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Methodological approach to assess the efficiency of the implementation and practical use of the results of scientific research

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Abstract. Accelerated implementation of scientific research results significantly increases the rate of economic growth. However, the complexity and laboriousness of the production of innovative products for various purposes requires the development of new approaches to assess the effectiveness of the processes of its implementation. The article substantiates a modern methodological approach to assess the effectiveness of innovative products. It allows identifying the most promising areas for its implementation, as well as the use of the accumulated scientific potential. In addition, the developed approach makes it possible to assess the significance of the scientific results of scientific, technical and technological programs, systematically analyze the prospects for their application and choose the most effective ways of their practical implementation.

Key words: system analysis, scientific, technical and technological results, risks, expert assessment, planning, criteria, innovations, practical implementation.

Introduction

In recent years, the complexity of determining the ways of practical implementation of the results of scientific, technical and technological programs (STTP) increased significantly. The limited resources that allocated for implementation activities necessitate the concentration of main efforts on a limited number of relevant research results. Justification of the choice of scientific, technical and technological results closely related to the assessment of their effectiveness and efficiency. Like any problem of choice, the choice of STTP results based on a systematic analysis of state, public, economic, information, transport, environmental, energy and other aspects. In its main features, the problem of choosing effective ways to implement the results of STTP, in relation

to ensuring innovative economic development and national security, refers to weakly structured problems in which qualitative, poorly formalized aspects tend to dominate. For such problems, it is extremely difficult to build reliable objective models that make it possible to obtain quantitative values of efficiency based on multicriteria assessments. For such problems, it is extremely difficult to build reliable objective models that make it possible to obtain quantitative values of efficiency based on multicriteria assessments.

The purpose of the study is to analyze existing and develop new scientifically based methodological approaches to assessing the effectiveness of the processes of introducing innovative products and promising areas for the practical implementation of the results of STTP.

Status and analysis of research in this subject area

Currently, a large number of works have been published on effective methods for predicting the development of science-intensive industries [1, 10] and the effectiveness of investments [16], as well as the rational solution of the problems of choosing promising ways to implement the results of scientific, technical and technological activities. They use special methods and procedures to highlight the most significant factors that characterize the objects of choice, and to build uniform decision-making rules.

The monograph [8] analyzes foreign experience in using predictive tools designed to assess the prospects for innovative development of national economies. Separately, the domestic practice of technical and innovative activities considered. The authors propose a methodical approach to technology development planning based on expert opinions, which then combined into generalized quantitative indicators to select priority areas.

The article [2] proposes a technique based on verbal-numerical expert assessments. The methodology designed to assess the potential of domestic science in terms of the possibility of neutralizing global challenges, as well as to form a portfolio of fundamental and exploratory research that has the potential for commercialization in the long term. The methodology uses many weighting factors, and as an optimality principle for choosing used a portfolio of fundamental and exploratory research, a linear convolution of numerical estimates and coefficients.

A description of the main domestic forecast documents and their role in creating a scientific and technical reserve presented in the article [4]. It rightly notes that the difficulties in determining effective ways of practical implementation of R&D results are associated with the long duration of the creation of new science-intensive technologies, when up to ten or more years pass from the stage of fundamental research to their practical application.

Scenario methods for assessing the risks of implementing such technologies described in the works [2, 5, 14]. These works suggest:

- criterion of net present value as an indicator of the commercial efficiency of the project for the implementation of scientific results;

- economic and mathematical tools for accounting, management and compensation of risks inherent in the processes of creation and development of modern technology within the framework of innovative plans and programs, which based on transcendental and empirical methods for developing planning options;

- methods and approaches that make it possible to successfully solve the problems of identifying, assessing and neutralizing risks that arise in a science-intensive production complex when creating innovative products for various purposes.

The assessment of commercial effectiveness based on an assessment of costs and results, presented in quantitative (numerical) terms in the form of cash flows [3].

To calculate the indicator of net present value, it is necessary that all the main characteristics that determine its effectiveness determined in monetary terms. However, it is very difficult to obtain adequate monetary estimates for the scientific result of STTP. The activities of programs of this type R&D usually dominated, which have a high degree of risk and uncertainty of the results. Estimation of cash flows (necessary costs and results) is so uncertain that sometimes it does not even make sense to talk about the practical feasibility of a scientific result, and not just about its commercial application. Moreover, the assessment of inflows and outflows should be carried out from the standpoint of public interests and at economic (not market) prices that correspond to the usefulness of products and resources in terms of protecting the vital interests of the individual, society and the state.

Articles [6, 15] substantiate the necessity to study the concept of innovation and a correct understanding of the concept of economic progress based on this definition. The state of the main directions and general trends in the processes of research and use of the fundamental and applied foundations of the theory of innovation outlined. The most precise definition of this term proposed, which makes it possible to determine the most rational mechanisms for increasing the innovative potential of high-tech domestic industries. Authors developed an investment strategy focused on state support for science-intensive enterprises that produce innovative products for various purposes.

Research methods and results

Planning the implementation of the scientific results of the STTP aims to identify the most promising areas for using the accumulated scientific, technical and technological potential.

The essential stages of the planning procedure are an assessment of some quality (for example, importance) of various elements of the implementation process (problems, methods, etc.), as well as a comparison of homogeneous elements (for example, problems) with each other.

The result of a comparative assessment is the identification of key opportunities and limitations of the practical use of R&D results. Assessments made by experts - highly qualified specialists in this field of science. It is characteristic that the factors taken into account in the assessment are of a qualitative nature, for example, "the relevance of the problems of implementing scientific research", "the prospects for measures that contribute to the implementation of scientific research results", etc.

Evaluation of such concepts using quantitative indicators is methodologically incorrect [11, 13], so the information received from experts should have a non-numerical form. When developing qualitative aspects of the implementation problem, it is well to bear in mind that the reliability of expert information most significantly depends on how clearly and unambiguously the task proposed to the expert formulated. Therefore, the measurement problem (method of obtaining and type of expert information) is one of the most important in planning the implementation of scientific and technical results.

Quite often used in planning the implementation of scientific results, a brief assessment on the principle of "important - unimportant" is very uncertain and methodologically incorrect, because in the concept of "importance" one can distinguish various components, including those whose influence can be mutually opposite. For example, the following aspects of the implementation problem studied: fundamental importance, achievability of important production results, applied importance of implementation, importance of additional theoretical and experimental research, etc. If the meaning of the concept "importance of implementation" not deciphered to the expert, then, giving a brief assessment of "important - not important", he will inevitably take into account only some aspects.

Thus, in the absence of a clear assessment program, each of the experts chooses his own system of criteria that reflect various aspects of the problem of implementing R&D results. As a result, the estimates given by several experts are in principle incomparable, since in each case, different sets of criteria evaluated. However, these brief scores usually compared and analyzed, although none of the experts deciphered what criteria he used.

Methodically, it would be more correct to break down a complex concept such as "importance of implementation" into separate components, i.e. draw up a system of criteria for a comprehensive assessment of problems, directions, etc. In this case, the experts should assess the individual aspects of the problems sequentially. Then the estimates for each criterion become much more reliable, because in each case, the expert, now consciously, excludes the influence of other aspects. We need to make criteria for evaluating problems, directions and methods of implementation in such a way as to single out one of their many characteristics and consider it independently of the others. This:

- firstly, facilitates the work of experts, since the formulation of the problem becomes narrower and more specific;
- secondly, it makes it possible to more fully take into account the impact of various factors;
- thirdly, it makes it possible, when summarizing the results, to analyze a wide variety of combinations of characteristics and external factors, selecting among them the closest to the real situation.

The concept of the importance of implementing the results of scientific research is multidimensional. When determining the overall indicator of importance, it is necessary to take into account, in addition to the fundamental importance of implementation, the influence of other factors - economic, organizational, industrial and social. The introduction of such aspects is because modern scientific research is associated with significant material costs, requires the efforts of large scientific teams and rare specialties. If the planned implementation carried out within the framework of international scientific and technical cooperation or the expected effect of the implementation is of a transboundary nature, then when planning, one should also consider models of integration into international and interstate systems.

The criteria used to evaluate the results of scientific research of STTP should be qualitative (non-quantitative), i.e. scores on these criteria do not have an adequate numerical expression. Only discrete rating scales allowed, the gradations of which are detailed verbal formulations that, if possible, fully and unambiguously describe the content of the evaluated aspect for a systematic analysis of the problems of practical use of the STTP results.

Methods for obtaining expert information should ensure its greatest reliability. Special studies have shown, for example, that the issuance of numerical estimates of qualitative characteristics causes difficulties even for highly qualified experts. In other words, the reliability of information depends not only on the competence of the expert, but also on the form in which it is required from him [7].

In accordance with the above principles, the expert questionnaire should be developed in such a way as to enable:

- analyze the most significant aspects of implementing the results of STTP (financing, staffing, level of logistics, etc.);
- assess the degree of interconnectedness of various elements of implementation activities;
- determine the prospects for the practical application of research results, as well as assess the conditions for organizations providing services and introducing advanced technologies, and identify the necessary types of resources.

The discussion of the results

In modern science, various scientific and methodological approaches already used to assess the demand for the results of STTP; the characteristics of the relevance and possible demand for the results obtained assessed. [12]. Using the developed tools for conducting a systematic analysis of the prospects for applying the results of scientific research in practice, it seems appropriate to develop the main criterion that determines the dependence of the integral indicator of the significance of the implementation of a scientific result on its individual assessments for various indicators. At the same time, expert assessments should be subject to minimal distortions and transformations. As already noted, a serious methodological error is the attribution of arbitrary numerical values to expert estimates and the use of the latter in complex mathematical models along with objective and accurately measurable parameters [17].

For this reason, it will be methodically correct, for example, to construct the following decision rule: it assumed that the most important would be those results of STTP for which the demand and feasibility of implementation have the highest rating, and where domestic R&D results are not inferior to the world level. By setting such a set of requirements, it is possible, according to the existing array of estimates, to select those results of STTP that meet these requirements. At the same time, expert assessments not subjected to any formal transformations.

Based on the assessments given by experts according to the relevant groups of criteria, from the entire set of STTP results, only those selected that meet the given principle of optimal implementation - the main rule. For example, we can:

- make a list of scientific results that satisfy the initial set of requirements;
- identify scientific areas of additional research that are necessary to implement the implementation of scientific results;
- develop management decisions necessary to solve the problems of the identified areas;
- determine what kind of resources needed for the practical implementation of the results of STTP, etc.

Conclusion

The complexity of the tasks of forming and searching for effective ways of practical implementation of the results of various scientific, technical and technological programs requires the development of methodology, scientific and methodological approaches and effective tools for a systematic analysis of existing complex and numerous problems. For such problems, it is extremely difficult to build reliable objective models that make it possible to obtain quantitative estimates of the effectiveness of the practical implementation of scientific results based on multi-criteria assessments.

This article proposes a scientifically based methodology for identifying the possibilities and limitations of the practical application of scientific results in various areas of production

activities of high-tech enterprises. It is based on the following basic principles: the importance of implementing the results of scientific research (multidimensional concept); to evaluate the results of STTP, it is necessary to apply qualitative criteria; methods for obtaining expert information should ensure its greatest reliability. Based on this methodology, new approaches developed to the formulation of the main rule, which determines the dependence of the integral indicator of the importance of implementing the scientific result of STTP on its various assessments according to all the specified criteria.

The results of the study are of interest for further in-depth analysis in order to obtain both specific practical recommendations and systemic proposals to improve the situation with the implementation of the results of scientific, technical and technological programs.

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