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Analysis of the Systems for Monitoring the Scientific and Technological Development of the BRICS Countries: Problems and Possible Solutions



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Abstract. In the context of intensifying global technological competition, science and technology development has become one of the key factors of national competitiveness, resilience, and strategic autonomy. For the BRICS countries, this sphere is especially important because it combines the tasks of economic modernization, strengthening domestic scientific capacity, and developing national mechanisms of technological advancement. The purpose of the article is to identify common trends and national specificities in the monitoring systems of science and technology development in the BRICS countries through a comparative analysis of roadmaps and indicator architecture. The empirical basis includes official strategic and program documents of Brazil, Russia, India, China, and South Africa. The methodological framework combines comparative analysis, qualitative content analysis of documents, a systems approach. An approach distinguishing resource, output, applied-effect, and strategic-impact

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indicators was used for cross-country comparison. The study shows that the BRICS countries differ in the function of monitoring within the system of public governance of science and technology development. Russia and China demonstrate predominantly centralized models in which monitoring is embedded in the strategic planning framework. India is characterized by a mission-oriented evaluative model that combines program flexibility, digital monitoring contours, and pronounced feedback mechanisms. Brazil and South Africa are closer to coordination-transformational models focused on linking strategic and program levels. The scientific novelty of the article lies in comparing the BRICS countries not by aggregate statistical indicators, but by the architecture of monitoring as a specific element of public science and technology policy. The practical significance of the study lies in the possibility of using its conclusions to improve national monitoring systems, develop interim assessment procedures and adjust government policy in the scientific and technological field, as well as identify the need for a strategic system of scientific and technological cooperation within the entire BRICS association.

Key words: BRICS, science and technology development, science and technology policy, monitoring system, roadmaps, indicators, public governance, comparative analysis, performance evaluation.

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Introduction

Technologies are becoming one of the most important resources for the socio-economic development of society in today’s geo-economic conditions. Research in this area is of critical importance for the development and implementation of state strategies for science and technology development. Geopolitical instability and fragmentation have led to technologies becoming the basis for interstate competition (Kireeva, Pozdnyaev, 2026). A number of countries are following the path of increasing their technological leadership. China (Cha, 2023), the states of the European Union (Roch, Oleart, 2024), the United States (Reynolds, 2024); others are on the path to achieving technological sovereignty (Russia, India, Brazil) and bridging the gap in technological innovation (Dezhina, Ponomarev, 2022).

A large body of research has been accumulated in the scientific literature devoted to these issues. The works of N.V. Smorodinskaya and D.D. Katukov examine the issues of technological self-sufficiency,

primarily in Russia (Katukov, Smorodinskaya, 2025; Smorodinskaya, Katukov, 2024). M.A. Gershman and co-authors analyze the science and technology policies of various countries, focusing on strategies for achieving technological leadership (Gershman et al., 2025).

However, issues related to the effectiveness of national systems for assessing and monitoring the science and technology development of the BRICS countries are addressed relatively rarely. Within the framework of existing studies, for example, those conducted by the Russian Institute of Economics, Politics and Law in the scientific and technical sphere (Ilyina et al., 2023), the problem of the effectiveness of scientific and technological development is considered more from the perspective of the need to develop a universal tool for the subsequent harmonization of monitoring systems within the association. The works of foreign authors are more focused on the effectiveness of national innovation systems and their role in ensuring the

sustainability of economic growth (Alnafrah, 2021). The indices and aggregated indicators collected by the OECD and UNESCO are convenient metrics for comparative studies in an international context, but they often conceal imbalances¹, whereas sets of indicators, although more transparent, are fragmented. In this regard, the questions of how exactly the performance indicator systems are structured methodologically, what levels of effectiveness dominate in them, and how they reflect the priorities of science and technology policy often remain unexplored. The methodologies developed within the framework of the OECD² and UNESCO³ Statistical Institute only partially address this research question. For example, the Frascati Manual proposes an institutional-sectoral approach⁴. However, the authors of the manual warn that they do not provide official recommendations, as the statistical infrastructure varies from country to country: different data sets are collected and different methodologies are used.

Within the BRICS framework, there is heterogeneity both at the level of the goals of national strategies in the scientific and technological sphere and at the level of the effectiveness of the implemented scientific and technological policy. In comparative studies of the BRICS countries, the main focus is often placed on strategic goals, institutional architecture, publication and patent activity, or overall indicators of innovative development. As a result, the questions of how exactly these countries form their own indicator

systems, which performance levels dominate in them, and how the actual priorities of science and technology policy are expressed through these systems are practically unexplored (Bshivanna et al., 2026).

Currently, the BRICS is governed by a number of documents signed by the Russian Federation at the international level and approved under national legislation, which highlight the need to establish a strategic system for cooperation in the fields of science, technology, and innovation among the BRICS member states, as well as the importance of monitoring the effectiveness of its operation⁵. First and foremost, this is the RF Government Order 434-r, dated February 14, 2015 “On signing of memorandum on cooperation in the field of science, technology and innovation between the Government of the Federative Republic of Brazil, the Government of the Russian Federation, the Government of the Republic of India, the Government of the People’s Republic of China and the Government of the Republic of South Africa,”⁶ which notes the commitment of the BRICS member states to strengthen cooperation in the field of science, technology and innovation for accelerated and sustainable socio-economic development. The strategic document “Concept of International Scientific and Technical Cooperation of the Russian Federation,” which was approved by the RF Government decision TG-P8-952, dated February 8, 2019⁷, identifies priority cooperation with countries participating in international

¹ Belousov D.R., Frolov I.E. (Eds). (2022). On the Long-Term Scientific and Technological Development of Russia: Monograph. Moscow: Dinamik Print. 168 p.

² Available at: www.oecd.org (accessed: 05.08.2026).

³ Available at: uis.unesco.org (accessed: 05.08.2026).

⁴ OECD (2018), Eurostat. Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation. 4th ed. Paris: OECD Publishing. DOI: 10.1787/9789264304604-en. Available from: https://www.oecd.org/en/publications/oslo-manual-2018_9789264304604-en.html

⁵ The joint website of the foreign ministries of the BRICS member states. Available at: <https://infobrics.org/en/documents/2016/> (accessed: 05.08.2026).

⁶ Current legislation of the Russian Federation. Available at: <https://rulings.ru/government/Rasporyazhenie-Pravitelstva-RF-ot-14.03.2015-N-434-r> (accessed: 05.08.2026).

⁷ The concept of international scientific and technical cooperation. Available at: https://www.minobrnauki.gov.ru/upload/2021/07/kontsepsiya_MNTS_Rossiyskoy_Federatsii.pdf (accessed: 05.08.2026).

associations, including the BRICS, as one of the main areas of international scientific and technical cooperation.

The scientific problem of the study is that differences in national systems for monitoring science and technology development hinder the possibility of forming a strategic system of scientific and technological cooperation within the entire BRICS alliance. The models for implementing state science and technology policy, the varying sets of indicators in terms of structure, and the differences in the logic for assessing results and effects create a research gap that this work addresses.

The aim of the work is to identify the common and specific characteristics of the assessment and monitoring systems of the countries that are part of the BRICS core. The subject of the study is the architecture of the assessment and monitoring systems for science and technology policies. The research hypothesis is that the differences between the BRICS countries manifest themselves not only and not so much in the composition of the indicators used, but rather in the logic of assessing the results of the science and technology policy being implemented.

The article addresses the following tasks to achieve the set goal: systematizes theoretical approaches to the analysis of science and technology policy and monitoring systems; develops an analytical framework for comparing policy documents and the architecture of indicator systems; conducts a comparative analysis of the

monitoring systems of five BRICS countries; identifies common trends, national characteristics, and limitations of the comparability of the analyzed systems. The scientific novelty lies in the development of an analytical approach to comparing policy documents and the architecture of indicator systems for monitoring the science and technology development of the BRICS countries. The practical significance lies in the possibility of using the obtained results when forming a strategic cooperation system within the framework of the BRICS alliance, improving national monitoring systems, and enhancing the quality of assessment of science and technology policy.

Current state of science complexes in the core BRICS countries

The BRICS countries have science complexes that differ in scale, structure, and effectiveness. To form a strategic system of science and technology cooperation, it is necessary to analyze their current state. *Table 1* presents the key parameters of the main BRICS members (R&D expenditures, human resources, patent activity, etc.).

The analysis of R&D expenditures shows that the BRICS countries are highly heterogeneous. While the average share of expenditures in China is 2.23%, in India and South Africa it is 0.67% each. In terms of the number of researchers per million people over the period under analysis, Russia is among the top three. However, if we compare these figures with the number of patent applications filed, China is the leader, followed by Russia and India.

Table 1. The main characteristics of science complexes of the key BRICS countries, average values for 2014–2024

Country	R&D spending, % of GDP	Number of researchers per 1 million people	Number of patent applications filed by residents of the country, pieces	Number of publications, pieces	Share of high-tech exports in GDP, %	Share of added value of high-tech products, % of GDP
Brazil	1.22	903.2	5046.25	62401	12.4	33
Russia	1.05	2832.4	24313	74996	12.3	31.6
India	0.67	241.2	17241.25	13421	10	42
China	2.23	1405.1	1203615	576093	30	41
RSA	0.67	475.8	836.6	13756	6	24

According to: data.worldbank.org.

China is also the leader in terms of the number of publications, followed by Russia and Brazil. In terms of the share of high-tech exports – China, Brazil, Russia, and India. The data presented on the science complexes of the BRICS countries allow drawing the following conclusions: heterogeneity is observed both between the countries and when comparing the ratios of the indicators. For instance, in China, the number of researchers per 1 million people is 1,405.1, and the share of high-tech exports is 30%; in India, it is 241.2 researchers and 10% of high-tech exports, respectively. This imbalance indicates that the BRICS countries are on different trajectories of technological development. And while China is capable of competing with the United States, the task for the other BRICS states is to build up their technological sovereignty.

The discrepancy between the number of scientists and the share of high-tech exports in Russia indicates that the commercialization of technologies is a pressing problem. Patent activity in the country is 50 times lower than in China, which also confirms the thesis about the gap between theoretical developments and their practical application. It is worth noting that high spending on R&D does not guarantee results: with 0.67%, India has a higher share of high-tech products (42%) than Brazil. Therefore, the key factor is the institutional infrastructure of the science sector.

It is this indicator that serves as the basis for calculating the readiness index for advanced technologies, which is calculated based on the presence of institutional conditions for the development of artificial intelligence (AI) and

innovation. Currently, in the ranking by the readiness index for advanced technologies, the BRICS countries occupy positions from 21 to 52 (Tab. 2).

The brief analysis of the current state of science complexes in the BRICS countries has proved that their science and technology development is heterogeneous, and their science complexes operate with varying degrees of efficiency.

Literature review

The following areas of research are relevant to this research: the study of national innovation systems, works on combining instruments of state policy in the science and technology sphere, studies on measuring science and technology development, and comparative research on the BRICS countries (Niembro, Levin, 2026).

The first block consists of works on national innovation systems, which represent the result of interaction between the state, the research sector, business, the education system, and infrastructure institutions (Alnafrah, Bogdanova, 2018). These studies show that the effectiveness of science and technology policy is determined not only by the volume of resources but also by the quality of the institutional environment, the density of cooperative ties, the capacity for knowledge transfer, and the stability of coordination mechanisms (Isaksen et al., 2022; Belussi et al., 2024).

The second block is related to research on the tools of state policy. These works focus on the fact that the effectiveness of state policy depends not only on the quality of individual measures but also on the logic of combining them. For the BRICS

Table 2. Index of readiness for advanced technologies in the BRICS countries

Country	Place	ICT	Professional qualifications	R&D	Industrial potential	Funding opportunity
China	21	101	64	1	6	3
Russia	33	41	29	17	72	63
India	36	9	113	3	10	70
Brazil	38	38	59	18	50	41
RSA	52	76	71	41	55	27

According to: UNCTAD Technology and Innovation Report 2025 (UNCTAD, 2025).

countries, this approach is important, since their science and technology policy is typically based on a combination of strategies (Howoldt, 2024; Lenihan et al., 2025).

The third block consists of studies that examine the problems of measurability of the results of science and technology development. In modern literature, science and technology development is increasingly viewed less as a linear accumulation of resources, publications, and patents. On the contrary, the focus of research is shifting toward analyzing the conversion of accumulated knowledge into specific products and services with export potential (Zhang et al., 2025).

Overall, two main vectors can be identified in the literature on measuring the results of science and technology development. The first relies on the aggregation of traditional statistical indicators that characterize research and development expenditures, the number of research personnel, publication activity, patenting, and innovative products. This approach is implemented in supranational institutions⁸. However, standard sets of indicators, developed for economically homogeneous countries, do not always adequately reflect the specifics of states with varying levels of institutional maturity, territorial asymmetry, different sectoral structures, and different combinations of growth, modernization, and social transformation challenges (Kruss et al., 2025; Olariaga-Santa-Cruz et al., 2024).

The second vector is focused on building more complex evaluative and analytical tools that distinguish between levels of performance, use hierarchies of indicators, and take into account the relationship between invested resources, immediate results, practical application, and long-term effects. It is this vector that is particularly important for

comparative analysis, as it allows going beyond simply recording the scale of scientific activity and raising the question of which results the state considers most significant for evaluation and monitoring (Corrente et al., 2023; Zhang et al., 2025).

The next block consists of studies directly focused on the BRICS countries. One part of them is concerned with comparing macro-level indicators of science and innovation development (Santana et al., 2024), while the other examines national models of science and technology policy, institutional conditions, and strategic priorities of individual states. Russian researchers focus on the institutional logic of the innovation system, the impact of external constraints, and the issues related to technological sovereignty (Volchik, Fursa, 2015; Lenchuk, 2022; Lenchuk, 2024; Smorodinskaya, Katukov, 2024). Chinese scholars concentrate on the state coordination of technological development, the combination of support tools, environmentally oriented innovations, and the regional complexity of innovation policy (Liang, 2024; Liefner, 2025).

Researchers from India emphasize the evolution of the national science and technology policy, its connection with development goals, and the importance of digital infrastructure as a practical tool for implementing science and technology policy (Krishna, 2022; Mammen, Nirupama, 2024; Desai, Manoharan, 2024). The Brazilian case is examined through the lens of innovation barriers, regional and technological disparities, as well as the sectoral and institutional foundations of modernization (Silva, 2025; Araújo et al., 2026; Nehring, 2021). For the Republic of South Africa, studies on the coherence of science and technology policy and the link between innovation and economic growth are significant (Kahn, 2023; Kasongo, Makamu, 2024).

⁸ OECD (2018), Eurostat. Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation. 4th ed. Paris: OECD Publishing. DOI: 10.1787/9789264304604-en. Available at: https://www.oecd.org/en/publications/oslo-manual-2018_9789264304604-en.html

With regard to the BRICS countries, the identified gap manifests itself in the fact that comparative studies either compare aggregated indicators or analyze individual aspects of science and technology policy. It is much less common to analyze how the implementation of national strategies is assessed, how program documents and the architecture of indicators are related, and which monitoring functions dominate in various models of managing science and technology development.

Thus, the existing body of scientific literature provides the necessary theoretical foundation but does not offer a methodological basis for the joint analysis of policy documents, the architecture of indicators, interim assessment mechanisms, and feedback procedures aimed at adjusting science and technology policy in the BRICS countries. It is precisely this gap that this study addresses.

Materials and methods

The object of the study is the systems for assessing and monitoring science and technology development in five BRICS countries: Brazil, Russia, India, China, and the Republic of South Africa. The main documents used were both the national strategies of the BRICS countries and the official documents of the science and technology assessment centers.

For example, for Brazil, the main document regulating science and technology activity is the National Strategy for Science, Technology and Innovation (ENSTI)⁹. In 2020, a new strategy for

2020–2030 was adopted, which revised the science and technology policy and identified systemic problems that had prevented the achievement of the results set out in the 2016–2022 policy¹⁰. The document regulating the assessment of science and technology policy is the Innovation Law (Law 10.973/2004)¹¹. The National Council for Scientific and Technological Cooperation (CNPq)¹² regularly publishes criteria for evaluating the effectiveness of scientific activity (scientific productivity, training of scientific personnel, contribution to innovation). Also in 2021, a national innovation strategy¹³ was published, aimed at expanding the capabilities of the innovation ecosystem in Brazil. To assess the effectiveness of science and technology development in the country, the following indicators are used: spending on R&D, the number of scientific publications, patent activity, the share of high-tech exports, the level of business digitalization, and the number of researchers per 1 million inhabitants¹⁴.

In China, where the main goals of science and technology development are set out in five-year plans, the assessment of science and technology activities is carried out in accordance with the standards developed by the National Center for Science and Technology Evaluation (NCSTE)¹⁵. The standards set out the principles of assessment (objectivity, ethics) and define the methodology and rules for the work of experts. The key objective of the standards is to shift the focus from purely quantitative indicators to a more comprehensive

⁹ Available at: <https://www.gov.br/mcti/pt-br/acompanhe-o-mcti/noticias/2021/07/publicada-a-estrategia-nacional-de-inovacao> (accessed: 05.08.2026).

¹⁰ RIAC: Model of scientific diplomacy in Brazil and the prospects for the development of Bilateral scientific cooperation between Russia and Brazil. Available at: <https://russiancouncil.ru/analytics-and-comments/analytics/model-nauchnoy-diplomatii-v-brazilii-i-perspektivy-razvitiya-dvustoronnego-nauchnogo-sotrudnichestva/?ysclid=mt76s18481672590473> (accessed: 05.08.2026).

¹¹ Available at: <https://www.wipo.int/wipolex/en/legislation/details/19033> (accessed: 05.08.2026).

¹² CNPq – Conselho Nacional de Desenvolvimento Científico e Tecnológico. Available at: <https://www.gov.br/cnpq/pt-br> (accessed: 05.08.2026).

¹³ Available at: <https://leemanncenter.stanford.edu/media/fostering-a-new-brazilian-national-innovation-policy> (accessed: 05.08.2026).

¹⁴ Available at: https://www.theglobaleconomy.com/Brazil/GII_Index/ (accessed: 05.08.2026).

¹⁵ NCSTI – International Center for Science & Technology Innovation. Available at: <https://en.ncsti.gov.cn/> (accessed: 05.08.2026).

assessment of innovative potential. The National Bureau of Statistics of China¹⁶ is responsible for collecting indicators reflecting the effectiveness of science and technology development. In addition to traditional indicators, China collects information on the average cost of contracts in the technology market (indicator of the commercialization of developments), the share of graduates in natural sciences and engineering, and the innovation potential index¹⁷.

The system for monitoring the effectiveness of India's science and technology development is based on a technology maturity assessment scale¹⁸, which makes it possible to move from subjective assessments to measurable indicators¹⁹. India also tracks R&D spending, the number of scientific publications (especially in engineering and natural sciences), the number of patents and trademarks, the development of innovation clusters, and the effectiveness of startup support programs²⁰.

In Russia, all target indicators are set out in the Strategy for Scientific and Technological Development until 2035²¹. The list of indicators reflecting the effectiveness of science and technology development is regulated by Order 880-r, dated 08.04.2025 and includes domestic spending on R&D, the share of extra-budgetary spending on R&D, Russia's position in the world

in terms of the volume of scientific research, the share of young scientists, etc. In South Africa, the main strategic document defining the country's science and technology policy is the White Paper on Science, Technology and Innovation²². The Monitoring and Evaluation Framework for the South African Science, Technology and Innovation System²³, developed by the National Advisory Council on Innovation (NACI)²⁴, is used to evaluate its results. The South African approach is the closest to the approach proposed in the Frascati Manual. To assess effectiveness, it is collected data on R&D expenditures, the number of researchers; and the impact of scientific and technological development on the economy and society is assessed²⁵.

The methodological basis of this study consisted of comparative analysis, qualitative content analysis of documents, a systems approach, as well as the classification and typologization of indicators.

The research procedure consists of five main stages. In the first stage, regulatory documents for the BRICS countries were systematized. In the second stage, the selected documents were analyzed to identify strategic priorities, indicators, and feedback mechanisms. In the third stage, the indicators were distributed across analytical levels of performance. In the fourth stage, cross-country comparison was carried out. In the fifth stage, based

¹⁶ China's Innovation Index in 2024. Available at: https://www.stats.gov.cn/english/PressRelease/202510/t20251030_1961735.html (accessed: 05.08.2026).

¹⁷ Available at: <https://issek.hse.ru/news/688845347.html?ysclid=msixbtdslq372001684> (accessed: 05.08.2026).

¹⁸ Available at: <https://psa.gov.in/national-technology-readiness> (accessed: 05.08.2026).

¹⁹ OPSA: Driving Science, Technology, and Innovation for India's Growth. Available at: <https://psa.gov.in/about-us> (accessed: 05.08.2026).

²⁰ Available at: <https://dst.gov.in/dsts-key-achievements-during-2024-year-end-review-2024>; <https://clarivate.com/academia-government/blog/insights-from-the-g20-scorecard-indias-research-performance-in-focus/>; <https://dst.dashboard.nic.in/DashboardF.aspx> (accessed: 05.08.2026).

²¹ Presidential Decree 145, dated February 28, 2024. Available at: <http://www.kremlin.ru/acts/bank/50358/page/1> (accessed: 05.08.2026).

²² Available at: https://www.saasta.ac.za/wp-content/uploads/2019/03/FINAL-White-Paper-to-Cabinet_11-March-2019.pdf (accessed: 05.08.2026).

²³ Available at: <https://www.saasta.ac.za/wp-content/uploads/2025/01/framework-for-the-promotion-of-excellence-in-a-national-network-of-science.pdf> (accessed: 05.08.2026).

²⁴ NACI – Innovation for a better future. Available at: <https://www.naci.org.za> (accessed: 05.08.2026).

²⁵ Available at: <https://hsr.ac.za/about-cestii/measuring-rd-activity-in-south-africa/>; https://hsr.ac.za/wp-content/uploads/2025/10/RD_StatisticalReport2023-24_FINAL.pdf (accessed: 05.08.2026).

on the information obtained, a typology of national models for assessing and monitoring science and technology development was proposed.

It is worth noting that it was the function of the indicator in the assessment and monitoring model that was analyzed. The same indicator could belong to different analytical levels, depending on whether it was used as an indicator of resource provision, direct result, applied effect, or long-term strategic impact. This approach made it possible to avoid the mechanical comparison of seemingly similar indicators, which would obscure the differences in logic and the institutional role of monitoring.

Resource indicators included metrics that characterized the financial, human resources, infrastructure, and organizational aspects of science and technology activity; performance indicators included publications, patents, developments, and other formalized results of scientific and innovative activity. Indicators of applied impact recorded the implementation of results, commercialization, cooperation between science and production, the dissemination of technologies, and the use of scientific solutions in the economy, public administration, or the social sphere²⁶. Indicators of strategic impact reflected longer-term changes related to competitiveness, technological self-sufficiency, structural modernization, sustainability, and progress toward national development priorities²⁷.

The following systematization criteria were used for cross-country comparison: the strategic goal of the policy, the type of roadmap (as a tool for implementing science and technology policy), the coordinating framework, the predominant category of indicators, the presence of interim assessments, adjustment mechanisms, and the final type of assessment and monitoring model.

The limitations of the study are related to the varying degrees of openness of official data and the differing levels of documentation of assessment and monitoring procedures. For this reason, the article focuses on identifying differences in the monitoring architecture and in the functions of indicators as elements of state science and technology policy.

Results of the study

The comparative analysis conducted has shown that the differences between the BRICS countries manifest themselves not only in the declared priorities for science and technology development, but also in the way these priorities are institutionalized, in the configuration of roadmaps, and in the logic underlying the design of assessment and monitoring systems.

A comparison of strategic documents that define the architecture of indicators shows that in the BRICS countries, the monitoring system performs different functions. In some cases, it primarily serves as a tool for mobilizing resources and focusing efforts on priority areas; in others, it acts as a mechanism for tracking the applied effect and social return; and in yet others, it serves as a means of aligning long-term strategy, program implementation, and subsequent policy adjustments.

The parameters presented in *Table 3* allow drawing two preliminary conclusions. First, the differences between countries are not so much about the formal presence of strategies and programs as about the degree to which they are operationalized through measurable indicators and feedback procedures. Second, the architecture of assessment and monitoring is closely linked to the function that the state assigns to science and technology policy, which is why the typology in this study is based on a combination of four criteria: the strategic goal of the policy,

²⁶ OECD (2015). Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development. Paris: OECD Publishing. DOI: 10.1787/9789264239012-en

²⁷ OECD (2018), Eurostat. Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation. 4th ed. Paris: OECD Publishing. DOI: 10.1787/9789264304604-en. Available at: https://www.oecd.org/en/publications/oslo-manual-2018_9789264304604-en.html

the type of roadmap, the predominant category of indicators, and the degree of institutionalization of the assessment.

Russia and China demonstrate the most pronounced examples of centralized architecture. In Russia's case, the foundation is the Strategy for Scientific and Technological Development until

2035, followed by detailed elaboration through state programs and support for priority areas. In China's case, the same function is performed by five-year plans and related program documents, within which scientific and technological goals are integrated into a unified system of socio-economic planning. In this regard, despite the outward similarity of centralized

Table 3. Comparative parameters of monitoring systems for science and technology development of the BRICS countries

Country	Strategic objective of the policy	Type of roadmap	Coordinating contour	Prevailing level of indicators	Interim assessment and adjustment	Type of monitoring model
Russia	Technological sovereignty, reduction of technological dependence, ensuring competitiveness and security	Strategically centralized, with subsequent detailed elaboration through government programs and priority areas	Strong state coordination, integration into the strategic planning system	Resource, performance, and strategic impact indicators	Adjustment is integrated into the overall framework of strategic management, but the procedures for multi-level assessment of effects are limited	Strategic and mobilization
China	Innovative development, industrial modernization, strengthening internal potential, long-term technological leadership	Centralized planned system integrated into the nationwide socio-economic planning	Unified coordination center within the framework of five-year planning and long-term benchmarks	Performance indicators and measures of strategic impact, while maintaining strong resource base	Adjustment is carried out through a planned system and a hierarchy of target indicators	Centrally targeted
India	Self-sufficiency in critical areas, mission-driven development, and solving social problems through science and technology	Mission-oriented and programmatic, with a strong focus on specialized initiatives and digital monitoring frameworks	The combination of state goal-setting and distributed institutional implementation	Effective indicators of applied impact and, to some extent, strategic influence	Clearly defined monitoring procedures, databases, key performance indicators, and expert feedback mechanisms.	Mission-assessment
Brazil	Reindustrialization, sustainable development, bioeconomy, digital and social transformation	Two-level: framework strategy and its subsequent operationalization through an action plan	Interdepartmental coordination with a transition from the strategic level to programmatic detail	Mixed structure: resource-based, outcome-based, and indicators of applied effect	A significant portion of the assessment mechanisms is shifted to the level of strategy operationalization.	Coordination and transformation
Republic of South Africa	Inclusive development, addressing social and structural issues, and enhancing the social impact of science and technology	Problem-oriented and transformational, with clear focus on the policy monitoring, evaluation, and learning loop	Coordination through a long-term white paper and a ten-year implementation plan	Indicators of applied effect and strategic impact while maintaining resource and performance levels	The most pronounced institutionalization of monitoring, evaluation, reflection, and policy adjustment	Socio-transformational
Source: own compilation.						

coordination, the Russian model tends to gravitate more toward strategic mobilization in priority areas, whereas the Chinese model focuses on integrating science and technology into the overall framework of socio-economic development.

Brazil and the Republic of South Africa represent a different type of architecture, in which the role of inter-level coordination is particularly noticeable. In the Brazilian case, the strategy sets long-term guidelines but assumes subsequent specification through an action plan. In the Republic of South Africa, the basic long-term documents and the implementation plan directly link strategic priorities with the assessment and monitoring framework. This allows speaking not just about a difference in the form of the document, but about the degree of institutionalization of the assessment mechanism.

India occupies an intermediate position, combining targeted state task setting with a more distributed implementation system. Empirically, this is manifested in the fact that framework documents of science and technology policy are combined with mission-oriented programs and digital monitoring circuits, and the implementation itself is accompanied by key performance indicators and expert feedback.

The comparison showed that national assessment and monitoring systems differ not just in the set of indicators they use, but in which performance levels are dominant in them.

Russia is characterized by combination of strong resource base and pronounced focus on performance indicators and indicators of strategic impact. At the documentary level, this is manifested in priority attention to indicators of resource provision, human resources, research infrastructure, and the direct results of science activity, as well as to benchmarks related to technological self-sufficiency, reducing critical dependencies, and strengthening competitive positions.

The Chinese model demonstrates a list of indicators that is similar in structure but differs in logic. In the five-year planning documents, the resource block is combined with performance indicators and strategic targets related to innovative development, industrial modernization, digitalization, and strengthening domestic innovative potential. Thus, the indicators here function not only as assessment tools but also as elements of coordination within a unified system.

In Indian practice, the focus is shifting more toward performance determinants, indicators of applied effect, and, to some extent, indicators of strategic impact. The basis for this conclusion is the presence in the documents not only of target benchmarks but also of key performance indicators and mechanisms for monitoring how the results of scientific and technological activities are applied within the framework of mission programs²⁸.

For the Republic of South Africa, it is fundamentally important not only to achieve formal results but also to measure their social, institutional, and structural effects. This follows from the fact that in the documents under analysis, monitoring and evaluation are linked from the outset to the public benefits of science and technology and to the resolution of social problems; therefore, the South African model turns out to be the most sensitive to indicators of applied effect and strategic impact.

The Brazilian system occupies an intermediate position and is characterized by a mixed list of indicators. It retains the significance of resource-based and performance-based parameters. The strategy and the subsequent action plan are focused on a broader range of transformations — from technological modernization and the bioeconomy to the territorial, social, and environmental dimensions of development.

The results obtained make it possible to identify generalized types of assessment and monitoring models in the BRICS countries.

²⁸ Available at: <https://indiaai.gov.in/missions/atal-innovation-mission> (accessed: 05.08.2026).

The first type – strategically mobilization-oriented – is focused on concentrating resources, supporting priority areas, and achieving the goals of sovereignty, security, and competitiveness. Russia and, with certain reservations, China, belong to this type to the greatest extent. At the same time, their similarity is determined not only by the content of strategic goals but also by the general logic of how monitoring is integrated into the implementation of the state's science and technology policy.

The second type – mission-based assessment – is most clearly manifested in India. It is distinguished by a combination of a programmatic mission roadmap, distributed institutional implementation, and the predominance of performance and applied indicators.

The third type – coordination-transformational type – unites Brazil and the Republic of South Africa, albeit in different variants. The basis for distinguishing it is the combination of interlevel coordination, mixed structure of indicators, and

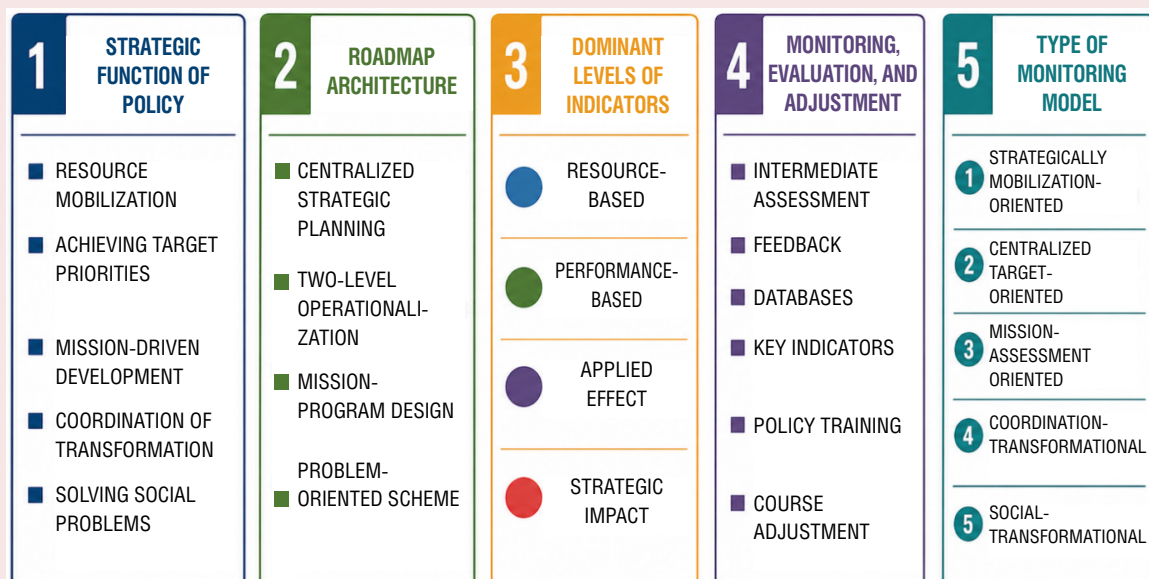
more pronounced focus on the projected effect of science and technology policy. In both countries, assessment and monitoring are largely linked to the alignment of long-term priorities and program implementation, as well as to broader structural and social effects.

The main result of the comparative analysis is that the BRICS countries differ not only in terms of the set of indicators but also in terms of the monitoring function itself within the system of public governance for scientific and technological development. The typologization shows that this function is empirically expressed through combination of policy goals, the configuration of roadmaps, the structure of indicators, and the ways of institutionalizing feedback.

The *Figure* presents the logic for generalizing the identified differences and forming a typology of monitoring models.

The presented diagram shows that the differences between the BRICS countries should be interpreted not as variability in indicator systems,

Logic behind the development of monitoring models for science and technology development in the BRICS countries



Source: own compilation.

but as differences in the logic of organizing assessment and monitoring within the system of public governance for science and technology development.

Discussion

The analysis showed that assessment and monitoring cannot be interpreted solely as a tool for implementing the strategy of science and technology development. It is an integral element of the public administration model and, through the structure of indicators and the presence of adjustment procedures, it identifies which results the state considers significant and subject to continuous monitoring.

This means that the differences between the BRICS countries should be interpreted not as a linear scale of “more developed” and “less developed” systems, but as differences in types of managerial rationality (Kalyanova, 2014). In strategically centralized models, primarily in Russia and China, monitoring is subordinated to the tasks of concentrating resources, maintaining priorities, and achieving long-term state goals. In systems with a more pronounced programmatic and evaluative component, such as in India, it is largely linked to intermediate stages of science and technology policy. In the transformational models represented by Brazil and, especially, the Republic of South Africa, monitoring is more closely linked to the goals of social, structural, and institutional impact.

From theoretical perspective, the analysis conducted makes it possible to refine the conclusions of works on the combination of policy instruments and the assessment of effectiveness. The system for monitoring science and technology development turns out to be the point of intersection of these aspects. It simultaneously reflects the institutional configuration of the innovation system, the logic of selecting and coordinating state policy instruments, and the understanding of acceptable success criteria.

This is also related to the issue of cross-country comparability. Formally similar indicators may perform various functions in different management systems. The same indicator may serve as a tool for the resource block in one case, as a means of assessing the applied effect in another, and as a strategic parameter in yet another. A more appropriate approach is the functional one, which compares the indicator's place in the management architecture and its predominant role.

From a practical point of view, the results obtained indicate that improving monitoring systems in the BRICS countries is unlikely to be based on a model of mechanically borrowing individual indicators. A more productive approach is to transfer the principles of monitoring organization: delineating levels of performance, linking strategic goals to measurable parameters, institutionalizing intermediate assessment, incorporating feedback mechanisms, and taking into account the resulting effects.

Conclusion

The study showed that the systems for assessing and monitoring science and technology policy in the BRICS countries differ not only in the composition of the indicators used but also in the monitoring function they perform. The comparison of roadmaps, the structure of indicators, and feedback mechanisms revealed that in some countries, monitoring primarily serves a mobilization function, in others – a mission-assessment function, and in still others – coordination-transformation function.

The proposed approach, based on the distinction between resource, performance, applied, and strategic indicators, makes it possible to identify differences in the logic of managing scientific and technological policy. Thus, the article contributes to the development of comparative studies of science and technology policy, focusing on analyzing not only the goals and tools but also the management mechanisms.

The practical significance of the work lies in systems and to analyze multilateral science the possibility of using the findings both to and technology cooperation within the BRICS improve national assessment and monitoring framework.

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