" as the final result of innovative activity that has been realized in the form a new or improved product sold on the market, a new or improved technological process used in practice, and "innovative activity" as a process aimed at implementing results for completed research and development or other scientific and technological achievements into a new or improved product sold on the market, into a new or improved technological process used in practice, as well as additional research and development related to this process.

Innovations directly affect the development of the material – technical base of production, the competitiveness of goods and services and the socio-economic development of society (Kiselevich, 2019).

Innovations are most often implemented in the form of projects, but their creation and implementation cannot be implemented without scientific thinking. The process of convergence of science and practice should become one of the characteristic features of our time. It is carried out through innovations, which should remove the accumulated problems or suggest ways to solve them. Thus, innovation is one of the tools to eliminate the alienation that arises between scientists and practitioners.

It is important to say that innovation activity begins with the emergence of an idea in the minds of innovation subjects (both scientists and practitioners), i.e. with scientific activity. The innovation process includes all stages from the inception of an idea to its commercial implementation (Leushina, 2015).

Innovation is “the result of a scientific idea, embodied in a document and embodied in a model of new technology, products or material, a description of a technology or service.

A more controversial situation is the introduction of such a concept as “research and development,” R&D for short. Discussions are ongoing regarding the interpenetration of R&D and innovation. A number of researchers believe that R&D is an integral part of the innovation process. There is an opposite point of view. Innovation complements the R&D process and focuses on the commercialization of research and development results. For example, it is argued (Mindeli & Pashintseva, 2017) that the innovation process should include all phases of the life cycle: from the idea and concept of innovation to the phase of mass production and operation. According to other researchers (Kalabin, Nurislamova, & Oleynik, 2019; Mindeli & Pashintseva, 2017), the innovation process begins with the phase of the invention and ends with the phase of development of the prototype and its transfer to mass production.

Based on the analysis of a number of works (Kalabin, Nurislamova, & Oleynik, 2019; Mindeli & Pashintseva, 2017; Ryzhkov, 2016) aimed at R&D management and innovation, we can come to the following conclusions:

• R&D process is part of the innovation process;

• the R&D task at the enterprise is to create scientific and technical foundations to achieve a specific goal, and the innovation process is focused primarily on the problems of organization, planning and management of innovative activities;

• at many high-tech enterprises, R&D is carried out in accordance with a specific concept and strategic goal, planned restrictions on time and costs, as well as with specific tasks for the development of new or improved products and technologies. The innovation process should take on the remaining tasks of implementing innovations that are not part of systematic R&D;

• R&D processes are easier to organize than other components of the innovation process because the main stages and tasks of R&D are quite well known. Therefore, their clear structuring, specialization and coordination are possible;

• in addition to R&D processes, innovative activity should be engaged in tasks and processes that are not repeated regularly, for example, coordination, integration, control, analysis of deviations and development of draft management decisions.

Obviously, innovation has a large role for the organization. Therefore, it is necessary to analyze innovation. In this case, it is advisable to analyze using a system of indicators formed in two groups:

1. Indicators in kind:

- absolute indicators in kind;

- relative indicators in kind.

2. Indicators in value terms:

- absolute indicators in value terms;

- relative indicators in value terms (Slobodnyak, 2013).

Moreover, at the final stage, the indicators of each of the groups should be combined to conduct a factor analysis of innovation.

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4. Purpose of the Study

The purpose of the research in this article is to generalize the definition of "Innovation" and develop indicators for calculating factor analysis of innovation activity.

5. Research Methods

5.1. Absolute indicators of innovation over a period of time in physical terms:

5.1.1. The total number of cases of the implementation of innovative projects in a certain period of time (T) – QIP. Theoretically, a larger number of ongoing innovative projects indicate a high activity of the organization in this direction. However, it should be noted that far from all innovative projects launched in the time period T will be brought to their logical conclusion. This leads to the need to refine the overall indicator using private indicators.

It is obvious that the duration of the time interval T, for which the level of innovative activity of the organization is estimated, should be quite long. It is proposed to use a period of 1 calendar year. This is explained not only by the length of the period sufficient to achieve a certain level of completeness (for example, traditionally for R&D, scientific and technical reports are generated exactly for a year), but also because factors that are most accurately determined for exactly 1 will participate in the calculation of relative indicators fiscal year, including revenue, financial result (profit).

A sufficient length of the period is necessary to minimize the risk of random factors in assessing the results of the implementation of innovative projects.

For example, if on a time interval of 1 (one) month (30 days) with the total number of implemented innovative projects QIP = 10 cases, the start of the work on the next project (study) occurs on the first day of the next period (although in fact the events of the past period obviously led to it: negotiations, approvals, accumulated work experience). So we can say that the level of distortion of the indicator for the total number of innovative projects carried out during the period of innovation projects (its understatement) is 10 %. If a similar situation occurs during the study of the 1 year interval, then the level of indicator distortion is 0.83 % with QIP = 120 cases.

5.1.2. The total number of cases of successfully completed implementation of innovative projects over a period of time T – Q success IP. Obviously, the level of Q success IP. should converge to the level of QIP, so the situation can be characterized positively if Q success IP ≈ QIP.

The greatest difficulties will arise with the classification of innovative projects into successful and unsuccessful. It is important that for all periods for which the analysis is carried out, the approach to determining success is the same.

5.1.3. The total number of unrealized (rejected) innovative projects in the time period T – Q rejected IP. It is obvious that this indicator in any case should tend to 0. Obviously, the sum of implemented and rejected innovative projects makes up their total number:

$$QIP = Q\text{ success }IP + Q\text{ rejected }IP \quad (1)$$

5.1.4. The total number of cases of innovative projects that have passed from earlier periods to a period of time is T’ – Q’IP. If the value of this indicator is different from 0, this probably indicates a not good situation in the field of work and the delay in the timing of their implementation (especially when a

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long time interval is selected for analysis). Naturally, it is necessary to take into account the industry specifics. Moreover, it should be ascertained how long a period of time an innovation project is being implemented. After all, if it was started in January of the previous year, but not completed, then this may indicate a delay in the implementation of the project. If the project started in December, then there is nothing suspicious that the project was not brought to its logical conclusion.

5.1.5. The total number of cases of completion of innovative projects that have passed from earlier periods T', through work in a period of time T – Q' success IP. Obviously, we can conclude that in order to ensure a normal level of efficiency in the implementation of innovative projects, it is necessary to fulfill the conditions Q'IP ≈ Q' success IP.

5.1.6. Q'failure IP is the total number of cases of innovative projects that were at the beginning of the time interval t0 and at the end of this interval t1 inside the time period T. This is an indicator characterizing the most critical situation in the effectiveness of the implementation of innovative projects. In most cases, this will mean that the work was not carried out during the time interval T, or its effectiveness was minor.

Thus, the balance of the number of innovative projects can be represented in this way:

$$QIP + Q'IP = Q\ success\ IP + Q'\ success\ IP + Qfailure\ IP + Q'failure\ IP \quad (2)$$

5.2. Absolute indicators of innovation over a period of time in value terms:

5.2.1. The costs of implementing innovative projects in the time period T is ZIP. This indicator characterizes the cost component of the ongoing work. At the same time, it is advisable to single out at least the following particular indicators from the total cost of innovation activity:

5.2.1.1. The costs of innovative projects that led to a positive result over a period of time T is Z success IP;

5.2.1.2. The costs of innovative projects that did not lead to a positive result over a period of time T is Zfailure IP. Naturally, the size of such costs should be minimized by the organization because it is unproductive costs. However, not all costs of innovative projects will bring benefits in the form of a positive effect;

5.2.1.3. The costs of innovative projects that led to the completion of work on similar projects of previous periods is Z' success IP;

5.2.1.4. The costs of innovative projects that did not lead to the completion of work on projects launched in past periods T' is Z'failure IP. Naturally, the amount of such costs should also be minimized by the organization, because these are unproductive expenses, and they relate to events actualized in past periods. At the same time, a certain amount of these costs must be implemented in order to complete the innovation project. They cannot materialize into a positive outcome on their own.

It is also obvious that the balance of costs for the implementation of innovative projects will look in value terms this way:

$$Z_{IP} + Z'_{IP} = Z\ success_{IP} + Z'\ success_{IP} + Z_{failure\ IP} + Z'_{failure\ IP} \quad (3)$$

Thus, the system of absolute indicators includes both indicators in physical terms and in value terms. This provides a decrease in information entropy. Using indicators from only one group does not reduce uncertainty. For example, in large corporations the number of implementation of innovative

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projects can amount to tens or even hundreds of cases per year. However, the costs of implementing innovative projects may be negligible, as well as work. The opposite situation is also possible, when the number of implemented innovative projects during the year is small, but their results and consequences in cost terms are very significant.

5.3. Relative indicators characterizing the implementation of innovative projects over a period of time:

In the first group of indicators it is advisable to include the coefficients, which are calculated by the ratio of various indicators characterizing innovative activity in kind and in value terms.

5.3.1. The success coefficient of innovative projects for the period calculated by the ratio of the total number of successfully implemented projects in the time period T to the total number of ongoing projects in the same time period T:

$$К_{\text{success}\,.} = \frac{Q_{\text{success IP}}}{Q_{\text{IP}}} \tag{4}$$

An additional indicator to this coefficient will be the coefficient of unsuccessful innovative projects for the period:

$$К_{\text{failure}} = \frac{Q_{\text{failure IP}}}{Q_{\text{IP}}} \tag{5}$$

The total value of these two coefficients is 1.

5.3.2. Integral success/failure coefficients of innovative projects, which are calculated not only taking into account their number in the time period T, but also taking into account those innovative projects whose implementation began in earlier periods T':

$$К_{\text{success IP integ.}} = \frac{Q_{\text{success IP}} + Q'_{\text{success IP}}}{Q_{\text{IP}} + Q'_{\text{IP}}} \tag{6}$$

$$К_{\text{failure IP integ.}} = \frac{Q_{\text{failure IP}} + Q'_{\text{failure IP}}}{Q_{\text{IP}} + Q'_{\text{IP}}} \tag{7}$$

The total value of these two coefficients is 1 too.

The second group uses relative indicators characterizing not only innovative projects, but also the activities of the organization as a whole.

5.3.3. The average number of innovative projects per employee (including for 1 employee involved in the implementation of innovative projects) (N_p) during the period:

$$\overline{Q_{\text{IP for 1 employee}}} = \frac{Q_{\text{IP}}}{N_p} \tag{8}$$

The higher the value of this indicator, the more intensively employees are engaged in innovative projects.

The calculation procedure for this indicator can be improved using not the total number of employees, but only those who implement innovative projects:

$$\overline{Q_{\text{IP for 1 innov. employee}}} = \frac{Q_{\text{IP}}}{N_{\text{IP.}}} \tag{9}$$

The higher its level, the higher the personnel involved in innovative projects.

The two indicated indicators are interconnected with each other through the share of employees (D) involved in innovation in the total number of personnel during the reporting period T – D(innov. employee)

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$$\overline{Q_{\text{IP for 1 employee}}} = \overline{Q_{\text{IP for 1 innov. employee}}} * \mathrm{D(innov. employee)} \quad (10)$$

At the same time, D(innov. employee) calculated by the following formula:

$$\mathrm{D(innov. employee)} = \frac{N_{\text{innov.employee.}}}{N_{\text{p.}}} \quad (11)$$

Using standard methods of factor analysis, it is possible to calculate the influence of factors on the average number of innovative projects per employee of the organization.

5.3.4. The average cost of innovation projects per 1 innovation project / successful innovation project / unsuccessful innovation project:

$$\overline{Z_{1\ \text{IP}}} = \frac{Z_{\text{IP}}}{Q_{\text{IP}}} \quad (12)$$

$$\overline{Z_{1\ \text{success IP}}} = \frac{Z_{\text{success IP}}}{Q_{\text{success IP}}} \quad (13)$$

$$\overline{Z'_{1\ \text{success IP}}} = \frac{Z_{\text{success ИП}}+Z'_{\text{success IP}}}{Q_{\text{success ИП}}+Q'_{\text{success IP}}} \quad (14)$$

$$\overline{Z_{1\ \text{failure IP}}} = \frac{Z_{\text{failure IP}}}{Q_{\text{failure IP}}} \quad (15)$$

$$\overline{Z'_{1\ \text{failure IP}}} = \frac{Z_{\text{failure IP}}+Z'_{\text{failure IP}}}{Q_{\text{failure IP}}+Q'_{\text{failure IP}}} \quad (16)$$

It is also advisable to conditionally divide these indicators into two groups:

- indicators calculated according to data on innovative projects for the reporting period of time T;

- indicators, the calculation of which takes innovative projects that started in earlier periods T ’, but not completed until period T.

A feature of the indicators of this group is that they are represented by standard deterministic models, which makes it possible to conduct a factor analysis of the dynamics of the relevant indicators. For example, using the method of absolute differences, we illustrate the procedure for determining the influence of 2 factors on the level of costs for the implementation of innovative projects:

$$\Delta Z_{\Delta Q_{\text{IP}}} = \Delta Q_{\text{IP}} * \overline{Z_{1\ \text{IP}\ 0}} \quad (17)$$

$$\Delta Z_{\Delta \overline{Z_{\text{IP}}}} = \Delta \overline{Z}_{\text{IP}} * Q_{\text{IP}\ 1} \quad (18)$$

In a similar order, the influence of factors on the resulting indicator is analyzed in the framework of other models described above.

An appropriate set of absolute and relative indicators helps to find out the quantity and quality of innovative projects during the period, what were its changes.

3.5. The share of costs for innovative projects (including for each type of cost: for successful innovative projects / unsuccessful innovative projects) in the total cost of manufacturing products, performing work and providing services, for example:

$$\text{Share } Z_{\text{success IP}} \text{ в } Z_{\text{manufacturing}} = \frac{Z_{\text{success IP}}}{Z_{\text{manufacturing}}} \quad (19)$$

Obviously, in most cases this indicator will be different from 0 (if the organization implements innovative projects). The question is what should be its optimal level. In our opinion, there is no single recommended level. The sets of ongoing innovative projects in specific organizations are different. However, it is obvious that the organization needs a situation where there is a fairly high level of correlation between the amount of work and the cost of implementing innovative projects on the one hand, and the level of cost of production on the other hand. In our opinion, a high correlation between

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these indicators may indicate the stable work of the organization in implementing innovative activities. It helps to more accurately calculate the budget for relevant events.

On the contrary, a low correlation indicates the lack of systematicity in the management of innovation and the randomness of events. This can have negative consequences for the organization. Thus, the primary task of the organization is to achieve a stable level of the considered ratios and to ensure a reduction in the level of costs in other economic indicators of the organization.

Naturally, the corresponding indicators can be calculated not only by indicators of the costs of production, services, work, but also by the revenue of the organization (V) or the financial result of its activities (P):

$$\text{Share } Z_{\text{success IP}} \text{ в } V = \frac{Z_{\text{success IP}}}{V} \quad (20)$$

$$\text{Share } Z_{\text{success IP}} \text{ в } P = \frac{Z_{\text{success IP}}}{P} \quad (21)$$

6. Findings

It should be noted that innovation can and should be analyzed. It should not become an end in itself. Any event should be economically justified. The developed system of indicators will allow us to conclude that the implementation of innovative projects is justified. Although, it should be noted that innovative projects are focused on the future, and therefore the indicators of the fifth group should be evaluated over a long time interval.

7. Conclusion

Finally, we can conclude that R&D is the most structured, defined and systematized part of the innovative activity of the enterprise. Therefore, R&D can be seen as an independent and largely independent part of innovation.

Innovation is a process that has undergone a complete technological cycle from the birth of an idea, its technological development and documentation to the necessary commercial procedures in order to enter the market as a product in the form of a product, service or technology.

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