SCIENCE COLLABORATION AS A MODERN INSTITUTION FOR DEVELOPING STATE MANAGEMENT OF INTELLECTUAL CAPITAL IN RUSSIA

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Abstract: In the contemporary context of scientific and technical development, the tendency to form science collaborations is of particular importance. The main driving force in developing a knowledge economy and an information society as intellectual capital is a tool aimed at creating and accumulating knowledge, improving creative skills and abilities, and solving strategic state problems. The low level of coordination between the activities of public authorities and scientific structures has led to an urgent need for integrative capacities in the form of scientific collaborations. The article highlights features of development of these associations, providing an effective modern system of public administration in the fields of science, technology, and innovation, and increasing the appeal of investing in research and development and assist in competitiveness and economic security of the country. Authors analyzed factors limiting the realization of intellectual potential and contributing to the formation of actual intellectual framework as well as trends of development of scientific collaborations in Russia.

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Introduction

The development of science and higher education with today's social generation of information is receiving far greater attention now than it did in the previous industrial era. The basic role of research and development, the increasing rate of acquiring and developing new knowledge, and the trend in producing innovative types of products are the main influences in realizing competitiveness and the security of Russia's economy. The modern Russian Federation embraces science and technology as the main drivers of Russia's social and economic growth and in ensuring the country's ability to respond effectively to various challenges. The article presents the fundamentals of intellectual capital development in the context of global research activity and scientific collaborations' frameworks to identify the patterns of these collaborations and prospects of intellectual capital development.

Formation of Institutional Fundamentals of Intellectual Capital Development

Extrapolation to the historical experience of the 'new' Russia marks the end of the 20th century as the initial stage of a profound transformation of Russia's existing social and economic structure, the transition to a new model of development, and the creation of an effective paradigm for the public administration of education and innovation. The historical experience of Russia confirms its status as one of the world's scientific powers. The domestic school of scientists effectively managed the tasks of social, economic, and political development of the state. It ensured the security of the country and significantly contributed to the accumulation of scientific knowledge and the creation of advanced technologies for humankind. This was facilitated to a large extent by the system for organizing research and scientific development that corresponded to the timing and structural features of the economy. The creation and accumulation of new knowledge in the Russian Empire reflected the concentration of scientists and engineering practitioners in higher education. The solution of large-scale research and engineering tasks in the Union of Soviet Socialist Republics (USSR) was facilitated by the concentration of resources in the Academy of Sciences of the USSR and industrial research institutes. These were under the directive of planning research and development (R&D) by the State Committee of the USSR Council of Ministers for Science and Technology and the USSR State Planning Committee.

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Since the formation of the Russian Federation in 1991, the state policy of scientific and technological development is represented by three large-scale stages (Figure 1).

Figure 1: Stages of scientific and technological development in Russia

1991-2001	2001 – until now	Prospects of development
Crisis optimization and adaptation to the market economy; preservation of the scientific and technological potential of the country; formation of new institutional mechanisms to support the development of science and technology	Transition of Russia to the innovative economy; a significant increase in the volume of science financing; strengthening the role of scientific research in solving strategic state problems	State support of intellectual potential of Russia; balanced regional development of the institutions of interaction between the state, the scientific community, business structures and citizens (students) in the form of **scientific collaboration**

Source: Authors

The transition to the 'smart economy' at the start of the 21st century, based on knowledge and creative implementation of technological innovations in the context of dealing with the political barriers and notwithstanding the requirements of authorities, began to gain increasing momentum. As Vasilenko (2016) noted at this time, the Russian public authority system, as an organizational structure that initiates and provides ongoing support to creating, distributing, and redistributing high-ranking positions, authorities, and political resources, were deprived of a focal means of capturing and directing the nation's momentum. The state system lacked an effective mechanism to transform the public demands into management decisions and technologies for practical implementation. Thus, there was a situation where scientific research was detached from the work of public bodies and at times the results had no empirical basis, which minimized the usefulness of these studies.

At present, Russia has taken the course of modernizing the state management of the country's intellectual capital. Features of state regulation of scientific and technological development of the state are evident by the growing role of science and technology as the basic elements in solving most national and international problems. Modern scientific research is focused on ensuring the ability to predict global trends, considering the internal changes, expectations, and needs of Russian society, as well as the timely identification of and the effective response to emerging challenges. The main objective of the current stage of developing the Russian Federation is to ensure the independence and competitiveness of the state by means of creating an effective system of constructing and fully using the intellectual potential of the nation. Despite the introduction of tools for developing Russia's intellectual potential, there are a number of structural problems that limit the state's management of this potential.

Despite a state development potential (Figure 2 shows Russia is among the world's top 20 countries in terms of research activity) and the competitive advantages of Russian intellectual capital, there are several identified negatives. These factors add to the increasing risks of the Russian Federation wavering as a world technological leader, of depreciating internal investments in science, education, and technology, and of reducing independence, competitiveness, and security of Russia at the international level. In the current context, the identified set of risks and threats has become a significant barrier to the long-term growth of the welfare of society and the strengthening of the sovereignty of the country.

In the framework of modernizing the state's management of Russia's intellectual capital and solve the identified problems of extending science and technology, the development of cooperative scientific and educational institutions, public authorities, and organizations of society deserves examination. To solve the existing problems, it is necessary to consolidate the efforts of public authorities, the scientific, educational, and business communities and civil society institutions to create favorable

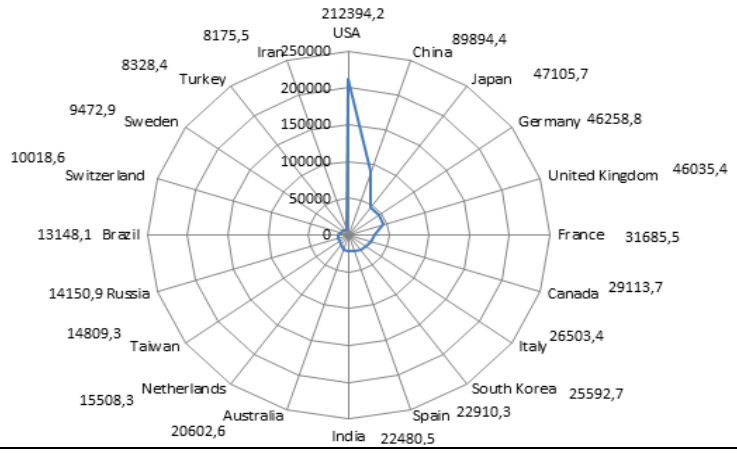
conditions for applying scientific and technological achievements in the interests of Russia's intellectual and social and economic development. One such institution comprises scientific collaborations. The 21st century, in terms of life sciences, is the century of scientific cooperation, otherwise expressed as 'scientific collaboration'.

Table 1: Factors limiting realization of state intellectual potential management in Russia

Name of the problem	Description of the problem
The uneven development of scientific and educational centers conducting research and development of national and world level	Significant differentiation of scientific and educational organizations by the productivity and performance, the concentration of the research potential only in a few regions of the country;
The problem of resistance of the economy and society to innovations	This trend hinders the practical application of research and development results (the share of innovative products in the total output is only 8-9 percent, the investment in intangible assets in Russia is 3-10 times lower than in the leading states, the share of exports of Russian high-tech products in the global volume of exports is about 0.4 percent). There is practically no transfer of knowledge and technology between the defense and civil sectors of the economy, which hampers the development and use of dual-use technologies;
The weak interaction of the research and development sector with the real sector of the economy	The openness of the innovation cycle leads to the fact that public investment in human capital actually ensures the growth of competitiveness of other economies resulting in the significant reduction of the opportunities of retaining the most effective scholars, engineers, entrepreneurs creating breakthrough products in comparison with the countries which are leading in innovation;
The inconsistency of priorities and tools for supporting the intellectual potential of the Russian Federation	The lack of coordination of managerial measures at the national, regional, industry and corporate levels does not allow forming value-added production chains of high-tech products and services, providing the greatest multiplier effect from the use of the technologies under development.

Source: Authors

Figure 2: Research activities ranking of countries of the world



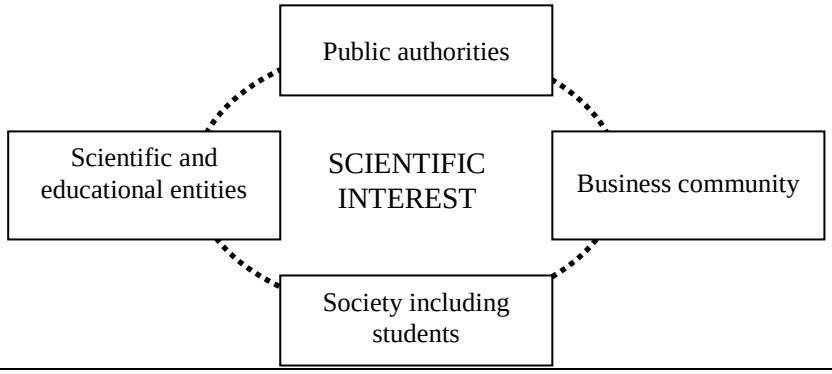
Source: LHC, 2018; NSF, 2018

Essential Characteristics and Mechanisms for Creating Scientific Collaborations

In modern literature, Korobkina and Omelchenko (2017) define the scientific collaboration as an organizational association of scientists and researchers from various organizations supporting a broad and dynamically repeatable social interaction aimed at the overall field of research and providing wide access to information, data sources, and tools needed for the purposes of the research. Hence, the literal translation of the word 'collaboration' as 'cooperation' refers to both the process and the

structure. In this study, the authors refer to scientific collaboration as an overarching infrastructure supporting the scientific and technological community, which includes public administration authorities, scientific organizations, business structures, and civil society. Figure 3 shows the form of scientific collaboration considered the most effective by the authors to solve modern problems of scientific and technological development in Russia.

Figure 3: Participants of scientific collaborations



Source: Authors

Collaboration can arise between individual researchers and research teams of academic institutions as well as those of government and private business. Furthermore, the geographic locations represented in the scientific collaborations are sufficiently wide and diverse to allow researchers from different regions to form teams and conduct joint scientific activities, facilitated through the use of the Internet.

Science collaborations are generally based on the scientific interests of researchers. In addition, a collaboration is formed based on the political, social, and economic influence that develops the group or personal relationships of the researchers. The existing global collaborations vary greatly in their parameters. They can comprise a few collaborators or thousands. Collaborations exist in different areas of scientific knowledge, for example, physics, astronomy, biology, and medicine. There is an increasing number of interdisciplinary and international associations of scientists. Furthermore, progress in modern science is now largely associated with the effectiveness of various scientific collaborations.

Modern scientific collaborations need to be transparent for the effective interaction of the scientific organizations involving R & D representatives of the business community, society, and the state. This is also important on the basis of national interests. Novikova (2017) notes that the sophistication of technologies that require an interdisciplinary approach contributes to an increased demand for scientific support for such activities from enterprises. Not only research organizations are involved, but also universities that receive funding from firms for targeted development. These organizations have the opportunity for graduates to gain experience and employment and adapt their curricula to the requirements of the market. The growth of innovation in the view of developing the country's economy stimulates more integrated associations between innovative companies of universities and research institutes (as well as corporations seeking to enter the market with R & D) in the form of scientific collaborations (Gudkova, 2018).

The significant regulatory impact of the state, in particular, the promotion of a variety of intellectual integrations, is the main feature of Russian science and technology. This effect determined the dominant position of public authorities in the scheme of scientific collaboration. At present, there are a large number of spontaneously formed scientific collaborations that vary in size, number of entities, and research subjects. On the one hand, the diversity of collaborative associations infers a wide potential for intellectual capital in Russia with supplementary relationships at work. On the other hand, such diversity somewhat complicates the development of a unified approach to forming state policy in the sphere of science and technology at the national level. One main problem in the functioning of scientific collaborations in Russia is the low degree of coherence of their activities, caused by institutional and regulatory problems. The three (but more often two) main collaborators are the state business, state research institutes, and the higher-education institutions of state and private. These are the most active institutes in scientific collaborations, rather than the four proposed by the authors

(Figure 3). This contrast leads to an imbalance in the interests of the main collaborators as these focus on solving a specific task within a specific timeframe. The state investing in the national scientific and technological sphere presupposes that these funds will have a cumulative return for the national economy, for example, through the development of an innovative system of business, high added-value production, large research centers, and licensing fees in the territory or country. The active involvement of all four participants of the collaboration in science and education will not only solve operational problems but will also become the basis for ongoing scientific and intellectual development of the Russian Federation.

To ascertain the multiplier effect from the proposed form of integration, a clear differentiation of the tasks faced by separate collaborations is needed, and, consequently, there is a need to develop various relating management models. These actions are proposed prerequisites for implementing the program objectives for developing Russia's intellectual capital in proceeding decades. The following lists the main recommended mechanisms for combining intellectual resources and scientific infrastructure:

- Software tools expressed in terms of state and federal target programs and obliging participants to engage students in scientific researches involve research staff of academic institutions in teaching activities;
- Identification of existing collaborations between scientists and organizations and the conditions for maintaining and strengthening such collaborations, by means of both new and established organizational forms that register the relations arising from these collaborations; and
- Large centers with extensive infrastructure for strategic solutions to state problems.

It was revealed, in the course of the research, that scientific collaboration can involve various means of combining intellectual resources and scientific infrastructure, such as the following:

- Based on the material and technical and instrumental resources in common use, e.g., centers of shared facilities (CSF) and unique scientific units (USU);
- By means of state and federal target programs (FTP) that create new or updated elements of the scientific or educational infrastructure through the funding of research teams (for example, financing the establishment of laboratories by the Russian Science Foundation (RSF);
- Experimental short-term forms of combining intellectual resources and scientific infrastructure, e.g., the institutions of prospective studies and academic mobility programs.

As noted in the study by Bogatov and Syroezhkina (2016), an analysis of collaborations of scientific organizations on the basis of publication activity indicates at least two types of collaborations by the stability of interaction: stable and unstable. The associations referred to as 'stable' collaborations by this study are where software tools are a form of support and the determining factors are proximity and common research topics and organizational structural units. The proximity of territories to each other contributes to the transfer of knowledge and innovation between both individual scientific organizations and individual scientists. Possibly, this is the reason proximity has such priority in organizing cognitive, organizational, social affinity, and successful activity of scientific networks (Sirazitdinova, 2014).

Social affinity within the framework of a collaboration results from close formal and informal relationships between collaborative members. In this context, scientific collaboration is a special system of group interactions between researchers or networks that are described as interactions involving content, form, and intensity. The intensity and stability of the interaction are largely determined by the general nature of the research topics or their interdisciplinary nature, which facilitates the merging of individual scientists and teams into scientific collaborations. Unsustainable collaborations include associations of scientific networks where the proximity between the territories is not a key condition for the joint research. The main condition for its existence is a research project with targeted funding and set goals and deadlines.

Prospects for the Development of Scientific Collaborations

The development of scientific collaborations will help each collaborative party meet their needs and will form the basis in modernizing Russia's intellectual capital by means of the following advantages:

- Expanded opportunities for talented youth to build a successful career in science, technology, and innovation;

- Conditions for conducting research and development under modern principles of organizing scientific, technical, and innovative activities and the best Russian and world practices;
- An effective communication system in the field of science, technology, and innovation, that ensures an increased receptiveness of the economy and society to innovations and conditions for developing knowledge-based business;
- An effective modern system of public administration in the field of science, technology, and innovation, that increases the appeal of investing in research and development and the ensures the effectiveness and relevance of research and development;
- Support for the individual territories (regions) with a high concentration of research, development, innovation infrastructure, and production and assist their relationship with other areas of the Russian Federation to aid the transfer of technologies, products, and services.

Conclusion

The development of scientific collaborations in the Russian Federation facilitates the strengthening of the scientific and educational network of the country, enhancing its effectiveness by means of interactions between the state, the business community, the academic staff, and students in research activities. A certain impulse is formed on the basis of such interactions in the framework of integrated associations that is broadcast to the political level, stimulating the adoption of appropriate decisions for harmonizing the policies and integrating the regions in the scientific, educational, social, and economic areas. To effectively develop the technology and introduce innovations, there needs to be a policy that adequately deals with the growing role of the state in developing and implementing measures that expand Russia's intellectual capital, enhance interactions between the producer and the consumer, adapt supply and demand, extend the potential of a 'new' economy, and implement a sound strategy for commercializing innovations. This policy is necessary to ensure the readiness of the country to challenges that have yet to be realized and widely recognized by the public and to envisage a timely assessment of the risks associated with scientific and technological development. It is recommended that scientific collaborations ensuring the acquisition of new knowledge, and based on their own logic of progress, play a key role in its development. The support of Russia's intellectual capital, as a systemically important institution for the long-term development of the nation, is the primary task of a modern state.

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