PRIORITIES AND POSSIBLE RISKS OF THE BRICS COUNTRIES' COOPERATION IN SCIENCE, TECHNOLOGY AND INNOVATION

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The viewpoint of most countries towards participation in programs and projects of international science and technology cooperation (ISTC) is based on the fact that collaboration in research and development allows them to increase the efficiency of national research systems and accelerate the inflow of new knowledge and technologies. The BRICS countries share this viewpoint; however, their aspirations go further, extending their concerns and expectations to cooperation in the sphere of innovation. BRICS – the association of Brazil, Russia, India, China and South Africa – was established in June 2006 at the St. Petersburg economic forum (South Africa a participant since 2011). Its results in establishing frameworks for cooperation in many sectors of their economies including science, technology and innovation demonstrate an unusually rapid growth. The BRICS countries' cooperation in science, technology and innovation started in 2014; since then, the five countries have carried out important steps in bringing together their practical approaches to science, technology and innovation cooperation.

This article is devoted to an analysis of the dynamics of the BRICS countries' cooperation in science, technology and innovation, and the possible risks and problems in the organization and implementation of joint projects. The need to go further in elaborating legal frameworks for international science, technology and innovation cooperation that would support the transition of their cooperation activities from science and technology to innovation is underlined.

Keywords: BRICS; science; technology; innovation; cooperation; risks; research coordination.

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Introduction

The globalization of economies, science internationalization, global technological chains and corresponding aspects of international science and technology cooperation (ISTC) are becoming powerful drivers of technological development for many countries. In the context of the BRICS countries' economic cooperation, ISTC is regarded more broadly than simply science and technology collaboration, it foresees as well cooperation in innovation. The transition from joint science and technology projects to cooperation in innovation is often aggravated by problems and risks predetermined by the different characters and aims of these two types of activities, since science and technology research activities are aimed at acquiring new knowledge, while innovation activities are aimed at the development of new products (goods and services).

1. The Meaning and Purposes of International Cooperation in Science, Technology and Innovation

In one of his articles, J.P. Holdren, former U.S. President Barack Obama's Science Advisor and Director of the White House Office of Science and Technology, pointed out a number of important factors that motivate countries to develop and support international science and technology cooperation.[1] Of these, the most important factors are:

[1] John P. Holdren, *How International Cooperation in Research Advances Both Science and Diplomacy*, Scientific American, 27 April 2017 (Nov. 18, 2018), available at https://blogs.scientificamerican.com/guest-blog/how-international-cooperation-in-research-advances-both-science-and-diplomacy.

– Science and technology are being internationalized and advanced all across the globe. Joint research and development (R&D) with other countries can provide access to valuable additional knowledge and competences. Cooperation in research shares costs, allows pursuing complementary lines of efforts and helps avoid duplication of efforts. The result of joint projects always hastens progress on common goals and at lower costs to national funders;

– Joint progress through science and technology cooperation is even more valuable when the goals are global public goods, for example combating epidemic disease, curing cancer, reducing oil dependence, mitigating climate change, improving nuclear reactor safety, providing water supply, which provide benefits for all countries;

– Even when science and technology cooperation is implemented with technically less advanced countries to help them build their scientific and innovation capacity and apply science and technology to development goals, this means significant progress for mutual economic development including consolidation of the goods and services markets of the participating countries; and

– Mutually beneficial science and technology cooperation also appears to be advantageous diplomatically, as the benefits provide a positive rationale for maintaining relations even in the face of disagreements on other issues.

One other factor that motivates countries to participate in ISTC is the growing complexity and costs of conducting research. This factor, for example, motivates the collaborating countries to unite their resources in building large research infrastructure installations that would serve for mutual purposes.

While discussing the prospective benefits of international science and technology cooperation between the BRICS countries it should be noted that the above-mentioned factors that motivate countries to develop science and technology cooperation are relevant to the BRICS countries as well. This is true especially at the present stage when science becomes a real driver of economic growth.

At this point, one should understand that the declared cooperation in science, technology and innovation (STI) with the main goal of raising the technological level and accelerating the economic development of the partner countries will have to pass through three principal stages, though in different forms and with different intermediate results.

Generally these three stages include:

1) Carrying out basic or fundamental research aimed at obtaining new knowledge;

2) Carrying out applied research aimed at technological development; and

3) Implementing innovation projects aimed at creating new goods (products or services).

In the event that a group of countries (BRICS, for example) declares their intention to jointly develop scientific research, technological development and innovation projects, the success of their joint activities will depend on how close their national legislations are in the field of international science cooperation, technology development and innovation cooperation projects.

If the partner countries intend to implement complex cooperation projects following the model "from an idea to a ready product," they would need to bring national R&D legislation closer together and have elaborated model agreements on cooperation in science, technology and innovation that would regulate the relations of countries and research organizations, universities and companies at every stage of their joint efforts.

Let us briefly consider the features of each STI cooperation stage, with the assumption that the forms of joint activities of the partner countries' organizations have been coordinated at the national level.

There are two levels of ISTC: bilateral cooperation between two countries and multilateral cooperation implemented on the basis of multilateral agreement of a group of countries. ISTC in the framework of international organizations is also considered to be multilateral cooperation.

Cooperation in research implemented in the framework of international bilateral agreements covers such forms of scientific interaction as carrying out coordinated or joint research projects; establishing joint research teams; holding international scientific conferences, seminars, symposia; exchange of scientific information; construction and operation of large scientific installations, etc. Bilateral agreements on science and technology cooperation usually include provisions on research staff mobility. This type of cooperation is usually aimed at obtaining new knowledge and is mainly implemented by research institutes and universities of the countries that participate in international research programs and projects. International research in science and technology may cover a wide range of areas and also may be aimed at solving problems of a global character including sustainable development, energy and the environment, cleaner technology, climate-oriented technology, etc.

The main goal of technology cooperation in the sphere of production-oriented technologies is carrying out applied research with the aim of improving technological knowledge and stimulating national technological and economic development at a new technological level. Another goal of international technology cooperation is to withstand the global challenges in such areas as, for example, water or energy supply, and in mitigating natural and technological disasters at the national or regional level.

International cooperation in innovation stands somewhat apart from cooperation in science and technology. The main reason for this is the fact that innovation, being "…the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices,"[2] is aimed at commercialization of the results of scientific research and development, i.e. it is the instrument of entrepreneurial activities. For this reason, international innovation cooperation in most cases is being implemented by

[2] Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data 46 (3rd ed., Paris: OECD & Eurostat, 2005).

business sector organizations (firms and enterprises) in cooperation with research organizations/universities based on direct agreements/contracts. The international outsourcing of R&D services has considerably expanded the opportunities of international cooperation in innovation, for example in the context of foreign investment in the science sector or in the context of global technology chains with the participation of research organizations of the partner countries.[3]

In the light of the above, it is reasonable to assume that the cooperation of BRICS countries in the sphere of science, technology and innovation in the framework of the BRICS STI Framework Program for funding multilateral joint research projects, technology commercialization and innovation will require the development of mutually acceptable legal tools that would regulate the relations of the partner countries' organizations while carrying out the transition from joint research projects to projects in the sphere of commercialization of the joint research results.

2. Advancement of the BRICS Countries' Cooperation in Science, Technology and Innovation

Although Brazil, Russia, India, China and South Africa have established the BRICS association quite recently, their results in establishing frameworks for cooperation in science, technology and innovation show rapid growth. As of August 2018, six meetings of the BRICS countries' ministers responsible for science, technology and innovation have taken place.

Since the first BRICS meeting at the level of ministers of science, technology and innovation in 2014 the five countries have managed to discuss and begin arranging cooperation in the areas of common interest and adopt a number of important documents that mark the legal framework for their cooperation in science, technology and innovation.

The initiative of a complex development of international science, technology and innovation cooperation was put forward at the first meeting of the BRICS ministers of science, technology and innovation in 2014, and already in the following year at their second meeting the ministers signed a Memorandum of Understanding (MOU) on cooperation in STI that appears to have become the basic instrument for the development of STI cooperation of the BRICS countries.

The main objectives of the proposed STI cooperation are formulated in the MOU, and include:

1) Establishment of a strategic framework for cooperation in STI to address common global and regional socio-economic challenges, utilizing shared experiences and complementarities in STI among the BRICS countries;

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[3] *Киселев В.Н.* Глобальные цепочки добавленной стоимости: вызовы и перспективы для российской науки и инноваций // Инновации. 2017. № 10(228). С. 17–23 [Vladimir N. Kiselev, *Global Value Chains: Challenges and Perspectives for Russian Science and Innovation*, 10(228) Innovation 17 (2017)].

2) Addressing common global and regional socio-economic challenges in the BRICS member countries utilizing shared experiences and complementarities in STI;

3) Co-generation of new knowledge and innovative products, services and process the BRICS member countries utilizing appropriate funding and investment instruments; and

4) Promoting, where appropriate, joint BRICS STI partnerships with other strategic actors in the developing world.

The MOU outlines nineteen main areas for cooperation on the way to obtain new knowledge and innovative products:[4]

(1) exchange of information on policies and programs and promotion of innovation and technology transfer; (2) food security and sustainable agriculture; (3) natural disasters; (4) new and renewable energy, energy efficiency; (5) nanotechnology; (6) high-performance computing; (7) basic research; (8) space research and exploration, aeronautics, astronomy and earth observation; (9) medicine and biotechnology; (10) biomedicine and life sciences (biomedical engineering, bioinformatics, biomaterials); (11) water resources and pollution treatment; (12) high-tech zones/science parks and technology business incubators; (13) technology transfer; (14) science popularization; (15) information and communication technology; (16) clean coal technologies; (17) natural gas and non-conventional gases; (18) ocean and polar sciences; (19) geospatial technologies and their applications.

The MOU is regarded as a principal mechanism for the BRICS countries' STI cooperation. The MOU includes provisions that the parties or their designated institutions can use to enter into sub-agreements which shall be governed by the terms of the MOU.

The modalities of cooperation under the MOU and sub-agreements arising therefrom between the parties in the fields of STI shall take the following forms:

– Short-term exchange of scientists, researchers, technical experts and scholars;

– Dedicated training programs to support human capital development in science, technology and innovation;

– Organization of science, technology and innovation workshops, seminars and conferences in areas of mutual interest;

– Exchange of science, technology and innovation information;

– Formulation and implementation of collaborative research and development programs and projects;

– Establishment of joint funding mechanisms to support BRICS research programs and large-scale research infrastructure projects;

– Facilitated access to science and technology infrastructure among BRICS member countries;

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[4] Memorandum of Understanding on Cooperation in Science, Technology and Innovation Between the Governments of the Federative Republic of Brazil, the Russian Federation, the Republic of India, the People's Republic of China and the Republic of South Africa (Nov. 18, 2018), available at http://brics.itamaraty.gov.br/images/BRICS%20STI%20MoU%20ENGLISH.pdf.

– Announcement of simultaneous calls for proposals in BRICS member countries; and

– Cooperation of national science and engineering academies and research agencies.

At this point, it is important to note that the BRICS countries' MOU on cooperation in science, technology and innovation specifies concrete modalities for cooperation in science and technology such as the establishment of joint funding mechanisms to support research programs and large-scale research infrastructures as well as the facilitation of access to science and technology infrastructures, but it does not include provisions on the concrete modalities for implementing cooperation in innovation.

In October 2015, the third BRICS STI ministerial meeting was held in Moscow, Russia. The meeting adopted the Moscow Declaration, extended the BRICS cooperation areas and approved new ISTC cooperation mechanisms, including:

– Construction of large research infrastructures, including mega-science research installations;

– Coordination of the existing large-scale national programs;

– Development and implementation of the BRICS Framework Program for funding multilateral joint research projects, technology commercialization and innovation; and

– Establishment of the BRICS Research and Innovation Networking Platform.

The meeting also approved the 2015–2018 BRICS Work Plan for Science, Technology and Innovation.[5]

To address common societal challenges of the BRICS countries and to advance BRICS STI cooperation, a number of contact institutions responsible for collaboration within the BRICS Research and Innovation Networking Platform were appointed. Also, five areas for potential STI cooperation initiatives along with coordinating countries for potential STI initiatives were selected (Table 1 below).

Table 1: The BRICS STI Work Plan, 2015–2018 Contact Institutions and Areas for Potential STI Cooperation Initiatives

	Cooperation Area	**Contact Institution, Country**
1	Prevention and mitigation of natural disasters (monitoring & early warning)	National Center for Monitoring and Early Warning of Natural Disasters, Brazil
2	Water resources and pollution treatment	Technology Platform for Sustainable Ecological Development, Russia

[5] BRICS Science, Technology and Innovation Work Plan 2015–2018 (Nov. 18, 2018), available at https://www.ranepa.ru/images/media/brics/china2016/BRICS%20STI%20Work%20Plan%202015-2018%20%20revised%20Action%20Plan%202017-2018.pdf. This Work Plan was revised on 8 October 2016 and again on 18 July 2017.

3	Geospatial technology and its application for development	National Spatial Data Infrastructure, India
4	New and renewable energy, and energy efficiency (solid-state lighting as a sub-area SSL)	Ministry of Science and Technology, China
5	Astronomy	National Research Foundation, South Africa
	Thematic Areas for Potential STI Initiatives	**Coordinating Country**
1	Biotechnology and biomedicine including human health and neuroscience	Russia or Brazil
2	Information technologies and high-performance computing	China and South Africa
3	Ocean and polar science and technology	Russia and Brazil
4	Material sciences including nanotechnology	Russia and India
5	Photonics	Russia and India

Source: BRICS Science, Technology and Innovation Work Plan 2015–2018, adopted on 28 October 2015 and revised on 8 October 2016.

The fourth meeting of the BRICS STI ministers was convened on 8 October 2016 in the city of Jaipur, India. During the meeting its participants discussed such important aspects for further development of BRICS STI cooperation as institution building, implementation of previous commitments, tapping synergies of the existing BRICS cooperation mechanisms, exploring a number of new areas for cooperation and maintaining continuity in the existing efforts. In the Jaipur Declaration, adopted at the fourth BRICS STI meeting, the member countries resolved to intensify, diversify and institutionalize STI cooperation through the BRICS research and innovation initiative.[6]

The fifth BRICS STI ministerial meeting, held in Hangzhou, China on 18 July 2017 brought about many important outcomes on STI policy exchange, thematic areas cooperation, joint funding for multilateral R&D projects, youth innovation and entrepreneurship, among others.[7] At their fifth meeting, the BRICS STI ministers adopted

[6] 4th BRICS Science, Technology and Innovation Ministerial Meeting at Jaipur, Press Information Bureau, Ministry of Science & Technology of India, 10 October 2016 (Nov. 18, 2018), available at http://pib.nic.in/newsite/PrintRelease.aspx?relid=151563.

[7] 5th BRICS Science, Technology & Innovation (STI) Ministerial Meeting Held in Hangzhou, BRICS official website, 4 August 2017 (Nov. 18, 2018), available at https://www.brics2017.org/English/Headlines/201708/t20170804_1760.html.

a series of documents, including the BRICS Action Plan for Innovation Cooperation 2017–2020, the BRICS STI Work Plan (2017–2018) and the Hangzhou Declaration. At this meeting for the first time innovation became the central issue of the multilateral discussions. The meeting underlined the significance of innovation dialogue and STI cooperation for innovation-driven development, global economic vitality and sustainable development. All of the BRICS countries agreed that innovation represents one of the major engines of global sustainable development and plays a crucial role in facilitating economic growth.

The Hangzhou Declaration was in line with the theme of the 5th BRICS Science, Technology & Innovation Ministerial Meeting "Leading Through Innovation & Deepening Cooperation." The BRICS STI ministers reaffirmed the importance of innovation dialogue leading to outcomes and STI cooperation for promoting innovation-driven development and supporting the robust and sustainable growth of the BRICS countries as well as global sustainability.

In order to promote innovation and leverage the central role of science and technology in enhancing socio-economic development and driving global sustainable development, the BRICS STI ministers agreed to adopt the BRICS Action Plan for Innovation Cooperation for the period 2017–2020.

The BRICS STI ministers agreed that it would be vital to promote entrepreneurship and build platforms in the BRICS countries, and mainly "…collaborate in technology cooperation, technology transfer and translation, science and technology parks, youth innovation and entrepreneurship and in fostering strategic and long term university-industry partnerships so as to build sound ecosystems for innovation and entrepreneurship."[8]

At the fifth STI ministerial meeting the BRICS countries' participants reached an agreement concerning one of the priorities for their countries' research policy. In this regard, they underlined the importance of supporting cutting-edge, high-impact research and encouraging researchers from their countries to publish the results of their research in acclaimed international journals and participate as external foreign reviewers (whenever possible) in the review of research proposals submitted to funders in the other BRICS countries, ensuring the quality of the scientific review system within BRICS.

In order to strengthen science and technology cooperation, the BRICS countries took the decision to finance the second set of multilateral R&D projects and launched the second call for proposals for multilateral science and technology cooperation projects.

At the sixth BRICS STI ministerial meeting in Durban, South Africa held on 3 July 2018 the participants reviewed the BRICS STI activities undertaken for the previous year,

[8] Hangzhou Declaration, Theme: Leading Through Innovation & Deepening Cooperation, Hangzhou, China, 18 July 2017 (Nov. 18, 2018), available at https://www.brics2017.org/English/Headlines/201708/P020170825391206316687.pdf.

including the meetings of thematic working groups, proposals on the establishment of new initiatives and adoption of the Durban Declaration, under the slogan "Leveraging BRICS Science, Technology and Innovation to Enhance Inclusive Growth and Development."[9]

The Durban Declaration welcomed and endorsed a number of initiatives in the context of BRICS STI international cooperation, including:

– Establishment of the BRICS Vaccine Research and Development Centre, which creates synergies between the BRICS STI and BRICS Health sectorial tracts from an STI perspective;

– Establishment of the BRICS Partnership on New Industrial Revolution (PartNIR) with emphasis on innovation; and

– Establishment of a permanent mechanism to manage and coordinate BRICS STI activities, proposed by South Africa and Russia.

In the Durban Declaration, the BRICS countries reaffirmed their vision "…to promote science, technology and innovation for human development utilizing people-centered and public-good driven policy and implementation frameworks."[10] They also reaffirmed the strategic value of the BRICS STI Framework Program as a mechanism for promoting BRICS research and technology development, and supported the launch of the third call for proposals of the BRICS STI Framework Program in the fourth quarter of 2018.

The BRICS Action Plan for Innovation Cooperation adopted in Hangzhou was discussed at the BRICS STI ministers' meeting in Durban, South Africa in July 2018. Out of eight items of the Action Plan, items number 4 and 5 were supported by initiatives of Brazil and China.

In this respect the Durban Declaration says:

> Pursuant to the BRICS Action Plan for Innovation Cooperation adopted in Hangzhou, China in July 2017, we welcome Brazil's proposal to establish the BRICS networks of science parks, technology business incubators and SMEs, and China's proposal to establish a BRICS Technology Transfer Center under the direction of the BRICS Science, Technology, Innovation and Entrepreneurship Partnership (STIEP) Working Group. We take note of China's proposal in consultation with India to host the 2nd Meeting of the STIEP Working Group, in mid-September of 2018 to give further impetus to this strategic area of cooperation.[11]

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[9] Durban Declaration, Theme: Leveraging BRICS Science, Technology and Innovation to Enhance Inclusive Growth and Development Durban, South Africa, 3 July 2018 (Nov. 18, 2018), available at https://www.ranepa.ru/images/media/brics/sapresidency2/BRICS_STI_2018.pdf.

[10] *Id.* at 2.

[11] *Id.* at 4.

3. Development of the BRICS STI Cooperation Areas

Analysis of the documents adopted by the BRICS STI ministers at their meetings allows one to conclude that the five countries demonstrate a common approach to formulating and following the main trend of their national science and technology policies: consistent transition from cooperation in science, including elaboration of joint thematic priorities, to cooperation in innovation and entrepreneurship in the context of the New Industrial Revolution.

The practical implementation of the BRICS countries' STI cooperation started in 2016 under the BRICS STI Framework Program. The first pilot coordinated call for BRICS multilateral projects was announced for carrying out collaborative multilateral basic, applied and innovation research projects in ten areas of science:[12]

(1) Prevention and monitoring of natural disasters;
(2) Water resources and pollution treatment;
(3) Geospatial technology and its applications;
(4) New and renewable energy, and energy efficiency;
(5) Astronomy;
(6) Biotechnology and biomedicine including human health and neuroscience;
(7) Information technologies and high-performance computing;
(8) Ocean and polar science and technology;
(9) Material science including nanotechnology;
(10) Photonics.

The basic rule of the collaborative call for project proposals says that each joint project proposal should be applied by organizations from at least three BRICS countries. In the framework of the first call for project proposals the following research funding organizations from the BRICS countries agreed to jointly support multilateral cooperative research activities:[13]

Brazil: National Council for Scientific and Technological Development (CNPq)
Russia: Foundation for Assistance to Innovations (FAI)
Ministry of Education and Science (MON)
Russian Foundation for Basic Research (RFBR)
India: Department of Science and Technology (DST)
China: Ministry of Science and Technology (MOST)
National Natural Science Foundation of China (NSFC)
South Africa: Department of Science and Technology (DST)
National Research Foundation (NRF)

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[12] BRICS STI Framework Programme Coordinated Call for BRICS Multilateral Projects – Pilot Call 2016 (Nov. 18, 2018), available at http://brics-sti.org/index.php?p=opportunities/BRICS+Pilot+Call +2016.

[13] BRICS STI FP: 2nd BRICS Call 2017 – RESULTS (Nov. 18, 2018), available at http://brics-sti.org/?p=news/News.

An important fact should be noted: all of the above-mentioned funding organizations are experienced mainly in funding scientific research projects, and only the Russian Foundation for Assistance to Innovations (FAI) is experienced in funding innovation projects, though in small business innovation initiatives and the corresponding projects.

In response to the BRICS STI Framework Program Pilot Call 2016 a total of 320 proposals were submitted. As the outcome of the selection procedures, 26 collaborative project proposals were selected for funding,[14] including the participation of the following numbers of the BRICS countries' organizations:

20 proposals from Russia;

8 proposals from Brazil;

22 proposals from India;

20 proposals from China; and

10 proposals from South Africa.

Distribution of the 20 supported proposals among the Russian funding organizations (Ministry of Education and Science – 7, Russian Foundation for Basic Research – 13, Foundation for Assistance to Innovations – 0) testifies that:

– Firstly, most of the approved proposals were aimed at carrying out fundamental research. These projects were supported by the Russian Foundation for Basic Research;

– Secondly, no innovation-oriented proposals were supported. The Foundation for Assistance to Innovations received five project proposals, but could not recommend any of them for funding.[15]

The second BRICS STI cooperation call for proposals opened in September 2017 in six thematic areas:[16]

– Prevention and monitoring of natural disasters;

– Water resources and pollution treatment;

– New and renewable energy, and energy efficiency;

– Biotechnology and biomedicine including human health and neuroscience;

– Information technologies and high-performance computing; and

– Material science including nanotechnology.

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[14] BRICS STI FP: Pilot Call 2016 – RESULTS (Nov. 18, 2018), available at http://brics-sti.org/?p=new/12.

[15] Подведены итоги конкурсов в рамках программы «Интернационализация» // Фонд содействия инновациям. 19 января 2017 г. [The Results of the Competition Within the Internationalization Program Are Summed Up, Foundation for Assistance to Innovations, 19 January 2017] (Nov. 18, 2018), available at http://fasie.ru/competitions/podvedeny-itogi-konkursov-v-ramkakh-programmy-internatsionalizatsiya/.

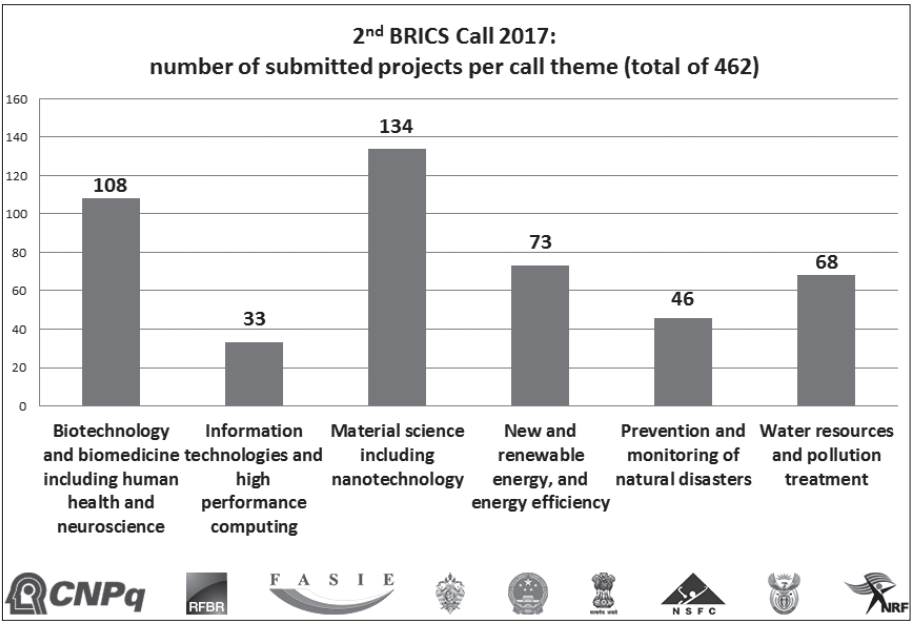
[16] Памятка российским участникам скоординированного Конкурса проектов Рамочной программы БРИКС по научнотехнологическому и инновационному сотрудничеству [BRICS STI Framework Programme: Coordinated Call for BRICS Multilateral Projects – 2nd Call 2017] (Nov. 18, 2018), available at http://brics-sti.org/files/Guideline_for_Russian_applicants_ BRICS_call_2017.pdf.

In response to this call, a total of 462 project proposals were submitted in the six thematic areas (Diagram 1 below) and 32 joint project proposals were selected for support.

By September 2018, all Russian financing organizations announced the competition results. As to the Foundation for Assistance to Innovations, only one collaborative project proposal was submitted. But for reasons related to the formal criteria, this proposal was not allowed to participate in the competition.[17] Actually then no single innovation-oriented joint project proposal from the BRICS countries received financial support in the framework of the two BRICS STI cooperation calls.

As to the Russian Foundation for Basic Research (RFBR), it received 257 project proposals in the framework of the second BRICS STI cooperation call. Following the results of independent expert evaluation, 19 project proposals received RFBR financial support.

Diagram 1: Distribution of Project Proposals to the 2nd BRICS STI Framework Program Call



[17] Утверждены результаты конкурсных отборов в рамках программы «Интернационализация» // Фонд содействия инновациям. 17 августа 2018 г. [FAI Results of Competition Within the Program Internationalization, Foundation for Assistance to Innovations, 17 August 2018] (Nov. 18, 2018), available at http://fasie.ru/competitions/rezultaty--otborov-v-ramkakh-programmy-internatsionalizatsiya/.

As to the Ministry of Science and Higher Education of the Russian Federation (formerly the Ministry of Education and Science), it received 33 project proposals, and following the results of independent expert evaluation six proposals were chosen for financial support from the Ministry in the following R&D areas:

1 project proposal in "Prevention and Monitoring of Natural Disasters";

2 project proposals in "Biotechnology and Biomedicine Including Human Health and Neuroscience";

2 project proposals in "Information Technologies and High-Performance Computing"; and

1 project proposal in "Material Science Including Nanotechnology."

The results of the 2016 and 2017 BRICS STI Framework Program calls allow one to draw several conclusions concerning the thematic priorities in science, technology and innovation cooperation of the BRICS countries.

Firstly, it is evident that the structure of the scientific priorities of the BRICS STI cooperation has changed. The 2nd BRICS STI Framework Program Call was arranged in six scientific areas instead of ten as in the first call. This can be explained by certain revisions of the BRICS countries' policy priorities to science, technology and innovation. The research areas of the second call focused on searching for solutions to global challenges and at the same time on creating a science and technology basis in the context of the research areas that underpin the next industrial revolution.[18]

Secondly, the fact that project proposals to the Foundation for Assistance to Innovations are practically absent (only six in two calls were submitted and none were supported) indicates that research organizations, universities and companies of the BRICS countries are not quite ready for cooperation in the sphere of innovation and that there is a certain structural imbalance of cooperation of the BRICS countries in the sphere of science, technology and innovation.

It should be noted as well that the imbalance between the number of the projects proposed and adopted has increased greatly. In the first call, the ratio between adopted and proposed projects (26 of 320) was 1 to 12.3, and in the second call the imbalance appeared to be 1 to 14.4 (32 of 462).

In the Durban Declaration, adopted at the 6th BRICS STI Ministerial Meeting (3 July 2018 in Durban, South Africa), the participants reaffirmed the strategic value of the BRICS STI Framework Program as a mechanism for promoting BRICS research and technology development and supported the launch of the third call for proposals of the BRICS STI Framework Program in the fourth quarter of 2018

> …in the following thematic areas: prevention and mitigation of natural disasters; water resources and pollution treatment; geospatial technology and its applications; new and renewable energy, and energy efficiency,

[18] Klaus Schwab, *The Fourth Industrial Revolution* (Cologny; Geneva: World Economic Forum, 2016).

> including solid state lighting; astronomy; biotechnology and biomedicine including human health and neuroscience; information technologies and high performance computing; ocean and polar science and technology; material science, including nanotechnology; photonics; research infrastructures, including mega-science projects; Science, Technology, Innovation and Entrepreneurship Partnership (STIEP); and aeronautics…[19]

It should be noted that the proposed thematic areas of the third call for project proposals within the BRICS STI Framework Program almost exactly repeat the thematic areas of the BRICS countries' STI cooperation stated in the Memorandum of Understanding on cooperation in science, technology and innovation. The "Science, Technology, Innovation and Entrepreneurship Partnership (STIEP)" was included in the third call for proposals as an addition to the MOU thematic areas.

4. Specifics of the BRICS Plan for Innovation Cooperation

At the BRICS STI ministerial meeting in Hangzhou, the BRICS countries adopted the Action Plan for Innovation Cooperation, aiming

> …to promote entrepreneurship and build platforms in BRICS countries and mainly collaborate in technology cooperation, technology transfer and translation, science and technology parks, youth innovation and entrepreneurship and in fostering strategic and long term university-industry partnerships so as to build sound ecosystems for innovation and entrepreneurship…[20]

It seems that the BRICS Action Plan for Innovation Cooperation (2017–2020) (Action Plan) is the first program document of the BRICS countries' STI cooperation which is intended to turn the vector of cooperation measures from the plane of science and technology cooperation to the plane of innovation cooperation aimed at high-tech business development. It is worthwhile to comment on the main items of the Action Plan for Innovation Cooperation:

> 1. Promoting exchanges and good practices among the BRICS countries on innovation strategies and policies; enhancing mutual understanding, complementarity and coordination for the BRICS cooperation in innovation, and in particular, for the attainment of socio-economic progress driven by scientific, technological and social innovation, for the building of a BRICS

[19] Durban Declaration, *supra* note 9, at 2.

[20] Hangzhou Declaration, *supra* note 8.

community of shared values and common future, and for the realization of sustainable development goals.

This item of the Action plan is aimed at promoting mutual understanding between the BRICS countries concerning national specifics in understanding and implementing the national innovation policy priorities. It should be noted that this item implementation will have to be executed on a year to year basis.

2. Strengthening cooperation in scientific and research activities, enhancing cooperation in innovation based on existing mechanisms and joint research programmes including such cooperation conducted through public-private partnerships; fostering strategic and long term university-industry partnerships to address the needs of industry and contributing directly to economic growth and development; continuing to encourage and support research and development projects in the areas of fundamental and applied research and innovation within bilateral and multilateral frameworks and continuing to carry out joint calls for STI projects; understanding the importance of implementing BRICS initiatives related to research and innovation; promoting open science and the sharing of research infrastructure; developing and initiating international mega science programmes.

This item of the Action plan presents an attempt to outline main common drives for innovation policy of the BRICS countries. Although all BRICS countries have their national innovation strategies and their own understanding of innovation development drivers, the vision of the intersection of the five national approaches to innovation development is a useful exercise to attract attention to common innovation development drivers.

3. Organizing joint activities on identifying priorities for STI cooperation of BRICS countries based on foresight and monitoring of global STI development.

It should be mentioned that the STI priorities of the BRICS countries are concretely expressed in the BRICS Memorandum of understanding on cooperation in science, technology and innovation. As to foresight and monitoring of the global STI development in order to identify priorities for STI cooperation of BRICS countries, it could be an interesting exercise and additional source of information.

4. In view of the importance of science and technology parks for regional economic development, encouraging cooperation among science parks including supporting the transnational establishment of BRICS hi-tech enterprises in S&T parks. We welcome the establishment of exchange mechanisms for science parks, and expanding areas of cooperation in these domains.

The idea to arrange cooperation between the BRICS countries' science parks is timely and important, especially from the point of view of establishment of the BRICS countries joint hi-tech enterprises in S&T parks. The main objectives for these joint hi-tech enterprises could be innovation development based on the results of joint research projects carried out in the framework of the BRICS joint calls for proposals.

5. Encouraging technology transfer among the BRICS countries, strengthening training of technology transfer professionals, developing platforms for collaboration among businesses and academia, enabling extensive and orderly transfer and translation of innovation achievements in the BRICS countries. Utilizing existing technological network platforms as instruments of search for foreign partners for technological collaboration and initiation of joint STI projects.

Technology transfer, platforms for collaboration between businesses and academia and utilization of existing technological network platforms are the best instruments for carrying out practical implementation and transformation of science and technology achievements into innovation goods and services. But it should be taken into consideration that technology transfer, including international collaboration between business and academia is a risky activity from many points of view, including regulations of the intellectual property rights, distribution of prospective profits and so on. For this reason the technology transfer, international collaboration between businesses and academia and other activities included into Item No. 5 need a legal framework elaborated and coordinated by all BRICS countries.

6. Promoting BRICS Partnerships on Youth Innovation and Entrepreneurship to carry out pragmatic cooperation, advocating the entrepreneurial spirit of encouraging innovation and tolerating failure, and to create a favorable ecosystem for innovation and entrepreneurship amongst the younger generation.

It should be noted that the problem of the research personnel aging in the sphere of science, technology and innovation seems to be a problem of many developed countries. For this reason promotion of the BRICS Partnerships on Youth Innovation and Entrepreneurship, being timely and reasonable, should be among priorities of the BRICS countries STI cooperation.

7. Acknowledging the importance of supporting STI investment and the need to establish inter-BRICS investment instruments, we support explore the possibilities of driving BRICS cooperation on innovation and entrepreneurship through the National Development Banks, New Development Bank and other existing financing institutions.

Under conditions when science and technology collaboration between the BRICS countries is financed by national funding organizations of the five countries through the BRICS STI calls for proposals for S&T projects, one of the main focuses in the activities of the National Development Banks, New Development Bank and other existing financing institutions should be aimed at funding joint innovation projects based on the results of science and technology projects carried out in the framework of joint calls for proposals. One of the main criteria for funding the innovation projects should be the prospective economic output of the funded projects.

8. Supporting the mobility of STI human resources, especially exchanges among young scientists and entrepreneurs, supporting efforts to help address

the future demand for new skills, sharing best practices on enhancing skills training for innovation and entrepreneurship, including improving access to Science, Technology, Engineering and Mathematics (STEM) education, creating jobs through joint research and collaboration in innovation and entrepreneurship, and stressing the role of youth in innovation. Stressing the role of women in science, technology and innovation activities as one of the key priorities of the BRICS STI Agenda.

One of the main preconditions of scientific, technological and innovation development of any country in the modern world is the intellectual capacity of its population and for this reason the initiatives that are mentioned in this paragraph are of the utmost importance.

Implementation of the Action Plan for Innovation Cooperation assumes that the BRICS Science Technology Innovation and Entrepreneurship Partnership (STIEP) Working Group will be responsible for the development of mechanisms and opportunities to implement the Action Plan. In the first turn, networks of science parks, technology business incubators and SMEs will be established and cross-cultural teams of experts will start working in the domains of: ICT, materials, water, health, energy, natural disaster risk reduction and resilience, and others as well.

5. Possible Problems and Risks of the BRICS Countries' Cooperation in Innovation

It is possible to assume that one of the main reasons explaining the above-discussed results of the two BRICS STI Framework Program Calls (in the part regarding innovation project proposals submitted to FAI) is insufficient understanding about the legal procedures on using the results of multilateral international innovation research projects aimed at the development of new products (goods and services). This conclusion is supported by the fact that the national annexes, of all of the BRICS countries, to the coordinated calls for BRICS multilateral projects (except for the Indian National Guidelines for Coordinated Call for BRICS Multilateral Research and Development Projects – BRICS Call for Proposal 2017) do not include recommendations concerning the prospective results of joint multilateral projects for commercialization.[21] Such a situation, if not improved at the initial stage of BRICS STI cooperation, may cause serious problems and restrictions in the future.

The only source of information concerning intellectual property rights on the results of the BRICS multilateral STI projects are the tender documents of the BRICS countries' funding organizations that include provisions concerning the use of the results of the joint science and technology projects.

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[21] BRICS STI Framework Programme Coordinated Call for BRICS Multilateral Projects – Call 2017 (Nov. 18, 2018), available at http://brics-sti.org/?p=new/15.

For example, the tender document of the Russian Federation Ministry of Science and Higher Education in the framework of implementing Activity 2.1 of the Federal Target Program "Research and Development in Priority Areas of Science and Technology Development of Russia for 2014–2020" says that,

> The rights to results acquired by the subsidy recipient and his foreign partner(s) (further – the parties) in the joint working on the project belong to the Parties in accordance with the proved Parties' contribution to implementation of the project.[22]

It should be admitted that this formulation in the tender document does not clearly explain how the parties to a multilateral research project should act to determine their contribution to a joint project.

The Foundation for Assistance to Innovations (FAI) for Coordinated BRICS STI Calls uses provisions of its tender document elaborated for the FAI "International Programs" section. Item 5.16 of the FAI tender document says:

> The rights to results of science and technology activities acquired in the process of implementing the contract belong to the grantee.
>
> The rights to the patent and the exclusive right to an invention, useful model or industrial design, selection achievements, topology of integrated chips, computer programs, databases and know-how, created in the process of carrying out activities under the contract belong to the grantee.[23]

It seems evident that this provision of the FAI tender document is not in accordance with another provision of the same document, which for its part says that "participation in the BRICS STI Framework Program requires participation of three organizations from three countries (including Russia)."[24] This situation may be understood such that the common result of an innovation-oriented multilateral project of three BRICS countries' organizations may belong to the grantee financed by FAI.

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[22] Конкурсная документация по проведению конкурсного отбора на предоставление субсидий в целях реализации федеральной целевой программы «Исследования и разработки по приоритетным направлениям развития научно-технологического комплекса России на 2014–2020 годы» [Ministry of Education and Science of the Russian Federation, Tender Documentation] (Nov. 18, 2018), available at http://fcpir.ru/upload/iblock/876/Konkursnaya-dokumentatsiya.pdf.

[23] Положение о конкурсе «Международные программы» // Фонд содействия инновациям [Provisions of the Programme "Internationalisation," Foundation for Assistance to Innovations] (Nov. 18, 2018), available at http://fasie.ru/programs/programma-internatsionalizatsiya/polozhenie-o-konkurse-mezhdunarodnye-programmy.php.

[24] Заявки на многосторонний конкурс в рамках программы BRICS принимаются до 20 декабря 2017 года // Фонд содействия инновациям. 1 ноября 2017 г. [Call for Proposals Within the Multilateral BRICS Program, Foundation for Assistance to Innovations, 1 November 2017] (Nov. 18, 2018), available at http://fasie.ru/competitions/zayavki-na-mnogostoronniy-konkurs-v-ramkakh-programmy-brics-prinimayutsya-do-20-dekabrya-2017-goda.

As far as scientific activities supported by the RFBR are concerned, it should be noted that the use of the acquired research results is executed in accordance with "[t]he rules of organizing and carrying out activities in the framework of projects supported by the federal state budgetary institution 'Russian Foundation for Basic Research'" that are applied to all tenders of the RFBR. According to these rules the grantee must only inform "the RFBR about results of the project that have signs of patentability or possibility of commercial use."[25]

Unlike Russian funding organizations, the Department of Science and Technologies of India published the "DST (India) National Guidelines for Coordinated Call for BRICS Multilateral Research and Development Projects – BRICS Call for Proposal 2017" which includes a provision about sharing the intellectual property rights (IPR) created within joint projects. In accordance with this provision:

> The IPR sharing will be govern by national domestic laws and under the framework of BRICS STI MoU and/or India bilateral S&T Agreement with BRICS Countries as applicable. The Indian public institution along with other BRICS partners will have to submit an IPR arrangements, technical annex documents and coordination agreement, in case, the proposal is finally selected for funding support.[26]

The National Research Foundation (NRF) of South Africa also published guidelines for national organizations that submit proposals together with their partners from other BRICS countries to the 2017 Call for Joint Project Proposals. But the South African guidelines do not include recommendations concerning managing the IPR created within a joint multilateral project.

The Brazilian Guidelines (National Annex) to Coordinated Call for BRICS Multilateral Projects – BRICS Call for Proposal 2017 issued by the National Council for Scientific and Technological Development (CNPq) do not contain any provisions concerning sharing IPR acquired within a joint project.[27]

As far as the position of China on the results of joint research activities in the context of the BRICS multilateral projects call for 2017 is concerned, it should be noted that neither the Ministry of Science and Technology nor the National Natural Science Foundation of China (NSFC) include any provisions about IPR management in

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[25] Rules of organization and implementation of scientific projects supported by the RFBR were adopted by the decision of the bureau of the RFBR Council on 19 February 2015.

[26] DST (India) National Guidelines for Coordinated Call for BRICS Multilateral Research and Development Projects – BRICS Call for Proposal 2017 (Nov. 18, 2018), available at http://brics-sti.org/files/DST_National_Guidelines_2017_BRICS_Call.pdf.

[27] National Annex, National Council for Scientific and Technological Development (CNPq), BRICS STI Framework Programme, Coordinated Call for BRICS Multilateral Projects – Call 2017 (Nov. 18, 2018), available at http://brics-sti.org/files/CNPq_National_Annex_2017_vCGSB_12-09-2017.pdf.

their guidelines (national annexes) to the BRICS STI Framework Program Coordinated Call for BRICS Multilateral Projects – 2nd Call 2017.

All of the above-mentioned facts testify to insufficient development and coordination of the BRICS countries' rules of cooperation in the sphere of STI. It is necessary to recall that implementation of technological innovations based on the results of large-scale and complicated research, especially in the framework of international multilateral projects, may be subject to certain risks and restrictions that can appear both because of the generally complicated character of research projects that form the basis for technological innovations and because of a number of challenges that cooperation projects sometimes demonstrate, as well as because of specific features that are inherent in international science and technology multilateral cooperation projects.[28]

Similar to any other cooperative scientific activity, multilateral international science and technology cooperation is subject to a number of risks. These risks can be divided into three key groups.[29]

The first group includes risks that are inherent in any scientific research: errors in selecting the areas and subjects of research, errors in determining the amount of funding, the required research devices, etc.

The second group includes risks arising from organizing and conducting cooperative research projects, that is, projects carried out jointly by several entities, including scientific, industrial and financial organizations. In this case, the research project risks included in the first group can be accompanied by the risks related to errors in selecting partners for joint research activities that could prove unable to perform their part of the work; errors in distribution and allocation of responsibilities for performing different work stages to different partners; errors in distribution of the intellectual property rights to the results of joint work; and errors in planning how to use the results of the completed work.

The third group includes risks that are mainly inherent in international science and technology multilateral cooperation projects. This group comprises risks stemming from the following aspects:

– The lack of information regarding the competences of the foreign partners. Its consequence is the risk that the competences of some partners may be overestimated, and the entire project could fail as a whole;

– The risk of losing the rights for some intellectual property. This risk can arise in cases where the contribution of one of the parties to the joint project consists of the use of earlier received research results, especially in the case where those results have not been properly registered;

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[28] Ricky Luppino et al., *Risk Management in Research and Development (R&D) Projects: The Case of South Australia*, 19(2) Asian Academy of Management Journal 67 (2014).

[29] The Russian Federation's International Science and Technology Cooperation: An Overview and Development Issues (I.S. Ivanov (ed.), Moscow: Spetskniga, 2014).

– The corporate and national specific features of some partners (recording insignificant results or oral agreements, the organization methods of joint work, etc.). Such specific features in general could lead to difficulties with project management, and thus slow down research;

– A large number of participants in an international project can cause certain difficulties and thus present a risk for the project. In this case, difficulties could arise from many disputes concerning project management and the ways of achieving the set goals of the joint research;

– Underestimating the strategic importance of the results of future projects completed jointly by an international group of partners obtaining an important result. This is perhaps the main risk inherent in international science and technology cooperation, particularly in the area of applied and innovation-oriented research which is potentially highly rewarding from the point of view of commercialization of the results of research. Some foreign experts advise against organizing international projects in cases where the area of cooperation has a strategic importance in terms of security (information, technology, etc.) or in terms of significant economic value;[30]

– Activities of foreign research and development organizations in the host country. Initiatives of this kind are often aimed at using the human resources of the host country (primarily highly qualified researchers) to benefit the foreign organization's own projects. The main risk such projects present is the "brain drain" from the host country. Another potential risk involves losing the unprotected results of intellectual activity obtained by the host country's scientists. It should be noted that this risk is also inherent in multilateral coordinated projects that are carried out in not one but several countries.

Minimization of these and other risks is important for successful development of the BRICS countries' cooperation in STI, namely from the point of view of taking into account and balancing their scientific and economic interests.

The scientific interests of the BRICS countries' organizations can be ensured through joint scientific publications based on the results of their joint research, especially in the fundamental sciences. As to the economic interests of the participating organizations (and consequently of their countries), they are inherent in the results of joint projects in applied research and innovation developments that promise commercialization potential. In this case the participating organizations can ensure their economic interests through the legal registration of the joint projects results, for example through joint patenting and further commercialization of their joint intellectual property.

One of specific features of the BRICS countries' multilateral research projects is the separate funding of national research organizations in the framework of the joint

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[30] T. Finne, *R&D Collaboration: The Process, Risks and Checkpoints*, 2 Information Systems Control Journal 18 (2003).

projects. In projects of this type the integrated budget is not established, rather each country carries out the funding of its own participation. Under such an approach disagreements concerning the purposes and amounts of financing may be less sharp than disagreements concerning distribution of the intellectual property rights and profits in the event that the project results hold potential for commercialization. Besides, in such an event there can be additional disagreements concerning distribution of the geographic markets in which the partners in the project have intentions to obtain exclusive rights for promoting the commercialized results of the project.

As to multilateral science and technology cooperation, one circumstance should be noted: the risks for all of the partners may lead to restrictions that would limit national research organizations in some activities within science and technology cooperation.

The most reliable and conventional way to avoid risks and restrictions inherent in international cooperation is to conclude a multilateral agreement between the parties that participate in the project. The agreement should include provisions necessary for regulating issues of organization, financing, performance, use of the project results, etc.

In this respect it should be mentioned that in most cases the tender documents of the organizations that provide financial support to national research organizations bidding for participation in the BRICS Multilateral Research and Development Projects include provisions concerning concluding agreements that are intended to regulate the use of the results of joint research activities. However, these provisions are very general, they do not offer any model agreement coordinated with foreign partners, but in fact they often appear to be formal and not designed to induce responsibility on the part of the parties for the unilateral use of common results.

For example, the tripartite Russian-Chinese-Indian agreement concerning research cooperation in the framework of the BRICS STI Framework Program Pilot Call 2016, within the research project named "Development of Novel Cooling Systems for High-Power LEDs for Enhancing Reliability and Lifetime," in the section "Rights for Intellectual Property," indicates that,

> the rights to results of research received by the Parties while implementing the mentioned project belong to the Parties according to their contribution established by the Parties within those activities in which the Parties jointly act as investors and performers. The Parties will conclude additional agreements on such kinds of activities. In case of using a previous intellectual property for implementing this project the Parties will conclude additional license agreements which will be a subject of independent interaction of the Parties.[31]

[31] Ministry of Science and Higher Education of the Russian Federation, Agreement on scientific and technological cooperation in the framework of the project No. 14.613.21.0067.

At least two issues still remain unclear:

– First, what would be the technique to determine the mentioned size of "contribution to those activities" in the event the parties have different financial possibilities?

– Second, if the parties jointly act as investors and performers in certain activities and if their own investments (additional to those of the national funding organizations) are not equal, then what would be the technique to determine the access of each party to the results of the joint science and technology activities in the event the result is unique and holds potential for commercialization?

These are only two issues that may require elaboration of additional legal frameworks for the international cooperation of the BRICS countries in the sphere of STI that can ensure better efficiency and help avoid risks in carrying out the projects in the framework of the BRICS countries' STI calls for cooperation projects.

It should be noted that the BRICS countries' STI cooperation is not free from the above-described risks inherent in any international science and technology cooperation in research, technology and innovation projects. If not regulated in due time and according to agreed formats, these risks may in their turn cause certain restrictions in implementing the BRICS STI Framework Program.

As to restrictions that may be caused by certain risks in international science and technology cooperation (ISTC), it is necessary to underline one circumstance: if the risks connected with international research projects are to some extent "universal" for each participant, the restrictions for them are different and depend on a combination of various factors, including the relative level of competences of the partners in the project, the "sensitivity" of the research area, the number of organizations participating in the project, their financial or other contribution to the project, and others as well.

Table 2 below shows the risks and possible corresponding restrictions that may occur at the stage of establishing an international research team for carrying out an ISTC cooperation project.

Table 2: Possible Restrictions Caused by the Main Risks of International Science, Technology and Innovation Cooperation Projects

	ISTC-Related Risks	**Possible Restrictions in Carrying Out ISTC**
1	Risk of increasing the overall budget of the ISTC project	Restrictions on the number of the project participants that are not able to provide the necessary level of project funding
2	Risk to increasing the competitiveness level of the partners in the project	Restrictions on the number of the project participants that have low research competences

3	Risk of a decrease of funding and flexibility of management	Restrictions in terms of objectives of the project
4	Risk to providing sufficient and reliable mechanisms that would guarantee participants' long-term commitment to the project	Restrictions in terms of selecting reliable and competent partners for the project Need to provide governmental support to the project
5	Risk to providing a fair distribution of expenditures and profits	Restrictions on any interpretation of appropriate sections of the agreement on joint research
6	Risk of losing critical national technologies	Restrictions on technology transfer
7	Risk of social and cultural differences	Restrictions on any interpretation of appropriate sections of the agreement on joint research
8	Risk connected with difficulties in managing the project	Restrictions on any interpretation of appropriate sections of the agreement on joint research

It follows from Table 2 that the main restrictions of international science and technology cooperation (including that of the BRICS countries' STI cooperation as well) can be presented within three groups:

1) Restrictions connected with the level of the competences of the perspective partners for participating in the ISTC project. In the case of the BRICS STI calls for proposals, these restrictions are present at the stage of the initial negotiations between the research organizations of the partner countries willing to arrange a multilateral research and development project. Rather often participation of a low competence candidate can be restricted or rejected at the stage of initial negotiations;

2) Restrictions connected with the level of financial support to the applicants for participation in the ISTC project. In the case of the BRICS STI cooperation projects, these restrictions are mainly caused by the insufficient level of some participants' financial resources in the event the project partners decide to conclude an additional agreement to commercialize the project results at the expense of their own financial resources. In the case where the multilateral research project of the partner countries' organizations is fulfilled with a result which promises commercialization, but one or two participants do not have the finances to proceed with commercialization of the common result in the framework of an additional agreement, then commercialization of the project results may be put at risk of delay;

3) Restrictions connected with the development of the agreement on implementation of the international research project. In the case of the BRICS STI cooperation projects, these restrictions may arise and restrict the implementation period of the project. But these restrictions are not crucial, for the reason that the

cooperation agreement passes at two levels of consideration: at the level of the government authorities of the partner countries and at the level of the partner research organizations.

Conclusion

The aspirations of the BRICS countries to develop mutually beneficial multilateral cooperation in the sphere of science, technology and innovation correspond to the main global trends based on rapid changes in manufacturing, communication, services, medical technologies, and in other areas. The key condition for the BRICS countries to remain in accord with this global trend is to ensure rapid and mutually acceptable implementation of the results of their common research projects in innovation technologies, goods and services. At the same time it is highly necessary to elaborate certain measures of a legal character that would provide conditions for minimizing the described risks and restrictions in arranging the BRICS countries' cooperation in science and technology. The most important measure at this point is to provide a legal framework for the transition from science and technology cooperation to cooperation in innovative business activities.

It should be noted that a certain shift in the main focus of the BRICS countries' cooperation from science and technology to innovation business activities was done in 2017 and 2018 at the Hangzhou and Durban BRICS STI Ministerial Meetings. The results of these meetings were reflected in the Hangzhou Declaration and the Durban Declaration.

The research areas of the 2nd BRICS STI Framework Program Call focused on searching for solutions to global challenges and at the same time on creating the science and technology basis in the context of the research areas that underpin the next industrial revolution.

In this regard, the achievement of the main objectives of the multilateral cooperation of the BRICS countries, stated in the Memorandum of Understanding on cooperation in science, technology and innovation, namely

> (a) To establish a strategic framework for cooperation in science, technology and innovation amongst the BRICS member countries;
>
> (b) To address common global and regional socio-economic challenges in the BRICS member countries utilizing shared experiences and complementarities in science, technology and innovation;
>
> (c) To co-generate new knowledge and innovative products, services and processes in the BRICS member countries utilizing appropriate funding and investment instruments; [and]
>
> (d) To promote, where appropriate, joint BRICS science, technology and innovation partnerships with other strategic actors in the developing world,[32]

[32] Memorandum of Understanding, *supra* note 4.

depends on elaboration of complex and multilevel legal frameworks, including bilateral intergovernmental agreements of the BRICS countries, and agreements between investors and performers of extra works within joint projects, especially in such sensitive cases where cooperation in research and development promises discoveries that may result in radical innovations.

It should be noted that the main objectives of the BRICS countries' cooperation in science, technology and innovation stated in the MOU are very ambitious and complex, for the reason that, being implemented within the BRICS STI Framework Program, they assume the transition from one type of activity to another,[33] that is to say, from research and development, having the aim of producing new knowledge, to innovation, having the aim of generating and manufacturing new products (goods and services). Cooperation in these types of activities assumes different types of results, and hence different types of additional agreements to the main agreement on science and technology cooperation. In this respect it seems expedient as well to determine the role of business and non-budget sources of funding in the BRICS countries' cooperation in innovation, and to elaborate corresponding amendments to the BRICS countries' Memorandum of Understanding on cooperation in science, technology and innovation, which is to be renewed in 2020.

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[33] Oslo Manual, *supra* note 2.

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