Prospects for the scientific and technological development of Russian regions in the framework of global science development trends

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Abstract. The main attention is devoted to the issues of the scientific and technological development of Russia at the regional level in the framework of the global trends in the development of science. The authors review and present a set of cutting-edge perspectives on problematic issues of public administration in this area. An approach is proposed to achieve a new quality of management of the scientific sphere.

Keywords: trends, science, technological development, scientific and technological potential, regional level, region

1. Introduction

As of today, there are 7.8 million research workers in the world, i.e. their number has increased by more than 20% since 2007. They are the most numerous in China (19% of the world number). Then the United States (16.7%) and Japan (8.5%) follow. An increase in the share of research workers is also observed in Germany (from 4.5 to 4.6%), Korea (from 3.5 to 4.1%), Turkey (from 0.8 to 1.1%). A decrease in their numbers is observed in Japan (from 10.7 to 8.5%) and Russia (from 7.3% to 5.7%) [1].

Due to the globalization of economic relations and the spread of new technologies, global chains of trends are concentrated around knowledge centers. Consequently, the importance of "smart" specialization of countries and regions on the basis of existing scientific and technological groundwork increases. The field of science is a fundamental resource for socio-economic transformations on a global scale. To a greater degree, the place of a state in the world community is determined by its scientific potential, which influences the prospects of its competitive struggle in the external market, the possibilities in solving its internal problems [12, 13].

2. Materials and Methods

The aim of the study is to conduct a comprehensive analysis of state policy in the field of scientific and technological development, taking into account global trends and strategic goals of the country, as well as the development of a new approach to managing the process of organizing research and innovation activities in the regions. The methodological base of the research relies on the general scientific methods of cognition used in economics, with an emphasis on ensuring economic security

and international competitiveness of a country through its intensive scientific and technological development.

3. Results

Countries with an open economy are integrated with world trends in the development of the scientific industry and are in a deep relationship with factors that influence policy and management in the field of science, technology, and innovation. These include major geopolitical changes, environmental crises of a natural and anthropogenic character, energy, as well as socio-economic trends occurring in the world. In order to preserve their advantages in a rapidly changing world, states adopt development strategies and roadmaps that define national priorities. And science is not the last one. In particular, in the United States, an emphasis was placed on global changes in climate, medicine, and energy. In the European Union, the growth strategy is focused on sustainable, inclusive growth. Japan and Korea face the challenge of rapidly aging populations and declining fertility rates. India is applying a new economic model aimed at creating new jobs, and Latin America is seeking to reduce high rates of economic inequality [2-4].

According to STM, since 2010, global spendings on research and development have grown faster than the global economy. Today, R&D investment is a leader in global spending [2]. The report on the state of science prepared by the US National Science Foundation *Science and Engineering Indicators of 2018* indicates that world research expenditures increased from 522 billion USD to 1.9 trillion USD from 1996 to 2015 [3]. As noted above, this is due to the fact that at present, states recognize R&D as the most important investments in the country's progress, international competitiveness, and public benefit. As a result, R&D intensity (the percentage of GDP that is invested in R&D) is widely discussed in international circles, because it provides a broad picture of the country's economic strength and future growth.

An analysis of statistical data makes it possible to point out [6] that the degree, trends, and structure of science funding do not meet either current needs or the strategic goal of overcoming the gap between leading countries. The Russian science still holds their position on individual results of scientific work, on the contribution to the global scientific system, but the backlog in the implementation of results, in the amount of technological development, in the implementation of Russian science and innovation policy from the leading world powers and some developing countries is increasing.

The main problematic issues of state policy in the field of science are inconsistency and inability to determine and implement key priorities. Decreasing volumes of state financing of science to the scale of small countries did not lead to an increase in the efficiency of state expenditures, positive changes in the development structure. The economy reserve is not used to optimize the use of budget funds to solve the most pressing current problems of the economy and society, creating reserves for the future. As a result, we are lagging behind the leading countries in the scale of research and development in key areas. Over the past 10-15 years, Russia's declared state priorities have not been met. Consequently, the backlog will continue in the future. As a result of inconsistent state policies, sectors of traditional Russian science are on the verge of losing their unique scientific and technological potential, and a small number of international cooperation projects have not been fully implemented.

In this situation, the topical issue is the development of collaboration projects in the field of scientific and technological development and the strengthening of interaction with all participants in the process, both at the federal and regional levels.

4. Discussion

In recent years, considerable attention has been paid to the problems of improving the science system, since this area is one of the most important components of the knowledge economy and competitiveness of the region. A new stage in the scientific and technological breakthrough not only strengthens the role of knowledge, but also conditions to the transition to the most flexible development model, in which searching for innovative solutions becomes the key goals.

It should be noted that the development in the scientific and technical sphere is uneven in accordance with the laws of cyclical dynamics. The transition to a new technological order as the basis for the next long-term Kondratiev waves occurs every few centuries. Since the middle of the 20th century, the overcoming of economic crises had been made on the basis of the spread of new generations of technology almost every decade. Thus, it is when a change in technological methods takes place on the basis of scientific results and innovations in technological structures.

World trends in the development of science are based on finding a way out to the path of sustainable development in order to effectively use the scientific and technical potential, human and natural capital of the country in the long term, as well as integration processes relating to an interdisciplinary approach to research and development. Science, technology and innovation are the fundamental tools for realizing the strategic goals of sustainable development and the development of the science system as a whole. In world science, the following topical issues that require increased attention are highlighted:

1. Taking into account the relationship between the objectives of the country's socio-economic development and the results of fundamental, applied research that contributes to the cumulative effect in the interests of several goals.
2. Increasing scientific and technical potential (hereinafter, STP) of a single state, including not only strengthening human and scientific potential, but also state policy in the field of STP. The latest technologies, such as robotics, artificial intelligence, automation, big data, and three-dimensional printing, have an impact on society that radically changes the population's quality of life.
3. Development of action plans and road maps that include STP in national development programs in all areas. The inclusion of specific actions of scientific institutions with participation of all stakeholders in joint design, joint development and joint production, taking into account the territorial and economic characteristics of the country, national priorities in the field of science and technology.
4. An expansion of public-private partnership to involve business in the process of implementing strategies for socio-economic development.
5. An integrated approach to the development of roadmaps at the global, regional, national, and institutional levels, development of inter-agency cooperation.
6. An integration trends in the development of science based on creating new interdisciplinary structures.

The *UNESCO Report on Science: Towards the Year 2030* contains a detailed and comprehensive picture of the development of world science. The report was published in 2015. It was devoted to the analysis and objectives of science and innovation, including trends in innovation and mobility, issues related to big data technology, and the contribution of indigenous and local knowledge to global issues [1].

Based on available fundamental and applied research in all areas of science, taking into account the development of the digital economy, information technology, Big Data, trends in science and education, promising areas of research in the world include the following:

- Modeling and analysis of information and telecommunication management systems in the field of science and education;
- Development of the concept of an integrated information environment for organizations of science and education;
- Research and analytical synthesis of innovative approaches and solutions in the field of science, based on the integrated use of information and communication technologies;
- Development of a unified scientific and educational telecommunication and information environment;
- Development and integration of monitoring information and analytical systems.

Thus, the main trends in the development of science in a global context attract much attention of scientists and specialists. But due to the scale of these changes, there are still many questions to be studied and analyzed. Several blocks of key issues can be identified regarding the current and future state of the global science, technology and innovation policy.

First of all, the key issue is a transformation of the policy in the field of research work, R&D, technology transfer in response to changing conditions of the global economy and the requirements of the subjects of the research and innovation system. The next key issue is new subject areas and system policy priorities that guarantee the sustainability of long-term development and leadership of developed countries. At the same time, tools and trends related to the development of breakthrough areas of science in general are of particular interest in the context of growing international competition.

In the Russian Federation, issues of science, technology, and innovation are governed by the Federal Law *On Science and the State Science and Technology Policy* [5], within which science is recognized as a socially significant sector that determines the level of development of the productive forces of the state.

The main tools for ensuring the solution of these problems in the system of state administration are the state and federal target programs, development strategies that determine the development of scientific and innovative activity.

Over the past 5 years, such significant strategic and program documents have been adopted, including the following:

- *The Forecast of the Scientific and Technological Development of the Russian Federation for the Period up to 2030* [7] adopted in 2014;
- In 2015, changes made to the *Program of Basic Scientific Research in the Russian Federation for a Long-Term Period (2013–2020)* were approved [8];
- *The Strategy of Scientific and Technological Development of the Russian Federation* was approved in 2016 [9];
- In 2018, the *Decree on the National Goals and Strategic Objectives of the Development of the Russian Federation for the Period up to 2024* was adopted. Breakthrough scientific, technological, and socio-economic development became new benchmarks for Russia. It should be achieved due to the following: (1) by ensuring Russia's presence among the five leading countries of the world, creating at least 15 world-class scientific and educational centers, (2) the formation of an integrated system of training and professional growth of scientific and scientific-pedagogical staff, (3) updating at least 50% of the instrumentation base of leading scientific organizations, as well as due to (4) the outrunning increase in domestic expenditures on research and development as compared with the growth of the gross domestic product (GDP) [10]. An amount of about 25 trillion rubles is needed for the implementation of all tasks;
- In 2019, the state program of scientific and technological development of the Russian Federation was approved [11]. Its goal is the integrated development of science and higher education, an intellectual potential and increase of competitiveness of the country's economy.

In these documents, special attention is paid to the need for the development of the digital economy, including the use of mainly domestic software by state authorities, local governments and budget organizations, the creation of a system of legal regulation of the digital economy. In this aspect, the scientific and methodological support of the development processes of the digital economy is a pressing issue. All goals and objectives are quite specific and solvable, and also fit into the framework of existing strategies. Achieving and solving these goals and objectives is based on the main and direct participation of the Ministry of Science and Higher Education of the Russian Federation, as well as the regions. At their level, similar conditions should also be created for the implementation of public policy.

Today, in Russia, the system of state administration of science is built up where the Russian Academy of Sciences carries out an expertise. The Ministry of Science of Higher Education of the

Russian Federation distributes the funds of the State Program on Scientific and Technological Development of the Russian Federation [11]. The role of the Russian Academy of Sciences is increasing on the basis of expanding its functions and powers, as part of the implementation of the Strategy [9], as well as creating a number of scientific and educational centers (SECs) in which industry and business are necessarily present.

The SECs are already beginning to be created in the regions of the country: Sverdlovsk region, Nizhny Novgorod region, and Tyumen region. They are consortiums, their task is to build relationships between industry, education, and regional science. At present, a whole range of measures and mechanisms for implementing the main strategic documents of the country and the development of Russian science in general has been developed. Sources, volumes, and rules of public investment in research and development, infrastructure and information support of scientific and scientific-technical activities are established to transfer results of intellectual activity to the real economy.

At present, due to objective and subjective reasons (underfunding, reforms in the science system, an outflow of the most qualified part of scientists abroad, a sharp decline in the status of a scientist, etc.), the science and innovation complex of the country is in extremely inoperable condition. The country's leadership understands this trend, and it is taking emergency measures, including the adoption of a whole series of decrees, strategies, and programs since 2002. However, given the scale of this process, one cannot wait for a quick resolution of this issue. The leadership of a number of Russian subjects understands this and takes emergency measures to support science at the subject level, without waiting for the results of the reform of all Russian science (Republic of Tatarstan, Republic of Bashkortostan, as well as Belogorod, Novosibirsk, and Tomsk Regions). The results of their activities are reviewed in federal programs and in the development of the regions as a whole.

The development of collaboration projects in the field of science and technology development and the strengthening of interaction with the process participants at all levels can significantly speed up the process of achieving the goals set. For example, in the Republic of Sakha (Yakutia), the Academy of Sciences of the Republic of Sakha (Yakutia) performs an integration function as an expert, coordinating body of regional scientific and scientific-technical activities. In Yakutia, 11 scientific institutions of the Siberian Branch of the Russian Academy of Sciences, 4 large state universities and institutions of industrial science carry out activities. The Academy of Sciences of the RS (Ya) has an effective organizational structure that allows for greater flexibility and ability to respond to changing internal and external conditions and trends for the implementation of strategic and operational objectives. In order to carry out scientific research, the creation of temporary creative teams is an effective mechanism for interaction at the federal and international level based on an integrated and interdisciplinary approach.

5. Conclusion

Based on the above, we can conclude that the prospects for scientific and technological development at the regional level in the framework of global trends in the development of science rely on scientific collaborations. The main factors for the development of collaborations for scientific and technological development are:

- Availability of interdisciplinary temporary research teams (WTC);
- An infrastructure based on research centers and research and educational centers;
- An adaptive state policy at both the federal and regional levels, as the most important component of the mechanism for regulating scientific and technical activities.

Thus, for an integrated scientific and technological development at the regional level, a mechanism for the development of collaboration processes based on the cluster approach needs to be developed.

6. Acknowledgments

The work was performed in the framework of the state task of the State Budget Institution "Academy of Sciences of the RS (Ya)" for 2019.

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