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Information Basis to Assess Russian Technological Security: Problems and Solutions

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ABSTRACT

In this study we continue the research on the main indicators of Russia's technological security assessment. In previous study we identified and outlined the main vulnerabilities in the information base for assessing technological development. In this article we will consider the ways to address the problems identified earlier in order to improve the information base and minimise threats to technological security. The methodological basis of the study comprises the normative documents defining the technological development of the Russian Federation, as well as the information base of its indicators. The authors analysed the main strategic documents to determine whether there is a methodological basis for calculating the indicators contained in them, the relevance of their target values and the consistency of planned values with the nature of their dynamics at the present time — to identify the possibility of achieving them. The authors assess the relationship between the level of depreciation of fixed assets in the regions of Russia and the degree of reconstruction and modernization of fixed assets. The article suggests directions of improvement of the information base of indicators, necessary for their improvement and updating.

Keywords: technological sovereignty; technological development; information base; indicators of technological development

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INTRODUCTION

At the current stage, Russia faces challenges and threats to economic security, which necessitate the identification of directions for establishing technological sovereignty based on the development of high-tech industries and innovation-driven economic growth. The primary strategic documents on technological development outline goals for achieving independence in this critical area for the country and indicators for each goal. However, assessing the effectiveness of state policy measures and monitoring the achievement of these goals require an informational foundation. Much scientific research today is dedicated to the quality of indicators for technological independence.

The issue of selecting indicators that can assess the achievement of sovereignty is actively discussed: scientists emphasize the need for their development and for "measuring achieved results and comparing them with costs and potential alternatives" [1]. It is also noted that analyzing the dynamics of key indicators of technological security will help determine its state and identify strengths and vulnerabilities [2]. In publications by foreign authors, it is suggested that the system of technological sovereignty indicators should include qualitative indicators in addition to quantitative ones, allowing for an understanding of when a country can rely on its own resources and when it depends on others [3]. Some researchers propose combining quantitative indicators with expert surveys to assess the level of technological sovereignty, while also utilizing not only statistical data but also patent and bibliometric indicators [4]. Many researchers stress the need to consider limitations when selecting indicators. One of the studies describes difficulties encountered with official statistical data when assessing technological sovereignty: the data is not always available, its reliability is questioned, and the lack of a unified methodology complicates international comparisons [5].

There are also shortcomings in the domestic information base for assessing technological security: it is noted that there is no continuity between the indicators established by key regulatory documents [6]; some indicators are still under development [7]; and threshold values for key technological development indicators are absent [8–10]. In a previous article, the authors examined the main indicators for assessing technological security in Russia [11]. This study proposes solutions to the identified problems to improve the informational foundation and minimize threats to technological security.

RESEARCH RESULTS

In developing proposals to improve the information base of the technological security indicator system, it was taken into account that this system is part of economic security, which, in turn, is an element of national security. It was also considered that security cannot be absolute, and the domestic technological development sphere is not isolated but interconnected with other countries worldwide.

One of the shortcomings of the current information base for indicators is the partial connection between them and their incomplete alignment with the indicators established in key documents regulating technological development. Therefore, this system requires an update and improvement to enable effective monitoring of proposed measures.

In our view, to assess Russia's technological development, it is essential to evaluate the state of the technological sphere to promptly identify challenges and threats. For instance, the Economic Security Strategy[1] identifies creating economic conditions for the development and implementation of modern technologies as one of the measures to ensure security (Section III, Clause 15.3). This means that the conditions established in the economy for technological development are an element of technological

[1] URL: https://www.garant.ru/products/ipo/prime/doc/71572608/

Table

Compliance of indicators of the state of the technological sphere recommended by the Ministry of Economic Development and the Economic Security Strategy

Methodological Recommendations by the Ministry of Economic Development	Economic Security Strategy
Share of investments in fixed assets in GDP	Share of investments in fixed assets in GDP
Physical volume index of investments in fixed assets, % year-on-year	–
Renewal rate of fixed assets by economic sectors, for commercial and non-commercial organizations	–
Share of machinery and equipment in the total volume of fixed assets by economic sectors, for commercial and non-commercial organizations	Share of investments in machinery and equipment in the total volume of investments in fixed assets Share of machinery, equipment, and vehicles in total imports
Share of information, computer, and telecommunication equipment, as well as intellectual property objects and intellectual activity products, in the total volume of fixed assets	–
Degree of depreciation of fixed assets	Degree of depreciation of fixed assets

Source: compiled by the authors.

security in the narrow sense and economic security in the broader sense. Unfortunately, none of the strategic documents defining Russia's technological development include indicators of the state of the material base for creating and implementing technologies. This omission prevents the identification and mitigation of potential threats.

One of directions for improving the information base for technological security assessment is the inclusion of indicators reflecting the state of the material base. These indicators would serve as markers of potential threats in creating economic conditions for developing and implementing modern technologies.

As early as 2020, Russia's Ministry of Economic Development recommended assessing the state of the technological sphere. It approved methodological guidelines[2] containing twenty-three indicators grouped into five categories. The Economic Security Strategy proposes forty indicators for monitoring threats to Russia's economy. A comparison of the two documents shows that three indicators overlap, and three additional indicators proposed by the Ministry of Economic Development aim to expand the set of metrics characterizing the intensity of economic asset modernization (see *Table*).

One of the indicators of technological security is the share of investments in fixed assets as a percentage of GDP.

Additionally, in our view, the physical volume index of investments in fixed assets is an important metric, as it is sensitive to both domestic crises and external shocks. As shown in *Figure 1*, the physical volume index of investments in fixed assets significantly declined during the 2008 financial crisis (by 13.5%), the imposition of sanctions in 2014 (by 10.1%), and the COVID-19 pandemic (by 0.1%).

The depreciation of fixed assets, which reflects the state of economic sectors for technol-

[2] URL: https://ivo.garant.ru/#/document/73685552/paragraph/7:0

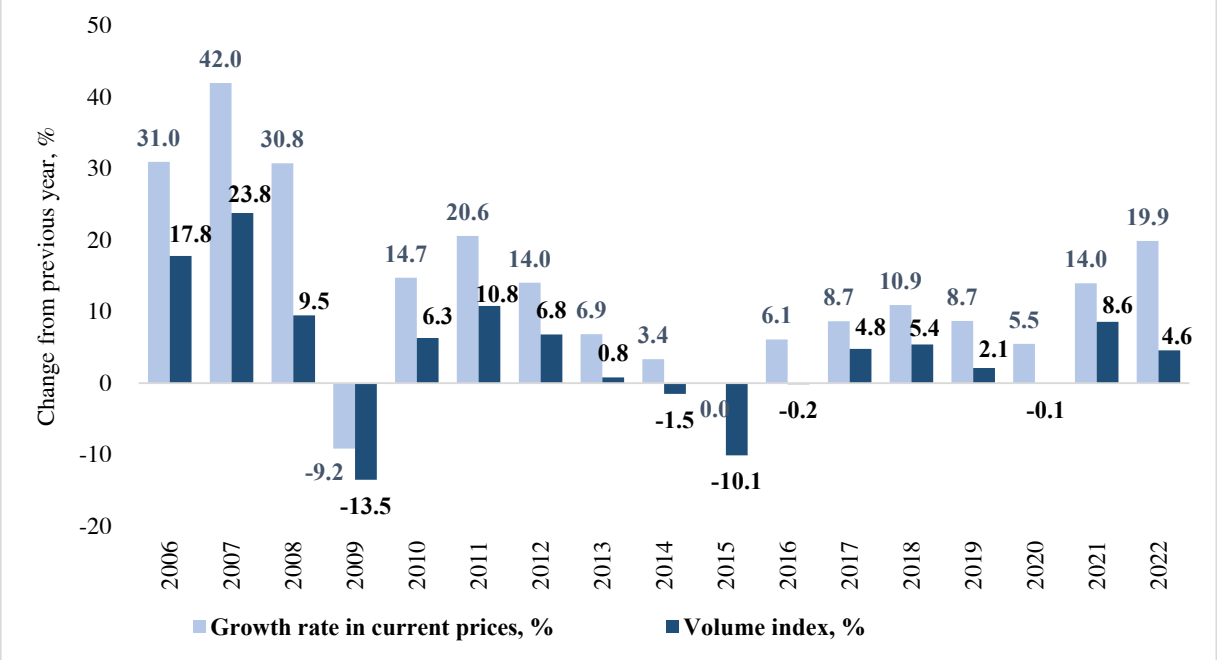

Fig. 1. **Percentage growth of investments in fixed assets in current and comparable prices**

Source: compiled by the authors.

ogy creation, also poses a threat to technological security. As of 2022, Russia's fixed assets were 41% depreciated: machinery and equipment were the most depreciated at 64%, followed by buildings at 54% and vehicles at 49%. This highlights the need for modernization and reconstruction. However, in 2022, with investments in fixed assets totaling 28 trillion rubles, only 14% was directed toward technological development of economic sectors, i.e., reconstruction and modernization. A statistical analysis was conducted to assess the correlation between the level of fixed asset depreciation and the level of reconstruction and modernization of fixed capital. The data used for this analysis was provided by the Federal State Statistics Service.[3] The analysis was carried out across 85 regions of the Russian Federation using the Spearman non-parametric test. The relationship was considered statistically significant at $p < 0.05$. The results showed no statistically significant correlation between the indicators (*Spearman's coefficient* = 0.061; $p = 0.578$), indicating an imbalance between the technological state of the economy and the measures taken to improve it. To monitor the level of modernization and reconstruction of fixed assets, it is advisable to consider the indicator for the share of investments directed toward this in the total volume of investments in fixed assets. Additionally, it is necessary to track the level of the physical volume index of investments in fixed assets and the degree of fixed asset depreciation.

It seems necessary to give uniform names to the indicators established in strategic documents on technological development.

Given that in 2022 the government[4] introduced a moratorium on accounting for scientific publications in journals indexed in international databases, it would be appropriate to remove the indicator reflecting Russia's position in these journals.

[3] URL: https://rosstat.gov.ru/folder/14304; https://rosstat.gov.ru/folder/11189

[4] URL: https://base.garant.ru/403731094/ (дата обращения: 22.09.2024).

The indicator demonstrating the dynamics of internal costs for research and development in the 2024 Strategy[5] is called "growth in the volume of internal expenditures for research and development", while in the 2023 Concept,[6] it is referred to as "growth rate of internal expenditures on research and development at comparable prices to 2022". The latter definition, in our view, more accurately reflects the dynamics of the indicator and is more suitable as an indicator of technological development.

For the indicator characterizing the sufficiency of young researchers, there are also two different formulations: in the 2016 Strategy,[7] it is "the share of researchers under 39 years old in the total number of Russian researchers," while in the 2024 Strategy, it is "the share of young scientists in the total number of scientists." Since data on researchers under 39 has been collected and published for a long time, it is advisable to stick with the first formulation.

Bringing the information base of indicators into uniformity and selecting those that will serve as indicators of technological security will allow for monitoring, timely identification of threats, and finding ways to eliminate them. In our opinion, given the tight deadlines for achieving technological security set by the 2024 Strategy, it is necessary to refine the existing information base of indicators, excluding outdated ones and clarifying the formulations of the relevant ones, selecting those that can already serve as the foundation for assessing technological security, with subsequent improvements.

To modernize the information base, it is essential to intensify efforts in developing methodologies for calculating technological security indicators. The analysis of key strategic documents revealed that, currently, there is no calculation methodology for six indicators out of the sixteen outlined in the 2023 Concept. These include: (1) the achieved level of technological sovereignty, (2) the achieved level of development of critical and cross-cutting technologies, (3) the growth rate of innovative products, works, and services by small technology companies, (4) the number of small technology companies, (5) the growth rate of investments in small technology companies, (6) the share of high-tech industrial products produced in Russia in the total consumption of such products in the country.

There is so far no calculation methodology for two of the five indicators outlined in the 2024 Strategy: (1) the volume of tax revenues to the budget from the sale of products manufactured using domestic technologies, (2) the ratio of sales of domestic science-intensive products to the volume of purchases of similar foreign products.

The calculation methodology for the indicator of the share of organizations engaged in technological innovation within the total number of organizations needs clarification. In December 2019, it was amended, and the value of the indicator since 2017 was recalculated, resulting in a sharp increase from 7.5% to 20.8%. The Accounts Chamber of Russia established that, during statistical monitoring, ambiguous criteria were used to select organizations,[8] and it also pointed out the low coverage (only 50,000 organizations were included in the sample, while the total number was 284,000).

For some indicators of technological development, target values are either missing or have become outdated. Currently, there is a need to determine threshold values for indicators that characterize the technological security of the country.

For monitoring the implementation of the 2016 Strategy, the set of indicators was approved by a government decree,[9] and the planned values were set by the State Program "Scientific

[5] URL: https://www.garant.ru/products/ipo/prime/doc/408518353/

[6] URL: https://www.consultant.ru/document/cons_doc_LAW_447895/

[7] URL: https://base.garant.ru/71551998/

[8] Accounts Chamber of the Russian Federation. Perchyan A.V. Technological development is not subject to statistical observation: the monitoring methodology needs to be improved. July 14, 2020 URL: https://ach.gov.ru/checks/12198

[9] URL: https://legalacts.ru/doc/postanovlenie-pravitelstva-rf-ot-07042018-n-421-ob-utverzhdenii/#

and Technological Development of the Russian Federation,[10]" which has undergone six revisions. Currently, the established planned values have lost their relevance, even though eleven indicators for assessing Russia's scientific and technological development have not been canceled. For monitoring the indicators of the 2024 Strategy, target values have not yet been established, while in the 2023 Concept, target values have been developed for fourteen out of sixteen indicators, six of which are in the form of growth rates at comparable prices to 2022.

This creates a problem, as indicators without developed target values (and in the case of security diagnostics, it is better to speak of threshold values) cannot fully reflect the state of technological security. The target values presented in the 2023 Concept reflect the level of technological development that is planned to be achieved by a certain year, and they should not be considered as indicators of technological security threats, since they have a different nature and do not address the set task.

We agree with researchers of economic and technological security monitoring systems that the foundation of assessment should be indicators for which threshold values have been developed, allowing the differentiation of various states of technological security. This is the so-called indicative approach to monitoring, which provides the opportunity to assess the current level of technological security and reflect the threats outlined in the main strategic documents of technological development. Indicators of the material base for the creation and implementation of technologies should increase as it improves; they should be correlated with the costs that contribute to technological development and the results achieved. Moreover, it is desirable for them to be aligned with the indicators of industrial policy effectiveness, as industrial policy is the main mechanism ensuring technological security.

Let us analyze the target values of some indicators that can be considered as indicators of technological security.

The development of the technology sector is determined by the volume of internal expenditures on research and development. This indicator appears in all three strategic documents: in the 2016 Strategy, expenditures are

[10] URL: https://ivo.garant.ru/#/document/77317971/paragraph/2:5

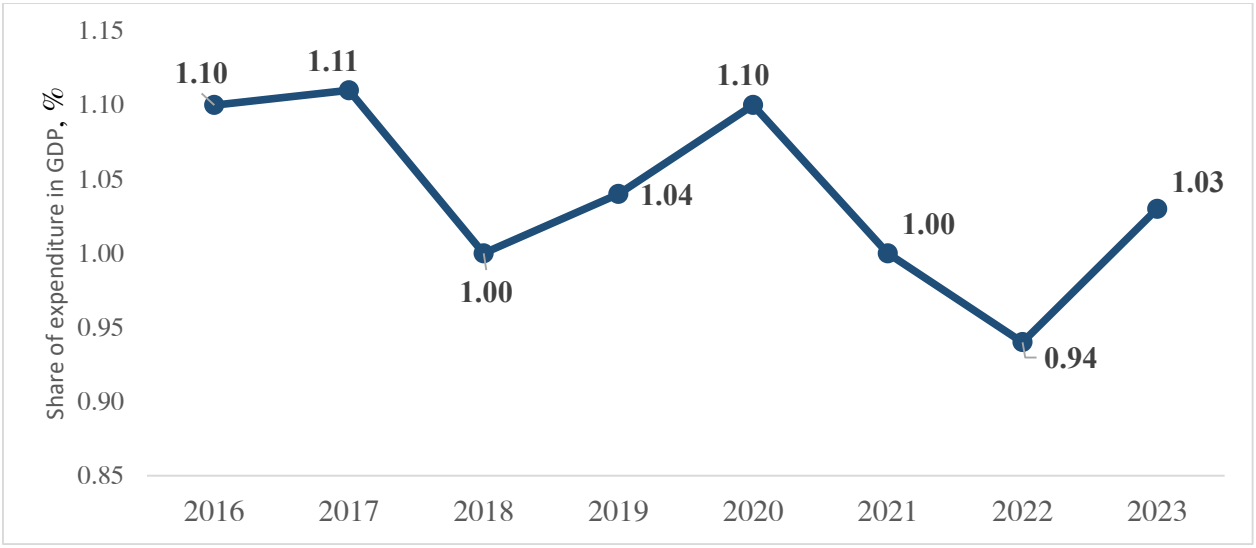

Fig. 2. **Dynamics of the share of domestic R&D expenditures in GDP for the period 2016–2023**

Source: compiled by the authors on the basis of: URL: https://rosstat.gov.ru/statistics/science /

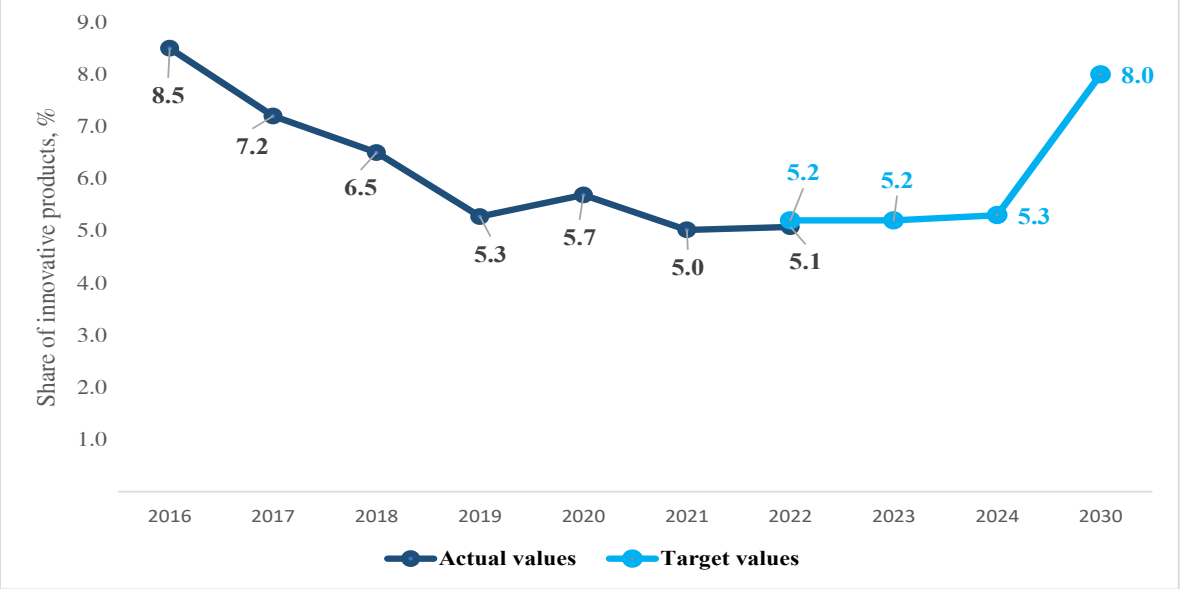

Fig. 3. **The share dynamics of innovative goods, works, and services in the total volume of goods shipped, works completed and services provided**

Source: compiled by the authors on the basis of: URL: https://rosstat.gov.ru/statistics/science

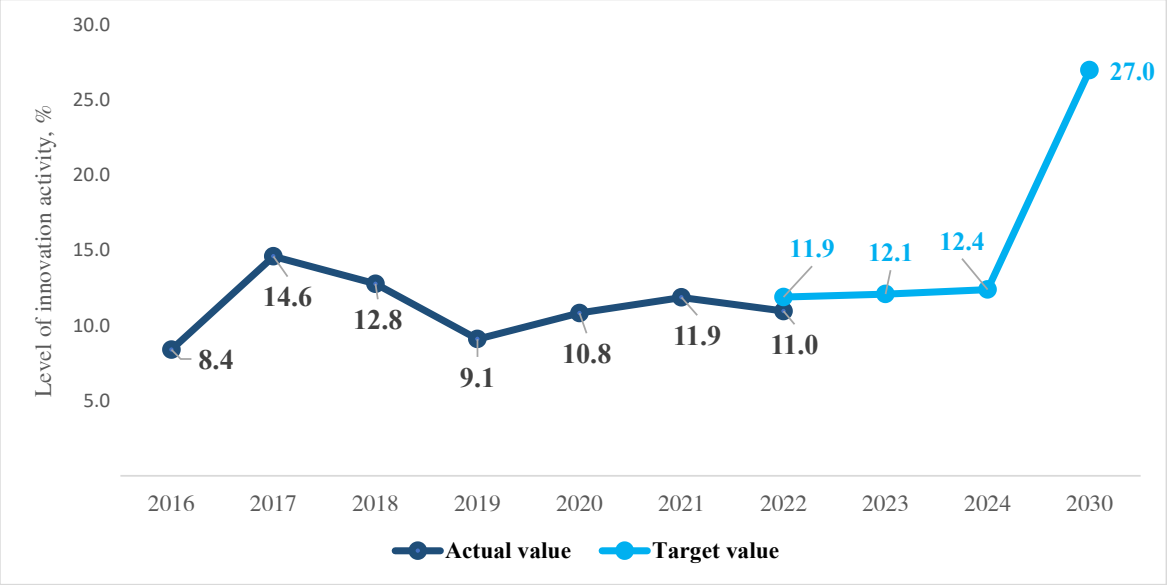

Fig. 4. **Innovation activity dynamics**

Source: compiled by the authors on the basis of: URL: https://rosstat.gov.ru/statistics/science

taken at current prices and compared with GDP; in the 2024 Strategy, it is recommended to calculate the growth of expenditures; and in the 2023 Concept, the growth rate is calculated at comparable prices to 2022. The 2016 Strategy assumed that by 2035, internal expenditures on research and development, as a percentage of GDP, should be at least 2%. From 2016 to 2023, the share of internal expenditures in GDP changed irregularly (see *Figure 2*) — it not only reached the target value but also did not approach it.

In order for the target value to be achieved, the share of internal expenditures in GDP should have increased by an average of 3% annually. However, significant fluctuations in the indicator resulted in an average growth rate of 99.1% over the period under consideration, which can be interpreted as an annual decrease of 0.9% on average. Even assuming that the target value of 2% was reached, it is still significantly lower than the levels of leading countries: the share of internal expenditures on research and development as a percentage of GDP is 6.0% in Israel, 5.2% in South Korea, 4.0% in Taiwan, 3.6% in the USA, and 3.4%[11] in Sweden.

The 2023 Concept includes a growth rate for internal expenditures on research and development at comparable prices to 2022: 146.3% by 2030. Intermediate values are also provided: 107.5% in 2023 and 109.2% in 2024. Since data for 2023 has not yet been published, it is not possible to assess how closely the actual growth rate matches the planned one.

Another important indicator of technological development is the share of innovative products in GDP. A retrospective analysis shows that from 2016 to 2022, this value decreased from 8.5% to 5.1% (see *Figure 3*). However, the 2023 Concept envisions growth to 8.0% by 2030, i.e., back to the 2016 level. To achieve this, the share of innovative products must grow by an average of 5.8% annually. Therefore, it is necessary to assess the validity of the planned indicators, considering that in 2022, the actual value was already below the target.

An important indicator for assessing technological security is the number of organizations engaged in innovation. From 2016 to 2022, there was an increase in innovation activity, partly due to changes in the methodology used by Rosstat to calculate this indicator in 2019. The values starting from 2017 were recalculated, which explains the sharp rise in the indicator in 2017 from 8.4% to 14.6% — the highest point in its actual dynamics (see *Figure 4*). After that, innovation activity decreased on average by 5.5% annually. However, the 2023 Concept envisages more than a twofold increase in growth by 2030, to 27%. To achieve this, the indicator should grow by an average of 11.9% annually, which does not align with the dynamics observed in the previous period.

An informative indicator for monitoring technological security is the technological dependence ratio, the calculation methodology of which needs clarification. However, if it is considered as the ratio of patent applications from foreign and Russian applicants, it is evident that technological dependence, fluctuating unevenly and abruptly between 2016 and 2022, overall decreased from 55.2% to 41.9%. This occurred against the backdrop of a 1.5-fold decrease in patent activity. Moreover, the rate of decline in Russian applications was higher than that of foreign ones, with an average annual decrease of 6.1% and 5.1%, respectively. The exception was 2022, when sanctions were imposed on Russia, and the rate of decline in foreign applications (30.3%) was ten times higher than the Russian rate (3.1%), which led to a reduction in technological dependence in the domestic intellectual property market.

The 2023 Concept provides for a reduction in Russia's technological dependence ratio to 27.3% by 2030. Considering that it was 41.9% in 2022, this suggests a 1.5-fold decrease, which is only achievable through significant structural changes in the domestic patent activity market and is not supported by the dynamics of the indicator in the preceding periods.

A similar situation is observed with the indicator that characterizes the share of manufacturing industry organizations engaged in technological innovations: between 2017 and 2022, its values fluctuated between 27% and 29%, but by 2030, a growth to 45% is planned.

Thus, the target values of some indicators do not align with their dynamics over the preceding period and can be considered inflated. For six of

[11] URL: https://www.oecd.org/

the sixteen indicators established by the 2023 Concept, target values are given in the form of growth rates in comparable prices to 2022. This significantly complicates their monitoring because the target is set not as a specific value but as the intensity of growth, for which the current values must first be recalculated into comparable prices. Therefore, a multi-step calculation process based on data from various sources is necessary.

Currently, Rosstat conducts statistical observations only for advanced technologies. The 2023 Concept includes a preliminary list of cross-cutting technologies, but a list for critical technologies has not yet been provided, even though it has been developed since 2002 and periodically updated. This creates a need for the development of lists for both types of technologies, as well as a methodology for statistical monitoring, taking into account the existing experience, to calculate technological security indicators based on them.

There are also difficulties in assessing the activities of small technological companies, the status of which is established by the Federal Law,[12] with criteria for classifying organizations into this group approved by the Government Resolution.[13] These criteria include revenue (up to 4 billion rubles) and activities in priority sectors of Russia's economy (more than 90 types of activities). A registry of small technological companies is planned, but it has not yet been formed, which complicates the determination of their number and other indicators. Since the 2023 Concept provides for three indicators related to the activities of small technological companies, there is an urgent need to create their registry.

An important area for improving the information base of technological security indicators could be the development of a system for assessing its achievement, which is necessary for monitoring the current state, identifying threats, and assessing the intensity of the development of Russia's technological sector in accordance with the goals and objectives set in the main strategic documents.

One of the options for assessing technological development is described by the Ministry of Economic Development of Russia in its Methodological Recommendations.[14] The proposed approach is based on an integrated indicator calculated for each type of economic activity, allowing for comparisons between them and providing an overall assessment of the technological development of the economy. Another approach to monitoring is outlined in the Regulations on the organization of monitoring of economic security.[15] Although the recommendations in this document are focused on economic security, this approach can also be used for assessing technological security. The methodology involves observing and analyzing the dynamics of economic security indicators and comparing their actual values with projected or permissible limits. The level of goal achievement is assessed in points, based on how close the actual indicator value is to the boundaries of one of five intervals that characterize five possible security states: favorable, stable, unstable, negative, and critical. Both approaches described above have undeniable advantages and could form the basis for creating a system for evaluating technological security, but for this to happen, threshold and target values must be developed.

Unfortunately, strategic documents lack an indicator for monitoring one of the technological security challenges — the concentration of scientific, technological, and educational potential in specific regions of the country — something that needs to be addressed.

Our experience shows that the information base for assessing technological security is based on quantitative indicators. This is correct, as target and threshold values can be de-

[12] URL: http://publication.pravo.gov.ru/document/00001202308040087

[13] URL: http://government.ru/news/50032/ (дата обращения: 22.09.2024).

[14] URL: https://ivo.garant.ru/#/document/73685552/paragraph/7:0

[15] URL: https://ivo.garant.ru/#/document/72272840/paragraph/7:0

veloped for them, and there are many tools for their analysis. However, it is also important to consider survey results, which provide feedback from the business community — information that cannot be obtained through indicators developed in the main strategic documents.

CONCLUSION

In conclusion, the following directions for improving the information base of the technological security indicator system can be identified:

1. Consider indicators of the state of the material base that will serve as indicators of the presence of threats in the area of creating economic conditions for the development and implementation of modern technologies.

2. Standardize the terminology of indicators established in the strategic documents on technological development.

3. Intensify efforts to develop methodologies for calculating technological security indicators that are not yet defined.

4. Develop threshold values for indicators that characterize the technological security of the country.

5. Clarify the target values of technological security indicators established by the main strategic documents.

6. Compile a list of cross-cutting and critical technologies, as well as methodologies for statistical monitoring of them, based on existing experience monitoring advanced technologies.

7. Create a registry of small technological companies to assess their quantity and activities.

8. Develop a system for assessing technological security based on threshold and target values.

9. Add an indicator to the technological security system to monitor the degree of concentration of scientific, technological, and educational potential in specific regions of the country.

10. Supplement the information base for assessing technological security in Russia with survey results from the business community on the introduction of new technologies into the production process and the obstacles to doing so.

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