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# Efficiency of State Policy in the Field of Science and Technology in the Russian Federation: Assessment Methodology and Approbation Results

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**Abstract.** The article presents a methodology for evaluating the efficiency of measures and tools of state policy in the field of science and technology. The approach was developed and tested in order to improve the mechanism for monitoring the achievement of strategic goals of Russia's scientific and technological development discussed at the meeting of the Presidential Council for Science and Education on February 8, 2023. The implementation of this direction is of great importance for ensuring technological sovereignty of the country. In the course of the research we used general scientific methods: analysis, synthesis and generalization, observation, comparison, measurement, grouping. Statistical methods such as correspondence analysis and cluster analysis were also used to implement the main task. The assessment was carried out in three directions: effectiveness assessment, assessment of the growth rate of targets, and assessment of the relevance of measures and tools of state policy in the field of science and technology by the scientific community. Based on these criteria, a set of data and a conclusion on the efficiency of public policy tools and measures were formed. The results obtained indicate the average efficiency of the tools and measures of state policy in terms of their effectiveness and relevance. The growth rates of most indicators are characterized by negative dynamics. This is primarily due to the fact that during the second stage of the implementation of the scientific and technological development strategy, restrictions caused by coronavirus infection were introduced, and we should also point out an increase in sanctions pressure.

**Key words:** efficiency assessment, state policy in the field of science and technology, state policy measures, target indicators, effectiveness, scientific and technological development.

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## Introduction

In the context of Russia's sharply increased isolation from global markets, it is important to evaluate the effectiveness of existing tools and mechanisms implemented by the state and aimed at ensuring the country's technological sovereignty. Do the tools applied meet current challenges facing Russia? To what extent are the projects attractive to potential participants and sources of extra-budgetary funding? Are these tools and mechanisms effective in terms of socio-economic impact and for society as a whole?

In 2016, the Russian Government took steps to implement the instruction of the RF President regarding the formation of the country's sovereignty: the Russian Federation must be ready to compete with leading countries in the development of science and technology, as it is a matter of its sovereignty[1]. The Strategy for Scientific and Technological Development of the Russian Federation (hereinafter – the Strategy)[2] was developed and approved, defining priority directions, for the implementation

[1] Transcript of the June 24, 2015 meeting of the Council on Science and Education. Available at: http://www.kremlin.ru/events/councils/49755 (accessed: September 4, 2023).

[2] "On the strategy for scientific and technological development of the Russian Federation": Presidential Decree 642, dated December 1, 2016 (amended March 15, 2021). Available at: http://publication.pravo.gov.ru/Document/View/0001201612010007 (accessed: September 4, 2023).

of which a set of support measures was adopted to strengthen and promote the development of Russian scientific and engineering research groups working at the forefront of science. The effectiveness of the proposed support measures and the development of evaluation methods became an immediate concern due to the lack of relevant measures to support scientific schools and developments in the new economic environment during the Strategy's development.

The Strategy is being implemented in stages that correspond to the development of the Russian Federation's economy and budgetary system. Indicators have been established for each stage to reflect progress and results. Starting in 2020, the second stage is being implemented (2020–2025). This stage will assess the measures implemented to stimulate the transition to the stage of active commercialization of the results of intellectual activity and the large-scale creation of new products and services based on technologies that meet significant challenges.

The purpose of the study is to develop a methodology for assessing the effectiveness of measures and instruments of the state science and technology policy outlined in the Strategy, as well as to test the methodology proposed, considering the degree of implementation of measures by the co-implementers of the Strategy and the applicability of specific results. The ultimate goal is to ensure the independence and competitiveness of the Russian Federation.

The methodology for assessing the effectiveness of measures and instruments of the state policy in the field of science and technology in the Russian Federation (hereinafter – the Methodology) was developed in 2023, when it became possible to analyze the results of the application of support measures proposed in 2016 and later. The assessment of the effectiveness of measures covers several years, during which project support measures were implemented and dynamics in each direction were analyzed.

The Methodology includes the assessment of state policy directions (measures) and expected results based on the monitoring data of the implementation of the action plan for the Strategy realization (hereinafter – the Plan) of the first stage (2017–2019), as well as the transition period of 2020–2022, including the relevant instructions of the RF President and Government. Currently, the Plan is not used to monitor the implementation of scientific and technological development activities.

The calculation also includes target indicators of scientific and technological development, the dynamics of which are subject to monitoring[3]. The results of the analysis of achievement of the Strategy target indicators, along with other resulting indicators, reflect the effectiveness of measures and instruments of the state policy in the field of science and technology[4].

The assessment considered the scientific community's opinion based on the use of the Strategy's tools and activities by the university and scientific community. In 2021–2022, the Russian Research Institute of Economics, Politics and Law in Science and Technology (RIEPL) conducted a sociological survey commissioned by the Ministry of Education and Science of Russia. The survey aimed to investigate the scientific and university community's attitude toward the implementation of science and technology policy mechanisms and tools that received funding from the federal budget as part of the Strategy (Vasilyeva et al., 2022).

[3] "On approval of the List of indicators for the implementation of the Strategy for scientific and technological development of the Russian Federation, the dynamics of which are subject to monitoring": RF Government Order 1824-r dated August 15, 2019. *SPS Konsul'tantPlyus* (accessed: September 6, 2023).

[4] Following the results of the meeting of the Presidential Council on Science and Education, held on February 8, 2023, the Russian President instructed to submit proposals to define and clarify the main results and target indicators characterizing the achievement of national development goals in the field of science and technology development of the Russian Federation through to 2030: List of instructions following the meeting of the Council on Science and Education, paragraph 2a (approved by the President of the Russian Federation on April 20, 2023, Pr-800). *SPS Konsul'tantPlyus* (accessed: September 7, 2023).

Thus, the results of the analysis of the effectiveness of measures to support scientific and technological development, outlined in the Strategy, based on the proposed Methodology will allow identifying the trends of accelerated/delayed development of a particular technological area. This information can be used to develop sustainable state policy approaches, taking into account the effectiveness of their activities in the context of global challenges and ongoing economic and foreign policy changes.

**Literature review**

At the turn of the century, Russia's science and technology policy prioritized resource-based economic development rather than striving to become a global technological leader. As a result, the country developed a low-tech, resource-oriented economic structure.

The situation changed fundamentally in 2018, when in his March Address to the Federal Assembly of the Russian Federation, President Vladimir Putin formulated a new strategy for Russia's development: to improve the quality of life, advance scientific and technological development, and eliminate technological lag behind developed countries.

The new vector of the country's development, when the key direction is not profit, but the improvement of the quality of life, fundamentally changes the traditional innovation policy (science – technology – industry – education) by adding a social component (Onishchenko et al., 2020).

For several years, federal executive and legislative authorities have adopted documents to assess the efficiency of budgetary fund usage. According to the RF Government Resolution 1613, dated September 25, 2021[5], there is an incomplete coverage of measures to assess the effectiveness of all instruments of state support, as well as there is no unified mechanism for managing resources, goals and objectives in the scientific and scientific-technical sphere of civilian use.

In 2021, the Federation Council recommended the Government of the Russian Federation to take measures to improve the efficiency of science management. This includes forming a mechanism to assess the effectiveness of the measures of state policy in the field of science and technology, analyzing the effectiveness of budgetary and extra-budgetary funds spent on research and development, and evaluating the demand for state support for scientific, scientific-technical, and innovation activities[6].

As a result of the meeting of the Presidential Council on Science and Education (hereinafter – the Council on Science and Education) on February 8, 2023, the President of the Russian Federation instructed the Government and the Council on Science and Education to conduct a comprehensive assessment of the effectiveness of measures and instruments of the state policy in the field of science and technology applied to achieve specific results to ensure the independence and competitiveness of the Russian Federation[7].

Currently, it is necessary to take into account the position of the President of the Russian Federation, as expressed during the Council on Science and Education meeting[8], regarding the need to adjust the Strategy of Scientific and Technological Development of the Russian Federation due to the changes in the geopolitical situation.

[5] "On amendments to the State Program of the Russian Federation 'Public Finance Management and Regulation of Financial Markets'": RF Government Resolution 1613, dated September 25, 2021. *SPS Konsul'tantPlyus* (accessed: September 7, 2023).

[6] "On measures for the development of higher education and science in order to adapt to the needs of the real sector of the economy": Federation Council Resolution 123-SF, dated March 31, 2021. *SPS Konsul'tantPlyus* (accessed: September 7, 2023).

[7] List of instructions following the meeting of the Council on Science and Education, paragraph 2a (approved by the President of the Russian Federation on April 20, 2023, Pr-800)

[8] Transcript of the February 8, 2023 Board of Science and Education meeting. Available at: http://www.kremlin.ru/events/president/transcripts/deliberations/70473 (accessed: September 11, 2023).

Assessing the effectiveness of state policy measures is a topical area that requires a critical analysis of existing theoretical developments and practiced methods to determine the optimal option that meets the current trends in scientific, technological and socio-economic development of the state at all levels of government. However, analysis of both foreign and Russian studies has shown that there is currently no set of optimal criteria for assessing the effectiveness of state policy in terms of measures implemented within the framework of various state programs. There are various efficiency assessment methodologies based on an integral assessment of the performance of these programs, which does not fully reflect their effectiveness in terms of quality budget planning for the future.

Foreign researchers (Sanz-Menéndez et al., 1997; Sanz-Menéndez et al., 2005) argue that scientific and technological policy interventions require continuous evaluation throughout their various cycles, including design, implementation, monitoring, evaluation, and change.

In the article *Evaluation as a Medium of Science & Technology Policy: Recent Developments in Germany and Beyond*, peer review procedures (using bibliometrics, etc.) are used as a criterion for the evaluation of scientific and technological policy measures in Germany. These tools are commonly used in the German scientific and technological system, especially in basic and long-term applied research (Kuhlmann, 1996; Kuhlmann, 2003).

China has shown significant interest in implementing an effective scientific and technological policy evaluation process. The National Center of Science and Technology Evaluation (NCSTE) was established in 1997 to address this need. The evaluation system is important in the following four aspects: improving the decision-making process; enhacing macro-level technology management; promoting innovation in the scientific and technological management system; and strengthening the implementation of the national science plan (Luo, 2012). K. Bloch and I. Caetano emphasize the importance of sufficient data in evaluations to account for substantial innovation activity (Bloch, 2007; Caetano, 2017). T. Luukkonen suggests that evaluations should be conducted from the perspective that all unfunded projects can be considered successful (Luukkonen, 1997).

According to Japanese scientists K. Tanaka and I. Sakata, the current methodology for evaluating state policy in the field of scientific and technological is mainly based on a non-quantitative approach, such as interviews or simply summaries of research papers. They propose a new bibliometric approach to quantitative policy evaluation (Tanaka, Sakata, 2017).

Laurent Bach and colleagues proposed an approach based on an original methodology, which involved direct interviews with 176 partners involved in 50 projects (Bach et al., 1995).

According to R. Barre, scientific and technological performance indicators can be a valuable tool for state policy decision-making, as long as they are viewed as starting points for discussion rather than outputs (Barre, 2001).

Swiss researcher B. Lepori suggests that indicators are a useful complement to other methods (surveys, case studies, debates) for summative evaluations, where the focus is on measuring program outcomes and the extent to which program goals have been achieved. However, indicators have a much broader potential for formative evaluation (Lepori, Reale, 2012).

Russian researchers suggest assessing effectiveness through an integral performance assessment that considers the level of achievement of target indicators, the assigned weight values of these indicators, and the level of financial provision of state programs (Tulyakova, 2017).

We believe that the most rational and comprehensive approach to the assessment of state programs in the context of their elements (main activities, subprogram, state program) is proposed by A.G. Breusova. The assessment should take into account the logic of the program (this will allow identifying defective elements and evaluate the relationship "activities – indicators"), as well as linking subprograms (target indicators) and the goal of the state program (in this case, it is possible to assess the contribution of subprograms to the goal of the state program). Then, the effectiveness of the state program is calculated using indices and an integral indicator that considers all the assessment elements listed (Breusova, 2015).

An alternative approach to assessing the effectiveness of state policy measures and activities was proposed by researchers at the National Research University Higher School of Economics. In 2022, L.M. Gokhberg and co-authors compiled a rating of scientific and technological policy measures (Gokhberg et al., 2022). The study is based on the survey of representatives from scientific organizations and universities. The survey results were used to construct indices of potential coverage; demand; success of use; significance; integral index (geometric mean of the indices of demand and significance of the measure).

In 2013, I.N. Rykova considered approaches to evaluate the performance of scientific research activities in Russia. According to her article, a number of organizations (Rosstat, Ministry of Culture, Ministry of Labor) use a point system of assessment that is ranked depending on the value obtained. While most methodological guidelines include a set of indicators, they do not provide the methodology for assessing and ranking them (Rykova, 2013).

Each of the presented methods solves specific tasks set by the researcher. In particular, the assessment of the effectiveness of state program measures is limited to the criteria specified in the programs and cannot comprehensively reflect the existing trends. Additionally, assessing state policy measures solely based on performance does not fully reflect their effectiveness. We believe that the analysis of any state support measure should involve multiple evaluation stages, with each element integrated into a comprehensive assessment to create an optimal analytical model.

**Research methods**

The research tasks were solved using general scientific methods, including analysis, synthesis, and generalization, as well as empirical methods such as observation, comparison, measurement, grouping, and forecasting. These methods were used to assess performance and growth dynamics of target indicators. The survey employed sociological observation methods and cluster analysis.

**Approbation of the developed methodology for assessing the effectiveness of measures and tools of the state policy in the field of science and technology**

This Methodology outlines the rules for calculating metrics that reflect the effectiveness of state policy in the field of scientific and technological measures and instruments. To comprehensively determine the effectiveness of state policy measures and activities and improve the quality of state support provided, an integrated approach to the assessment of effectiveness is required.

The effectiveness of measures/activities of state policy in a broad sense is an indicator of success in the implemented measures and directions of state policy and includes a comprehensive assessment of: 1) performance, 2) achievement of target indicators, 3) demand (usability, sufficiency) of measures and instruments of state policy by the scientific community. This approach is implemented in the framework of this study.

Thus, the implementation of the proposed author's methodological approach for evaluation includes performance assessment, which compares actual data with planned data, characterizes the degree of implementation of the Plan (stage 1 and the transition period) and serves as a basis for conclusions based on the results of checking the validity of planned indicators. The performance assessment consisted of five blocks, which align with the main directions of state policy in the field of scientific and technological development outlined in the Strategy (p. 31–35).

The assessment of target indicators compares their current values with those from previous years during the implementation of the Strategy for Scientific and Technological Development of the Russian Federation. The list of indicators subject to monitoring is based on the Strategy for Scientific and Technological Development of the Russian Federation[9].

Demand assessment is a study based on the analysis of survey data of the university and scientific community on the use of tools and activities outlined in the first stage of the Plan, and highlighting the most effective solutions for socio-economic development in the field of public administration.

***The evaluation of the effectiveness of state policy measures and instruments*** is conducted in five directions for each year of implementing the Strategy for Scientific and Technological Development of the Russian Federation (hereafter – the S&T Development Strategy), with equal weight given to each direction in the final result. The methodology uses a point-based assessment, with the total maximum number of points equal to 100 for the five directions of the S&T Development Strategy. Therefore, the maximum score for each direction is 20.

The following five state policy directions are involved in the assessment:

1) human resources and human capital;
2) infrastructure and environment;
3) interaction and cooperation;
4) management and investment;
5) collaboration and integration.

The effectiveness assessment is conducted through a series of stages.

The **first stage** is to analyze the anticipated outcomes and categorize the indicators into two groups: quantitative and qualitative.

For quantitative indicators, we collect and process the statistical base. For qualitative indicators, we define a scale to assess the implementation of the activity[10].

The **second stage** is to divide all indicators into three groups:

1) quantitative indicators – the percentage of fulfillment of the planned indicator in comparison with the actual values is assessed;
2) qualitative indicators are assessed in two ways:
3) regulatory legal act (RLA);
4) individual state policy measures that cannot be digitized.

During the **third stage**, performance assessment is conducted for each direction based on the group to which the expected result belongs.

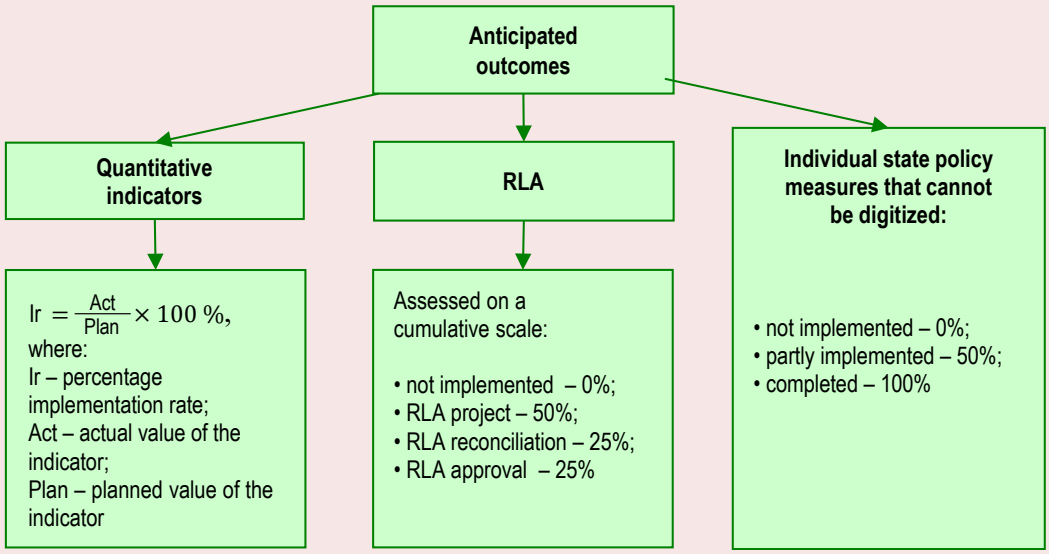
To assess qualitative indicators that are not numerical, it is essential to analyze the level of implementation regarding the preparation and approval of RLA. The same method is applied to assess other state policy measures that cannot be digitized[11] *(Fig. 1)*.

[9] "On approval of the List of indicators for the implementation of the Strategy for scientific and technological development of the Russian Federation, the dynamics of which are subject to monitoring": RF Government Resolution 1824-r dated August 15, 2019.

[10] Qualitative indicators are defined as indicators that cannot be analyzed using statistical methods and do not have specific numerical values.

[11] This approach includes peer review.

Figure 1. Algorithm for calculating indicators within the framework of state policy measures




Source: own compilation.

At the **fourth stage**, an indicator is calculated for each direction of the S&T Development Strategy.

Calculation of the total indicator for the direction is made according to the formula ($I_{dir}$):

$$I_{dir} = \sum_1^n \frac{20}{n} \times I_r, \quad (1)$$

where $n$ – number of activities to be assessed according to directions;

$I_r$ – percentage implementation rate.

For example, if there are 10 activities in a direction, then the maximum score for each item will be 2; if there are 20 items – 1 point.

At the **fifth stage**, the final score is calculated as the sum of the total scores for the directions (I):

$$I = \sum_1^5 I_{dir}, \quad (2)$$

where $I_{dir}$ – performance indicator according to the direction in points.

The **sixth stage** involves analyzing and evaluating the effectiveness of measures and instruments of the state scientific and technological policy.

The assessment is made for each direction of the S&T Development Strategy, for this purpose the number of points scored for a direction is compared with the maximum possible score. The final score of the effectiveness of measures and instruments of the state scientific and technological policy is assessed in the same way.

The level of activity implementation is evaluated using the following scales.

For the respective direction of state policy measures, the performance (%) equal to:

– 18–20 – high;
– 11–17 – average;
– 10 and lower – low.

To evaluate the total indicator:

– 80–100 – high;
– 51–79 – average;
– 50 and lower – low.

Further we interpret the results, assess the strengths, weaknesses, and factors that influenced the results; make conclusions.

***Assessment of growth rates of target indicators characterizing the effectiveness of measures and instruments of the state policy of S&T Development***

Assessment of growth rates of target indicators characterizing the effectiveness of measures and instruments of the state policy of S&T Development is carried out only for those measures for which the effectiveness is not lower than average in the period 2020–2022 at the first level of analysis.

The assessment is carried out on the basis of analyzing the dynamics of target indicators by assessing the dynamics of growth rates of target indicators in the areas of the S&T Development Strategy (in the periods 2017–2019; 2020–2021).

The **first stage** is to calculate the growth rates of targets related to the current direction.

The growth rate of the target indicator corresponding to the direction is calculated by the following formula (3):

$$GR_{ti} = \frac{V_{ti}^{e}}{V_{ti}^{e-1}}, \quad (3)$$

where:

$GR_{ti}$ – growth rate of the target indicator;

$V_{ti}^{e}$ – value of the target indicator in the assessed period;

$V_{ti}^{e-1}$ – value of the target indicator of the period preceding the period under assessment.

The **second stage** is to assess the dynamics of growth rates. We compare the growth rates of the indicator for each period:

– 2017–2019[12];

– 2020–2022.

If the value of the growth rate is greater than 1, it indicates the effectiveness of the implemented measures in the relevant direction of state policy. If the growth rate is not observed or even tends to decrease, it negatively characterizes the effectiveness of the implemented measures.

[12] The 2017–2019 growth rate is estimated in accordance with the first stage of the Plan.

The **third stage** is to form conclusions, findings and proposals for the implementation of the S&T Development Strategy**.**

***Assessment of the demand for measures and instruments of the state policy in the field of scientific and technical development by the scientific community***

The assessment of demand is carried out on the basis of a study conducted by the Ministry of Education and Science of Russia in 2021 of organizations engaged in educational activities for the implementation of educational programs of higher education, and other organizations engaged in scientific and (or) scientific-technical activities. The research was conducted by RIEPL by sending out inquiries to Russian scientific and educational organizations in order to collect statistical data and subsequent analysis of the obtained information using MS Excel software.

The survey results serve as indicators of the demand for state policy measures within the proposed Methodology.

We calculate integral indices for the relevant measures characterizing the respondents' opinions. Each index (D) includes a number of attributes (A).

The value of the evaluation attributes of the measures is calculated according to the formula (4):

$$\mathrm{A}_{x} = \frac{\mathrm{N}_{x}}{\mathrm{N}}, \quad (4)$$

$\mathrm{A}_{x}$ – value of the attributes of the evaluation of measures corresponding to the question alternative with rank $x$;

$x$ – rank assigned to the question alternative;

N – number of respondents who indicated an alternative to the question.

The rank is assigned as follows: the alternative "hesitate to respond" is assigned a rank of 0; a positive respond is assigned a rank of 1, a negative respond is assigned a rank of 2.

The value of the index ($D_i$) is calculated as the arithmetic mean of the values of the attributes of the evaluation of measures according to the formula (5):

$$D_i = \frac{\sum_1^n A_e}{n} \times 100\%, \quad (5)$$

where:

$D_i$ – value of the index corresponding to the measure with the number i;

$i$ – number of measures;

$A_e$ – measure evaluation attribute;

$n$ – number of indicator values.

The result is determined on the following scale:

up to 50% – low demand;

from 51 to 79% – average;

from 80 to 100% – high.

A consolidated report is formed based on the results of assessing the effectiveness of state policy measures in three directions. The report combines the results of the assessment of each level and forms a conclusion on the effectiveness of state policy instruments and measures by direction:

– performance;

– growth rate of target indicators;

– relevance to the scientific community *(Tab. 1)*.

**Research findings**

The analysis revealed average performance in all directions of the S&T Development Strategy. Out of the 46 planned activities, 25 were implemented, while 21 were only partially implemented. The final score of 74.5 corresponds to the average performance of the measures conducted under the state policy in the field of science and technology of the Russian Federation.

The growth rates of the indicators of the implementation of the Strategy for Scientific and Technological Development of the Russian Federation approved by the Resolution of the Government of the Russian Federation 1824-r, dated August 15, 2019 were also assessed. Three indicators out of eleven increased in relation to the level of values at the end of the first stage of the Strategy's implementation (2019; *Tab. 2*):

– share of organizations implementing technological innovations in the total number of organizations;

– ratio of exports and imports of technologies and services of technological nature (including intellectual property rights);

– technical equipment of the research and development sector (book value of machinery and equipment per one researcher). thousand rubles/person.

Two indicators remained at the same level:

– the share of innovative products (goods, services) created using the results of intellectual activity, the rights to which belong to Russian right holders, in the gross domestic product,

– ratio of extrabudgetary funds and budgetary allocations as part of internal research and development costs.

Table 1. Summary data on criteria for assessing the effectiveness of state policy instruments and measures

| Measure | Performance | Growth rates of indicators | Demand | Effectiveness assessment |
|---|---|---|---|---|
| Measure 1 | High/average | > 1 | High/average | Effective |
| Measure 2 | High/average | < 1 | Low | Ineffective, with growth rates that can be deferred over time |
| Measure 3 | High/average | < 1 | High/average | Effective, requires additional analysis as growth rates may be deferred over time |
| … | High/average | > 1 | Low | Effective in terms of growth rates, ineffective by demand criterion |
| Source: own compilation. | | | | |

Table 2. Change in the values of target indicators of the Strategy implementation between 2019 and 2021

| No. | Indicator | 2019 | 2020 | 2021 | Delta end of the first stage (2019) and second stage |
|---|---|---|---|---|---|
| 1 | Internal expenditures on research and development from all sources in current prices, % of gross domestic product | 1.03 | 1.1 | 1 | -0.03 |
| 2 | Ratio of extra-budgetary funds to budgetary allocations in internal research and development costs, % | 0.55 | 0.53 | 0.55 | 0 |
| 3 | Amount of extra-budgetary funds raised as part of the implementation of integrated scientific and technological programs (projects), federal scientific and technological programs and projects of the centers of the National Technological Initiative, million rubles | no data | 4,328.7 | 6,374.7 | - |
| 4 | Place of the Russian Federation in terms of specific weight in the total number of articles in the fields defined by the priorities of scientific and technological development in the publications indexed in international databases | 7 | 8 | 9 | -2 |
| 5 | Position of the Russian Federation in terms of specific weight in the total number of invention patent applications filed worldwide in the directions determined by the priorities of scientific and technological development | 10 | 10 | 11 | -1 |
| 6 | Share of innovative products (goods, services) created using the results of intellectual activity, the rights to which belong to Russian right holders, in the gross domestic product, % | 1.09 | 1.18 | 1.09 | 0 |
| 7 | Share of organizations implementing technological innovations in the total number of organizations, % | 21.6 | 23 | 23 | 1.40 |
| 8 | Ratio of exports to imports of technology and technological services (including intellectual property rights) | 0.73 | 0.94 | 1.08 | 0.35 |
| 9 | Exports of Russian high-tech goods, % | 12.2 | 26.2 | 8.3 | -3.90 |
| 10 | Share of researchers under 39 years of age in the total number of Russian researchers, % | 44.2 | 44.3 | 43.9 | -0.30 |
| 11 | Technical equipment of the research and development sector (book value of machinery and equipment per researcher). thousand rubles/person | 1,046 | 1,080.2 | 1,187.9 | 141.90 |

Source: p. 1–2 and 4–11 – Rosstat data;
p. 3 – The methodology for calculating the indicator is approved by the Ministry of Education and Science in 2019.

Five indicators are trending downward with respect to 2019:

– internal expenditure on research and development from all sources at current prices as a percentage of gross domestic product;

– the place of the Russian Federation in terms of specific weight in the total number of articles in the fields defined by the priorities of scientific and technological development in the publications indexed in international databases;

– place of the Russian Federation in terms of specific weight in the total number of invention patent applications filed in the world in the areas determined by the priorities of scientific and technological development;

– export of Russian high-tech goods;

– share of researchers under the age of 39 in the total number of Russian researchers.

No data is available for the indicator "volume of extrabudgetary funds raised within the framework of implementation of integrated scientific and technical programs (projects), federal scientific and technical programs and projects of the centers of the National Technological Initiative" for the year 2019.

However, the indicator's value increased by 47% in 2021 compared to 2020. This increase is primarily due to the low base, as 2020 was characterized by a drop in economic activity caused by coronavirus pandemic restrictions, as well as changes resulting from the geopolitical situation and increased sanctions pressure.

At the same time, the indicators, the dynamics of which are subject to monitoring, do not fully reflect the current conditions of functioning of the Russian scientific complex, which is due to the significant sanctions pressure of Western countries. The risk of failing to achieve the set goals can be measured by the indicator "the place of the Russian Federation in terms of the specific weight in the total number of articles in the areas defined by the priorities of scientific and technological development in the publications indexed in international databases". This indicator is affected by the sanctions imposed on the Russian Federation and the termination of access to international databases. In March 2022, access to international scientific citation databases Web of Science and Scopus was restricted for Russian organizations, resulting in 97.5% of information being blocked for Russian researchers. Additionally, obstacles to the publication of Russian researchers in foreign journals included in these databases were reported. The methodological approach used to calculate this indicator should be adjusted and/or revised.

The third block is to assess the demand (usability, sufficiency) of state policy instruments and measures by the scientific community on the basis of a survey conducted by RIEPL in 2021. The survey aimed to evaluate the scientific and university community's awareness of state policy instruments and measures. The sufficiency, usability, and demand for state policy measures and activities in five directions of state policy of the Russian Federation were assessed by the scientific community in different ways *(Tab. 3)*.

Table 3. Summarized results by criteria for assessing the effectiveness of state policy instruments and measures in five directions

| Direction | Performance score | Performance | Growth rate | Demand, usability, sufficiency | Conclusion on effectiveness |
|---|---|---|---|---|---|
| 1. Human Resources and Human Capital | 16.88 | Average | < 1; decline in most indicators | Average | Effective, requires additional analysis as growth rates may be deferred over time |
| 2. Infrastructure and Environment | 14.29 | Average | < 1; decline in most indicators | Average | Effective, requires additional analysis as growth rates may be deferred over time |
| 3. Interaction and Cooperation | 14.00 | Average | < 1; decline in most indicators | Average | Effective, requires additional analysis as growth rates may be deferred over time |
| 4. Management and Investments | 16.00 | Average | < 1; decline in most indicators | Average | Effective, requires additional analysis as growth rates may be deferred over time |
| 5. Collaboration and Integration | 13.33 | Average | < 1; decline in most indicators | Low | Ineffective, with growth rates that can be deferred over time |
| Total indicator by directions of the S&T Development Strategy | 74.5 | Average | < 1; decline in most indicators | Average | Effective, requires additional analysis as growth rates may be deferred over time |
| Source: own compilation. | | | | | |

The **"Human Resources and Human Capital"** and **"Management and Investments"** directions showed the highest performance, with 16 points or more, corresponding to the average implementation performance. In the "Human Resources and Human Capital" direction, 11 out of 16 measures were fully implemented, while 5 were partially implemented. In the "Management and Investments" direction, 6 out of 10 measures were implemented, while 4 were partially implemented.

Activities aimed at preventing the spread of newly emerging infections have been implemented. Rospotrebnadzor prepared a strategy to combat potential new epidemics in Russia in 2021 "Sanitary Shield of the Country – Safety for Health".

– Rospotrebnadzor's strategy contains four projects:

– using artificial intelligence to monitor emerging threats;

– new educational programs in medicine;

– development of laboratory diagnostics in the country;

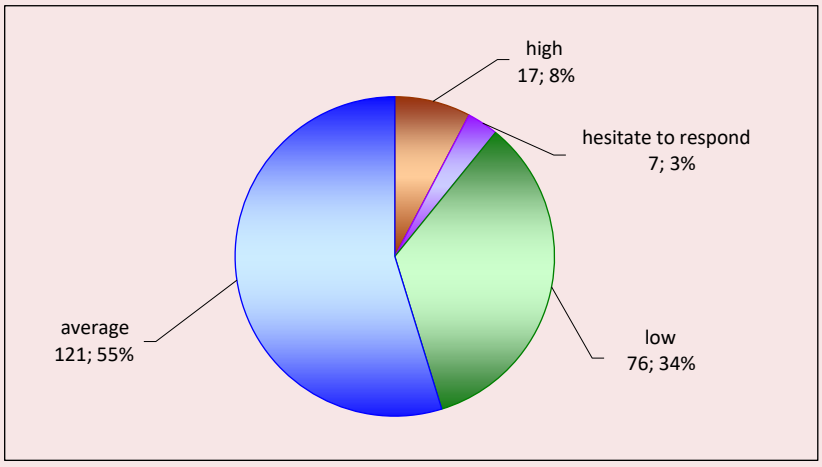
– accelerated implementation of mass testing and immunization.

It can be concluded that the restrictions associated with the pandemic in 2020–2021, as well as increased sanctions pressure, had a lesser impact on the implementation of activities in these directions compared to other directions such as "Infrastructure and Environment", "Interaction and Cooperation", and "Collaboration and Integration", which scored 14 points or lower.

However, the scientific community assesses the sufficiency and usability of measures and activities of state policy in the above two directions in different ways. Thus, more than half of the respondents assess the level of reproduction and growth of personnel in the research and development sector as medium and high. More than half of the respondents (55%) claim that the country has sufficiently developed the mechanism of targeted support for building a career in science and innovation *(Fig. 2, 3)*.

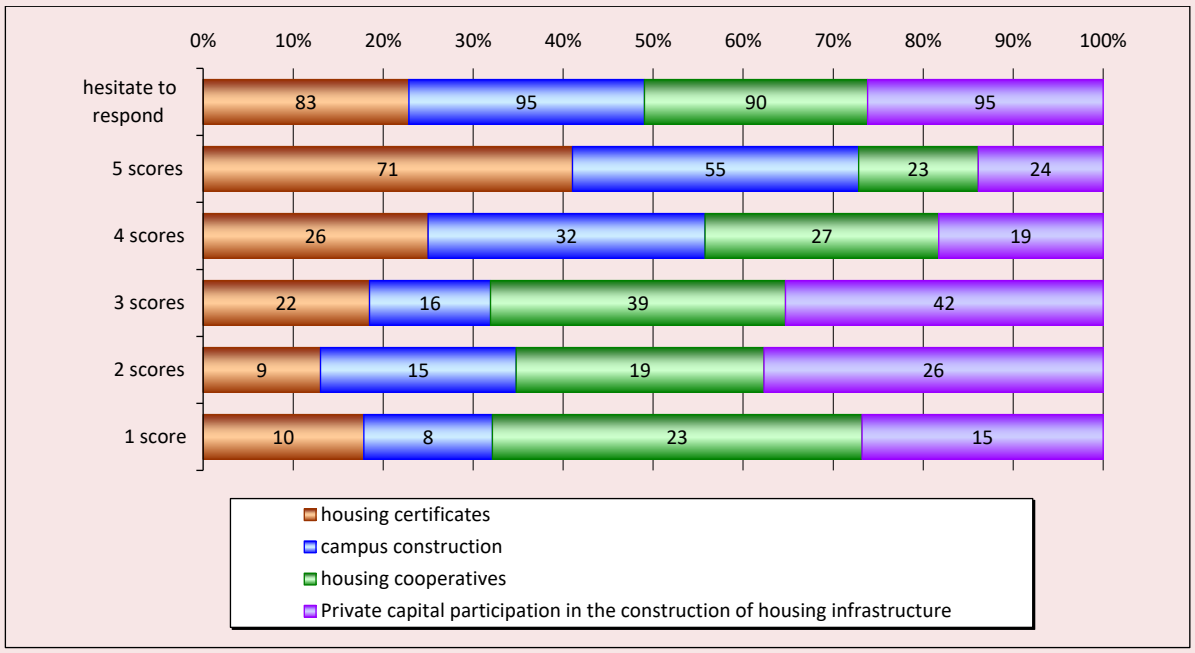
Respondents assessed the sufficiency and demand for measures and activities of state policy in the "Management and Investments" direction as low in terms of supporting and protecting small and medium-sized businesses engaged in research and development (42%; *Fig. 4*).

Figure 2. Distribution of answers to the question "Assess the level of reproduction and growth of highly qualified personnel in the research and development sector", people, %



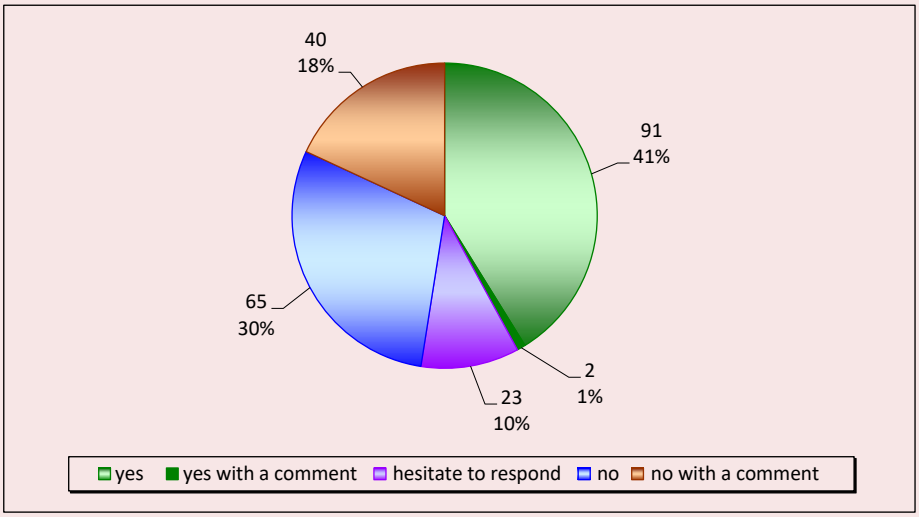

Source: own compilation.

Figure 3. Distribution of answers to the question "On a five-point scale, assess the effectiveness of the following measures to ensure housing conditions", people




Source: own compilation.

Figure 4. Distribution of answers to the question "Do you consider measures to support small and medium-sized businesses engaged in research, development and commercialization of intellectual activity results sufficient?", people, %?




Source: own compilation.

On the other hand, respondents frequently mentioned the lack or difficulty in obtaining support for small and medium-sized businesses, insufficient level of financing and benefits in terms of taxation and equipment purchase, high level of bureaucratization or cumbersome paperwork, high risks associated with doing business. Respondents identified a low level of awareness regarding support measures. They suggest the development of a system to support small and medium-sized businesses in research and development. It is noteworthy that 15% of scientific organization representatives found it difficult to answer, indicating a need for improved communication about support measures.

In the **"Infrastructure and Environment"** direction the sum of points is equal to 14.28, which corresponds to the average performance of measures of the state policy. As of the second quarter of 2023, 3 out of 7 measures have been implemented, and 4 have been partially implemented. The main reason is the increase of sanctions pressure on the Russian Federation in 2022, which caused problems with the supply of equipment and parts, as a consequence, the postponement of several projects. It became necessary to search for alternative suppliers from Russia or friendly countries.

For example, equipment for "Siberian Ring Source of Photons" (SKIF Center), a unique core shared research physics center, was previously planned to be purchased from Europe and Japan. However, the Budker Institute of Nuclear Physics SB RAS now manufactures the necessary equipment at its own production facilities or orders it from Russian organizations.

The **"Interaction and Cooperation"** direction suggests the formation of an effective system of communication in the field of science, technology and innovation, increasing the receptivity of the economy and society to innovations, development of knowledge-intensive business. The weighted average performance score was 14, which is one of the lowest scores. This is largely due to the fact that during the implementation period the world faced the pandemic and most of the events on scientific interaction and cooperation were canceled or moved to the online format.

Of the planned results, 100% have been achieved for four objectives, six objectives out of 10 measures have been partially achieved. It is worth noting that one hundred percent of the activities that can be conducted remotely have been implemented successfully. The partially implemented activities involve communication with the population and partners (format of introduction of digital, remote feedback technologies, formation of feedback).

Cooperation between corporations and structures that have mastered the work in the remote mode has also been successfully realized, and the result of such cooperation is the systems of distributed and remote mode of work.

The item related to support for projects included in the National Technology Initiative (hereinafter – NTI) was successfully implemented. This is largely due to the fact that NTI project lines were defined as the most demanded and competitive, and residents of the NTI program are high-tech, highly motivated subjects.

The level of demand and sufficiency of support measures in this direction is average.

Respondents named science cities, engineering centers, NTI centers and research and education centers as the most effective tools for forming requests for the results of scientific and scientific-technical activity.

Three activities related to **"Collaboration and Integration"** were evaluated, and the weighted average score was 13.3. However, only one of the three activities were fully implemented.

The implementation of this section largely fell on the period of the pandemic in 2020–2021, as a result, there is a decline in the implementation of measures and instruments of state policy in

the field of S&T Development. In addition, the strengthening of sanctions pressure and the subsequent breakdown of scientific ties in 2022 had a negative impact on international scientific and technological cooperation and the implementation of activities in this direction.

Cooperation with the scientific communities of the CIS countries continues despite the limitations. Russia is defining new vectors for partnership development, including cooperation with Middle Eastern and Mediterranean countries, African states, members of the BRICS and SCO interstate associations, and others.

During the previous stage, there was a significant push toward the development of scientific diplomacy mechanisms. This requires coordinated and verified collaboration with representatives of the Russian scientific community living and working abroad.

Among the surveyed respondents, 40% consider the support mechanisms aimed at promoting high-tech products abroad to be insufficient *(Fig. 5)*.

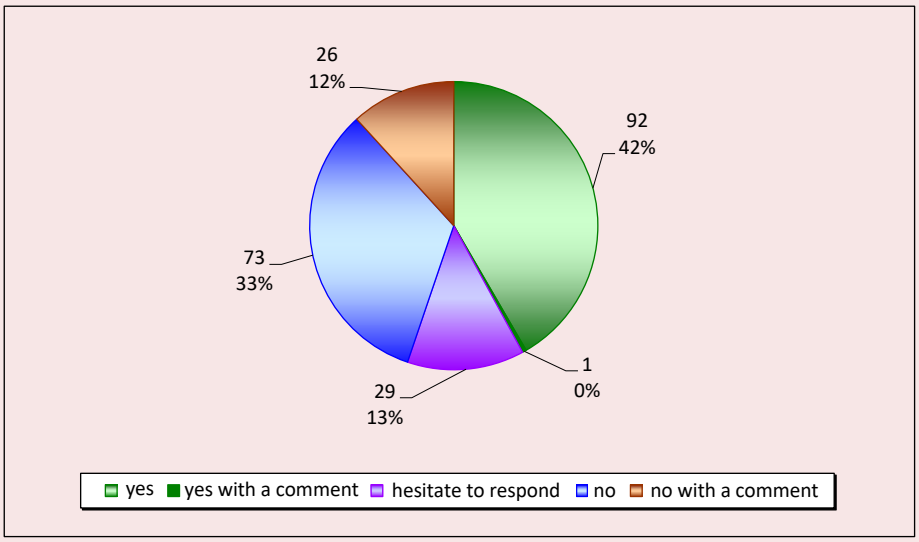
Additionally, 42% of respondents consider the efforts made by trade missions of the Russian Federation in foreign countries to promote Russian scientific and innovative developments in international markets as insufficient.

**Conclusion**

Within the framework of the conducted research we have developed and tested the methodology for assessing the effectiveness of measures and instruments of the state policy of the Russian Federation.

The study showed that despite the postponement of deadlines for some activities and the average performance of activities due to coronavirus restrictions, as well as the complex geopolitical situation, Russia is building capacity and striving to strengthen its global competitiveness in a number of priority directions: information and communication technologies, artificial intelligence, cybersecurity technologies and biomedicine, which are crucial for the development of advanced dual-use technologies.

Figure 5. Distribution of answers to the question “Do you think that trade missions of the Russian Federation in foreign countries make sufficient efforts to promote Russian research and innovation developments in international markets?”, people, %?




Source: own compilation.

It is the development of the country's information and telecommunication basis and the accelerated development of medicine and biotechnology that open up huge opportunities for Russia. There is a wide space for scientific and engineering work in these areas (Malinetskii, 2021). It is extremely important to maintain Russia's competitive position in strategically important areas (Dmitrenko, 2018).

The period under consideration (2020–2022) has become a transition period to the second stage of the S&T Development Strategy implementation. Organizational, financial and legislative mechanisms have been created; an integral system of sustainable reproduction and attraction of personnel for scientific and technological development of the country has been formed; scientific and technological projects within the framework of the priorities of scientific and technological development of the Russian Federation have been launched and are under implementation; conditions necessary for the growth of investment attractiveness of scientific, scientific and technological and innovation activities have been created.

The study suggests a successful form of support for the creation of solutions and technologies in the priority areas of the S&T Development Strategy. Nevertheless, efforts should be made to enhance the motivation of representatives of the industrial sector in order to form Russian technological base for the creation of high-tech production systems, as well as Russian cloud systems, artificial intelligence technologies and the practice of working with big numerical data.

The COVID-19 pandemic in 2020–2021 and the geopolitical situation, which changed in 2022, resulted in the suspension of cooperation between the Russian scientific and industrial complex and partners from European countries, the United States, and other states. This has accelerated the transition from market industrial policy to the policy of ensuring technological sovereignty and highlighted the need to adjust science and technology policy. However, Russian scientists persist in conducting research and development. Currently, scientific and technological collaboration is being redirected toward Asian, African, and Latin American countries, with a clear ambition toward global leadership in scientific development.

The research findings can be useful for executive authorities in the development and substantiation of corrective measures aimed at improving approaches to assessing the effectiveness, including the efficiency and relevance of state policy measures and instruments.

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