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Features of Integrative Relations between Science, State and Industry in Russia and Abroad

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ABSTRACT

The purpose of the article is to study the characteristics of the state stimulation of integrated cooperation of science and production in Russia and abroad, to identify problems in the different phases of the innovation process in the conditions of Russian reality. The leading method to the study of this issue is the method of systematization of Russian and foreign practices' features of interaction between science and the state as well as revealing of institutional "traps" in the framework of the Russian innovation. The article presents the foreign and Russian practice of interaction between science and industry, reveals the national peculiarities of integrative relations between science and industry, as a result of research systematizes institutional "traps" at different stages of the innovation process in Russia and proposes measures to minimize them. Materials of the article are of practical value to public administration bodies in the development and implementation of Federal and regional programs of innovative development, development of innovation infrastructure, stimulation of innovative activity, the use of tools of technological platforms.

Keywords: Integrative Interaction, Innovation Development, Modernization, Triple Helix, Institutional Traps
JEL Classifications: F15, F42, F31

1. INTRODUCTION

1.1. The Relevance of the Study

Innovative activity is the product of the integral work of the science sector and industry. And the role of the state is high in this process, since the return on innovation is more problematic and time-consuming than in the case with traditional economic activities (Malysheva et al., 2016; Gumerov et al., 2015; 2016a; 2016b; Drozdova, 2014; Drozdova and Lyapuntsova, 2015). In this regard the attention should be focused on the practice of state stimulation of integrative relations of science and production in Russia and abroad.

The hypothesis of the research is the idea that at the present time in the Russian scientific sector there is the problem of low quality and low efficiency of a large number of scientific organizations, the competitiveness of developments that, due to the lack of demand for innovative domestic developments and these circumstances lead to the failure in the sector of commercialization.

Natural phenomenon is the situation: In Russia in 2011, the volume of innovative goods, works and services for the whole manufacturing industry was 6.8%, in 2012-9.6%, in 2013-11.6% (Rosstat, 2015). Despite the dynamic growth, this indicator reflects the low innovative potential of the country. According to the research conducted by the World Economic Forum among 144 countries the Russian Federation occupies the 66th place in terms of innovation potential (3.8 out of 7), behind Switzerland (5.9), the USA (5.9), Japan (5.9), Israel (5.8), Germany (5.6), Finland (5.6), Sweden (5.5), and many other countries (Schwab, 2014). Also there

are barriers between science and education and, as a consequence, there is no synergistic effect of research and educational activities.

2. METHODOLOGICAL FRAMEWORK

2.1. Theoretical Base of the Study

Theoretical basis of research are fundamental and applied research of foreign and domestic scientists who study the patterns and institutional foundations of innovation processes. The object of the study is the integrative relations between science, government, and production in the Russian and international economy. The objectives of this research are: Comparative analysis of foreign and Russian experience of interaction between science, business and government; a study of problems arising at different phases of the innovation process in Russia and ways of their solution.

2.2. Methods of Study

The study is based on a systematic method of analytical data characterizing the foreign and the Russian economy in terms of innovation activity, as well as methods of formalization, analysis and synthesis. The used complex of methods allowed us to achieve objective results.

2.3. The Stages of Study

In the course of the study:

1. The regularity of institutional traps' emergency is revealed at the stages of the innovation process.
2. A comparative analysis of the financing of science in Russia and the USA is carried out.
3. A set of measures to minimize the consequences of institutional traps is developed.

2.4. Theoretical and Practical Significance of the Study Results

Theoretical significance of the study is to identify regularities in the emergence of institutional traps at the stages of the innovation process in the Russian economy.

The practical significance of the findings and results of the study consists in the objectification of the developments of Federal and regional programs of innovation development, innovation infrastructure development, elimination of gaps between science and industry.

3. RESULTS

3.1. Systematization of Institutional Traps on the Stages of the Innovation Process in the Russian Economy

Russian practice of interaction between science and the state has its peculiarities at different stages of the innovation process. Consideration of steps such as basic research, applied research, development, production (primary exploration, widespread implementation), consumption (full use) and institutional traps that arise at the junction of pair-wise interactions is presented (Table 1).

Under the institutional trap we understand the situation of the institutional trajectory preserving which is inefficient in terms of stability of innovative development and optimal only for two people - A local optimum ("anti-institution of innovation"), where participants are not focused on new technologies' appearing and aimed at situation when the traps are preserved (Shinkevich, 2011). As a result there is a specialized closed trajectory called "traps."

On the first two stages, there is the problem of sputtering of public funds, since the state has to finance simultaneously at the expense of the budget the fundamental science and applied one, while the private sector does not invests enough in research and development (R and D).

As a result, the financing of the first stage of the innovation process decreases (Figure 1). The situation is aggravated by the wait-and-see position of the business in respect of investment in science. There is a trap, which has a resource nature. This problem can be traced at all stages of the innovation process. Next, comes the

Figure 1: Financing of science in Russia and the United States of America from the federal budget (compiled by the author according to the Federal State Statistics Service and the US Congress Research Service). (a) Russia (million rubles), (b) USA (million $ USA)

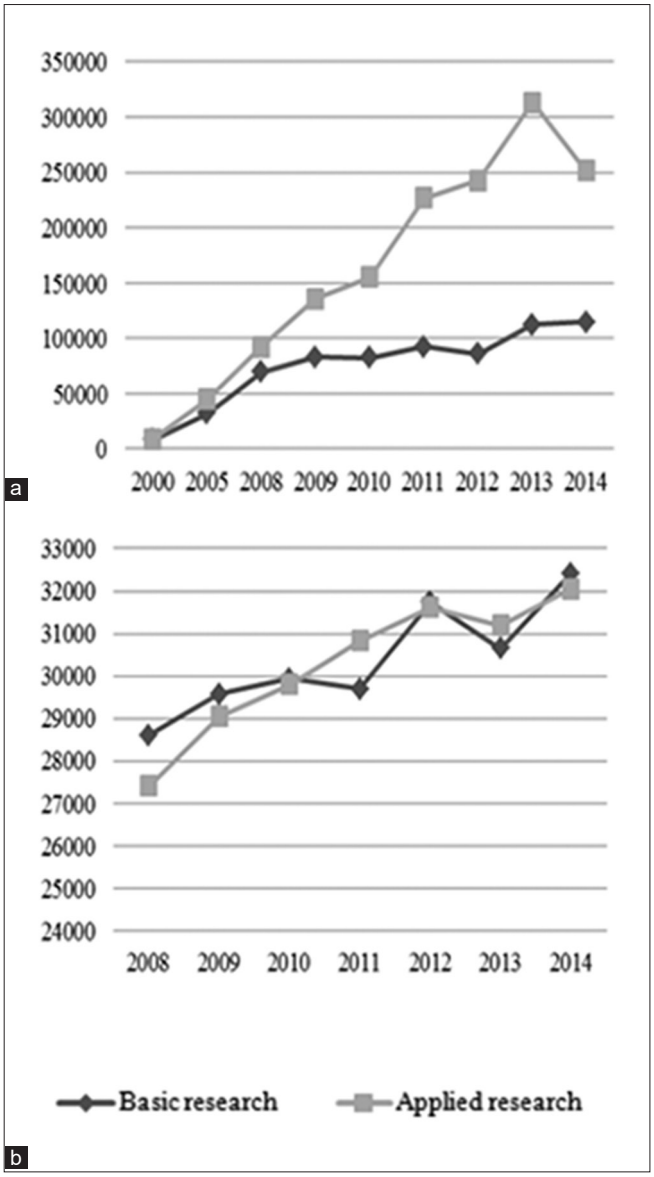


Table 1: Institutional "traps" at different stages of the innovation process

Basic research	Applied research	Development (projecting)	Production	Consumption
State support Grants of the President of Russia, state assignment, research funds Foundation for Advanced research "Scientific and scientific-pedagogical personnel of innovative Russia" for 2014-2020 (201.02 billion rubles) SEZ	FTP "R and D on priority directions of scientific-technological complex of Russia" for 2014-2020 (234.43 billion rubles) (2.3 billion rubles At 2013)		Fund Program of Development for New Technologies Developments and Commercialization Center (SKOLKOVO Fund) until 2020. (125.2 billion rubles) Fund for assistance to small enterprises in science and technology (innovation and technology centers)	Business
Institutional traps Traps "science-state" Traps "business-state"			"Traps' business science" Traps "business-state"	

SEZ: Special economic zones

problem of lack of legislative regulation of the projecting stage of the development, which also contributes to the establishment of a local optimum "science-state." Because of a delay in resources' investment the quality of R and D falls, the country's innovative development lags, the efficiency of funding use declines and their scarcity in the near future increases. This trap prevents scientific and technological development of the country.

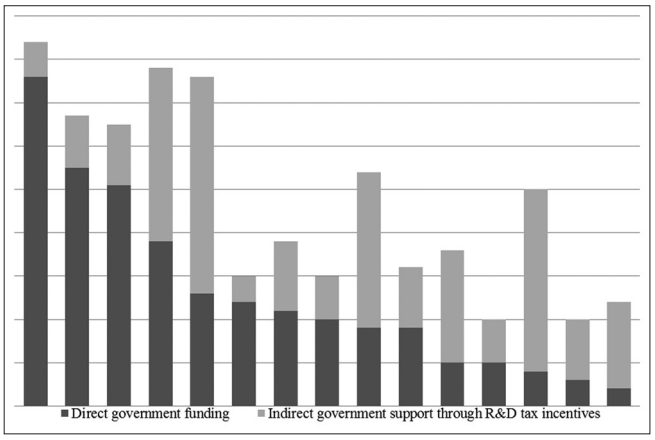
In Russia by the end of 2014 the level of funding in applied research was double the corresponding rate for basic science. This is due to the above-mentioned "resource trap." In the USA, there is less than stable ratio in the structure of financing structure however there are increasing amounts of funding for basic research. R and D financed by government, are essentially defensive in nature, but some state funds are directed to funding other scientific research, especially basic research. In general, the American innovation strategy is aimed at expanding of fundamental R and D in the transition to a new technological structure, wherein the catalysts of economic development are the "green" energy, information technology, health care.

At the stage of production (R and D implementation) there is a gap between the business community and science on the one hand, and the business community and government on the other.

Within the framework of the "triple helix" in the Russian economy an important institutional trap is inefficient use of public funds. An example is the low level of development of public funds by JST "special economic zones" (JSC "SEZ") - 40%. According to data provided by the Federation Council Committee on Budget and Financial Markets at the "round table" in April 2013, the amount of unused by JSC "SEZ" and its subsidiaries of state funds amounted to 33.7 billion rubles.

The volume of direct government funding of Russia takes the first place in comparison with other countries, while the volume of incentive measures are insufficient. However, public investment is often less effective because of the lack of control of funds at various levels of the budget system (Figure 2).

Figure 2: The proportions of stimulation of innovative activity of business in 2013 (% of gross domestic product) (calculated by the author according to the Organization of Economic Cooperation and Development)



In general, the Russian legislation provides a variety of benefits and preferences for companies engaged in innovative activities. These are standard benefits (benefits on tax on added value, tax benefits on property, income tax), benefits provided under the SEZ and preferences provided to organizations that received the status of a project participant of "SKOLKOVO" Foundation. However, the list of legislatively fixed tax benefits does not contribute to enterprises' innovative activity increasing due to low elaboration of the system of privileges and insufficient consistency. Moreover, state investments are always less effective.

3.2. Comparative Analysis of the Financing of Science in Russia and the USA

It should be taken into account in the study the level of system's perfection of budget financing priorities' formation. There is nothing to do but to face with an underestimation of the fundamental science as a basic component of the national innovation system. At the same time at the expense of the federal budget recently a large number of application developments were financed without prospects for demand in the domestic and

global markets. In addition to state sources of innovative activity financing the finance of companies, financial-industrial groups, small innovative business, investment and innovation funds, local governments, private individuals, etc., can act. To identify the root patterns of reproduction of innovations in the industry, it is proposed to carry out comparative analysis of the practice of R and D funding in Russia and abroad.

In developed countries, the funding of science is carried out both from public and private sources. Most countries in Western Europe are characterized by the flow of financial resources for R and D mainly from the business sector (Figure 3). The principles of financing of science in Russia in the model case should be focused on the diversity of funding sources and suggest a fast and efficient implementation of innovations with their commercialization to ensure the growth of the financial return from innovation. A study of the sources on R and D funding, should be considered on the basis of fundamental comparative analysis, hoping to identify differences in the level of development of science, education and business in Russia and the USA.

The information base for analysis was the statistical data of Rosstat, the Organization for economic cooperation and development, the National science Found of USA and Institute after Battelle. Four sectors of economy were allocated - state, business, research sector and sector of educational institutions, non-profit sector organizations. Then the statistical data on selected groups were transformed (Table 2).

The USA is on the first place in the world in terms of R and D volume (193 415 million $ USA). The largest performer of R and D in the country (and by expenditure on innovation and the number of employed scientists) and the main source of extra-budgetary funds is entrepreneurial sector in which leaders are large national and transnational corporations. Intra-corporate nature of R and D funding is observed. In 2011, funding from the business sector amounted to 267.3 billion $ USA (63% of total R and D funding in the country). Almost the entire volume of the funds aimed at the implementation of scientific development in the business sector - 98% (Table 3).

The remaining part goes to the financial support of R and D of educational institutions and noncommercial organizations. In-house financing is reasoned by the fact that the corporate sector is attractive to researchers in the framework of the issue of wages. Scientific activities of the private sector's organizations strengthen their position in the national scientific and technological development on the basis of the created with the help of the state education system, infrastructure and some of the benefits of an economic nature. Attention is focused more on supporting the development of small businesses in R and D. In 2011 35% of American scientific research in the business sector was carried out by large corporations (with a workforce of more than 25,000 people.), 20% - small (with a workforce of 5499 people.).

The second largest source of funding for science in the USA is the federal government funding. State support is provided by organizations such as the National Institutes of Health, the Agency of Advanced Defense Research Projects and the National Science Funds. Among the major and most successful programs to support research projects are:

- Program of Small Business Innovation Research, the purpose - Financing of the initial stage of new projects.
- Program Small Business Technology Transfer, which aims to fund R and D carried out by small businesses with universities.

In the USA on the final data of 2011 the largest share of the state sector's funds have been used by the federal agencies and research centers - 49.3 billion $. USA (Table 3). Besides, the latter received financial support in the amount of 400 million $ USA from regional sources, which accounted for <1% of their total support (National Science Foundation, 2014).

Figure 3: The ratio of participation of the state and the private sector in the financing of R and D in countries (in % of gross domestic expenditure on R and D) (systematized by the author according to the Federal State Statistics Service and the US National Science Fund)

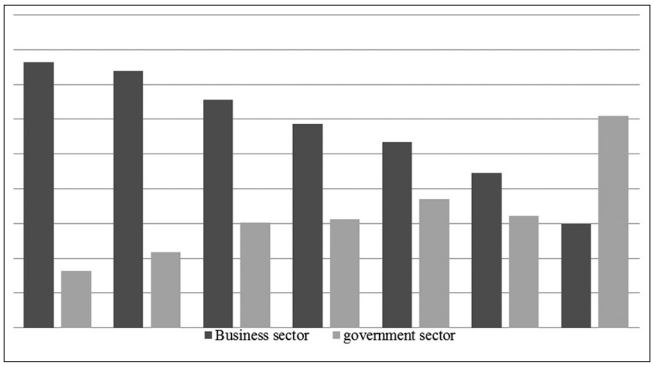


Table 2: Comparative analysis of funding structure of R and D in sectors on the examples of Russia and the United States (%)

Indicator	2010		2011		2012		2013	
	USA	Russia	USA	Russia	USA	Russia	USA	Russia
The share of state funds in total volume on R and D expenditures	3,028	6,459	3,244	6,666	3,215	7,079	3,052	6,701
The share of assets of the business sector in total volume on R and D expenditures	6,362	2,681	6,110	2,592	6,127	1,995	6,298	2,057
The share of funds of higher education and scientific institutions in total volume on R and D expenditures	286	844	294	734	295	916	294	1,226
The share of funds of noncommercial organizations in total volume on R and D expenditures	323	016	352	008	364	011	356	016
Total	100	100	100	100	100	100	100	100

Calculated by the author based on the data of Rosstat and the Organization of Economic Cooperation and Development (OECD), R and D: Research and development

Table 3: The expenses on R and D in the United States: Sources of funding and sectors engaged in R and D (million $ USA) (National Science Foundation, 2014)

	Funding sources						
	Total	Business sector	Federal government	Educational institutions	Non-government organizations	Other non-commercial organizations	Total expenditures (%)
Expenses on R and D	424,413	267,290	125,686	12,488	3832	15,117	100
Business sector	294,093	262,784	31,309	-	-	-	693
Federal government	49,394	-	49,394	-	-	-	116
Educational institutions	63,102	3,173	38,710	12,488	3,832	4,899	149
Other non-commercial organizations	17,825	1,333	6,274	-	-	10,218	42
The distribution between sources of financing (%)	100	63	296	29	09	36	

R and D: Research and development

The second by the volume of utilized state funds has become the business sector, which the federal government has provided with 31, 3 billion $USA (11% of the total federal support). It is followed by scientific and educational institutions, which the government has provided with 38.7 billion $ USA (61%). The share of other sources of funding is not so great, but for the 2008-2011 it is gradually increasing.

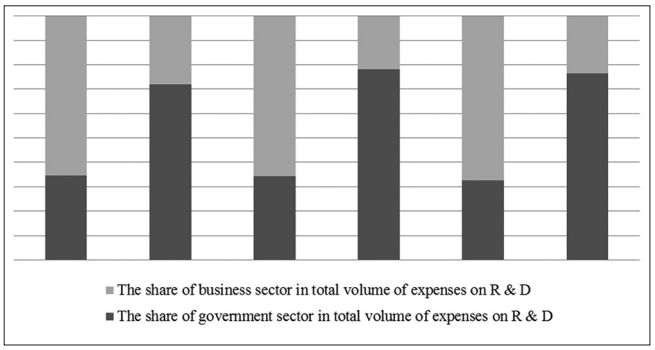
In Russia, the opposite picture is witnessed: The funding structure is represented mainly by the state sector and a major domestic business follows the huge USA corporations (Figure 4).

In Russia currently a large number of federal target programs exist providing funding for R and D. The country government support for innovation comes from the Russian Funds for Basic Research, the Russian Humanitarian Funds and the Funds for Assistance to Small Innovative Enterprises in the scientific and technical sphere. Funds key programs are:

- The state program "The development of science and technology", the purpose - to promote the competitiveness of the sector of R and D.
- The program "TEMP" ("Technologies - to small businesses"), is focused on the existing in universities and research institutes scientific developments' introduction to the market.
- The "START" program, aimed at scientific sphere representatives, students' promoting in development and production of new products, the creation of small innovative companies.
- The program "UMNIK" ("Member of the Youth Research and Innovation Competition"), which aims to identify young scientists seeking self-realization through innovation.
- The program "PUSK" ("The partnership of universities with companies"), focused on the creation in Russia of a civilized market of intellectual property and on human resources and technological support for the implementation of universities' developments by small innovative enterprises.

Thus, the Russian government in recent years, increases attention to the problem of innovation stimulating. However, this support is not sufficiently competitive in comparison with countries with developed innovative systems that are proved by various rankings of innovation activity:

Figure 4: Ratio of expenses of the state and the business sectors of economy on R and D (% of total domestic expenditure on R and D) (compiled by the author according to the Federal State Statistics Service and the Organization of Economic Cooperation and Development)



- An integrated rating of "Business doing - 2015:" Russia is on the 62nd place out of 189 (The World Bank, 2015).
- The Global Competitiveness Index of the World Economic Forum: Russia is on the 53rd place out of 144 (Schwab, 2014).

3.3. Mechanisms of the Institutional Traps' Elimination within the Technological Platform

Previously identified problems of interaction between science, business and manufacture necessitate their solving. So, one of the institutional traps within the manufacturing sector of the economy is the low degree of interaction between business and science.

In this direction active measures have already been undertaken to minimize the institutional gaps. In August 2013 the federal target program "R and D on priority directions of scientific-technological complex development in Russia" was reoriented to support the "umbrella" projects of technology platforms - Projects integrated within specific technology areas, with separate goals and objectives. It is planned to sign contracts with several performers, offering different ways of problems' solving. In the process of implementation of the "umbrella" projects it will be possible to assess the effectiveness of integrative interaction between science, business and government with potential customers of scientific developments. The advantage of "umbrella" projects in the context of minimizing of institutional projects' traps is primarily

the ensuring of a competitive environment that encourages representatives of the business sector to innovate.

Taking into account the high expenses of the development, implementing of innovative processes, companies can implement an innovative strategy for the full or stripped-down cycle of innovation. Accordingly, the effect will be different from the implementation of the strategy for the economic system of macro, meso and micro levels. The success in institutional gaps' eliminating between the links of the supply chain of high technology products is possible only on a balanced base. It is important to take into account the peculiarities of the regional innovation system. Focusing on the creation of an effective innovation economy requires a clear formulation of the strategic priorities of development taking into account social, economic features and the level of scientific and technological capacity and coordination of the chosen priorities with the business sector.

These tasks' solving are possible in case of using:

- Crowd-sourcing technologies aimed at involving the majority of real and potential entities for cooperation on the basis of a public offer.
- The key ideas of the theory of leadership, which dictates the need to focus available resources of the economic entity on the very areas of knowledge and production, in which it holds a leading position in global competition.
- The future management technologies based on the use at meso-level of technological foresight as a tool for technologies' development prediction and perspective markets' projecting.

As a result, it will be possible to combine the efforts of government, business and science in the implementation of priority directions of innovative development; increase the influence of the private sector to identify and develop the priority directions of scientific and technological development and in the future- the solution of key problems of the national economy; clearly define the orientation of certain priorities to meet important social needs, to solve the strategic objectives of development of economic activities and key government objectives; mobilize resources and efforts of the parties involved primarily in the development of those segments of the market R and D, which are the most promising in terms of the scale of impact on mezzo-economy, the labor market and can be developed within the framework of the technological platform. Currently, in the Russian innovation system the only rapidly developing high schools are capable to take responsibility for the development of innovative component of mezzo-economy. In this regard, the availability of universities of this quality defines the ability of the region to become as a point of start for growth in global innovative nets.

In interaction of business and government institutions there are also gaps caused by problems of normative legal regulation of public-private partnership. There are problems of normative legal regulation and accounting of intellectual property, the order and organization of state procurement, property management in the form of special equipment needed for R and D. A key problem is the omission by the existing contract system of implementation details in partnerships projects, where the government and the private sector act as co-investors. Russian laws and regulations (including the Federal Law "On Science and State Scientific and Technical Policy") do not contain items that regulate cooperative interaction between the participants during the R and D conducting. In this area of the law governing the procedure of state procurement and supply is so confusing and contradictory system of legislative and other normative legal acts, which is very complicate the process of implementation of the state order.

As a result, a set of specific measures to minimize the previously considered institutional traps is offered (Table 4).

The integrated implementation of the measures' system listed in Table 4, will help to reduce the gaps between key participants in the national innovation system, therefore, provide the most complete use of the potential of Russian technology platforms, which in general will enhance the competitiveness of Russia and Russian goods and technologies on the world market.

4. DISCUSSIONS

Shinkevich (2011) in his work examines the prerequisites of institutional traps' emergence, based on the existence of a negative transactional effect of innovation development in the manufacturing sector. However, it is not specified within what interactions there are these traps (science- business, science- government or business-state) and it is paid attention to integrative interaction of these institutions in the framework of the "triple helix" and to the problems' solving how to minimize the identified institutional traps.

Table 4: A set of recommendations to minimize institutional traps under the TP (summarized by the author)

	Institutional traps		
	Traps "business-the state"	**trap "business-science"**	**Traps "science-state"**
Recommendations to minimize institutional traps	The adjustment of legislation in the field of public procurement Reducing of the level of taxation Reduction of the % rates of commercial loans Implementation of the "umbrella projects" The possibility of budget financing of scientific research of not scientific organizations, but representatives of business on the base of contracting of R and D in government research organizations and universities Evaluating of FTP efficiency	The application of the basic provisions of leadership theory Crowdsourcing technology	Improving of the quantity and quality of research organizations' staff The advanced development of financial provision of researchers and creating of a favorable environment for creative work

R and D: Research and development

5. CONCLUSION

This study allows conclude the active development of innovative component of the Russian economy, accompanied by an increase in the pace of modernization. This is evidenced by the change of positions of Russia in world ratings of innovative activity in the direction of the leading countries. However, the technological gap between Russia and the world leaders (Japan, China and USA) remains significant. This gap is due to the presence of institutional traps in the triple helix system "science-business state." Detailed analysis of the pairwise institutions' interaction Science- business, science- government, business- government allowed revealing of problems inherent in the Russian innovation system and formulation of a set of measures to optimize these interactions that will provide a better use of innovative potential of the Russian Federation.

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