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Research and Innovation Activity in the Region as a Driver of Its Sustainable Economic Development*

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Abstract. In the unstable economic environment there is an ongoing search for ways to strengthen economic stability in the regions. The development of research and innovation activities can be considered a long-term fundamental factor in solving this problem. The aim of the study is to identify the following trends in the production and distribution of innovation in the macro-region: creation and development of a polycentric structure of research and innovation activities in the regions and possible forms of its strengthening from the standpoint of economic stability in the regions. As the method of research we use structural and functional analysis of the research and innovation space of the macro-region, its current status and development trend. In the course of our research we substantiate the tendency toward the formation of a polycentric structure of scientific and innovation activity. We provide the data characterizing it in the macro-region of the North-West of Russia: location of scientific organizations in the region, their employees, internal costs allocated to research and development, amount of higher education institutions and branches of higher education institutions established in the regions, which train highly qualified personnel for various sectors, including region's own scientific base, and serve as a source of local innovation. The fact that research complexes are being established in the regions promotes cooperation between local authorities and business structures on the use of local resources and implementation of scientific achievements. We put forward and describe a program method as an organizational form of cooperation to bring major research findings to practical application. The method integrates the work

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of scientific organizations, industrial enterprises, and regional authorities, and the implementation of conditions for commercialization of scientific results. Attention is paid to the development of the network form of organization of interaction between science and business. The results of our work include proposals for strengthening of the coordinating and stimulating function of authorities of subjects of the Russian Federation in enhancing the performance of research and innovation systems created in the regions with a focus on the use of local resources potential of the territory; for the development and implementation of a specialized scientific and production program for implementation of major scientific results; for the development of regional information interaction between enterprises of the region in the development and implementation of innovation. The results of the study can be used by regional governments in the development and adoption of legislation on regulation of innovation: strategies, programs, attracting business structures. Further research may be related to the development of pilot projects on programming innovations and scientific substantiation of measures to expand the information interaction between enterprises and organizations in the region.

Key words: region, research and innovation activity, center-periphery model, polycentric structure, own scientific base, implementation of research findings, scientific and production program, network organization of works.

Introduction

In theory and in practice, there is a search for new ways to achieve economic sustainability of administrative-territorial entities amid repeated external disturbances in international cooperation, credit relations, world market conditions, currency changes, as well as internal problems due to imbalances in the demand and supply structure, and negative climate impacts.

The concept similar to "economic sustainability" is "economic stability". The essence of stable economy is its state of equilibrium. The trends towards the equilibrium state of economic components is the core of researching many economic problems. The example may be some fundamental trends towards equilibrium: goods demand and supply [1, 2], goods production and consumption [3], savings and investment [4].

The system of economic theory presents comprehensive analysis of economic sustainability by stages of the crisis cycle with possible control levers to ensure balanced economic development. The macroeconomic balance analysis should be hierarchical in nature. Macroeconomic balance is analyzed based on the study of macro-sector balance; mesoeconomic balance – on the study of mesosectors in the regional and sectoral breakdown; microeconomic balance – on the study of enterprises and households [5].

The research subject in the present study is the aspect of system economic sustainability defined as the ability to function in the state close to balanced in terms of internal and external disturbances, and take on a new balanced state after the cessation of disturbances.

There are different approaches to the definition and characterization of the region's economic sustainability, focused on the preservation or restoration of people's living conditions [6]. An essential feature of the region's economic system can be its focus on improving the population's quality of life. Therefore, the region's economic sustainability can be defined as its balance with increased capacity to meet the increasing needs of its citizens. The economic literature emphasizes

two characteristics: stable economic growth and transformation of its results into socially significant effect for the population [7]. The region's economic sustainability may mean stable economic growth with the resulting increased quality of life of the population. Sustainable growth of the region's economy is possible if it is developing, i.e. qualitatively changing. Therefore, the term "growth" here includes the concept of "development".

The factors determining the development of the region's economic sustainability (resources, use of modern technology, etc.) include fundamental, long-term scientific innovation, development and diffusion of innovation as the main source of increased competitiveness of products and services, market retention and growth, revenue growth, revenue contributions to the budget. Ensuring regional economic sustainability through scientific and innovative activities can be a sign of stability of the scientific and innovative development itself. The greater the participation share, the more sustainable is the research and innovation activity. The article is devoted to some aspects of its development in the region amid the formation of scientific and innovative complexes. The purpose for the research is to reveal the trends in formation in scientific and innovative complexes in the northwestern Russian regions – the polycentric structure of production and distribution of innovation – of possible ways to overcome the barriers hindering the transfer of scientific results to the regions' economy.

There are two main approaches to the theory of production and diffusion of innovation in the spatial dimension: the centre-periphery model, originally developed as a theoretical foundation for international trade in industrialized and backward countries, then transferred to the regional level, and the models of "growth poles" and polarized production nuclei, application and diffusion of innovation. The essence of the "center-periphery" model [8] suggests that the center, concentrating resources: scientific, engineering and production capacity, creates innovation, which is then distributed to the periphery according to T. H gerstrand theory of innovation diffusion: first to the territories closest to the center, i.e. to the semi-periphery, and then further – to the periphery, gradually filling all the space available. According to the "center-periphery" model, the center, having a developed scientific and innovation potential, produces one innovation after another, the periphery constantly lagging behind the centre in scientific and innovation development due to slow innovation transfer and development, giving their resources to the centre [10].

The model of "growth poles" proposed by F. Perroux is understood as dynamically developing sectors or individual enterprises (machine-building, chemical industry, etc.) compactly placed on the territory or country that have an impact on the surrounding area due to the concentration of innovation around them. The rapidly growing industry or enterprise becomes a growth pole generating chain reaction of emergence and growth of industrial enterprises, causing the overall industrial development of the country [11].

Adjacent to the "growth poles" model, the model of polarized nuclei as the evolution of the "center-periphery" model represents the allocation of nuclear areas in the territory or country, where advanced economic sectors with high potential for innovation are concentrated. They have a certain zone of influence, forming a polarized region around them. As a result of their growth, the monocentric territorial structure is transformed into a polycentric one [12].

The polycentric structure of research and innovation activity in the space of a macroregion

In the Russian Northwestern macroregion there is a process when production and distribution of innovation evolve from the "center-periphery" model (Saint Petersburg in relation to the regions of the Russian North-West) to the model of polycentric scientific and innovation development, creation of regional scientific complexes of regional economic stability. The polycentric model of a macroregion will consist of the center – Saint Petersburg – and regional cores of scientific and innovation activity – Russia's constituent entities. The hypothesis of the polycentric model formation is confirmed by the following grounds.

1. The development of a network of scientific institutions in the federal district's regions. *Table 1* presents data on the development of scientific organizations in the regions.

Data from Table 1 indicate the growth of the scientific potential in most regions – the trend towards the development of the research base established in the regions. Saint Petersburg, despite the declined number of research and development institutions and staff engaged in research and development, remains the largest scientific center concentrating more than 60% of scientific institutions and more than 80% of staff employed in science and the cost of research and development in the macroregion. However, it is not the only source of new knowledge. Regions create their own scientific potential, which transforms the scientific space towards polycentric structure, expanding the opportunities of the region's economic stability.

2. An extensive network of innovation infrastructure facilities has been established in the regions in order to create favorable conditions for introducing research results in practice *(Tab. 2)*.

The development of the innovation infrastructure in the regions is currently not so

Table 1. Development performance of scientific institutions in the North-West of Russia

Region (constituent entity)	Institutions conducting research and development, units			Staff engaged in research and development, people			Internal cost of research and development in fixed prices (2010), mln RUB		
	2010	2015	Growth decline rate, %	2010	2015	Growth decline rate, %	2010	2015	Growth decline rate, %
Republic of Karelia	16	22	137.5	934	1202	128.7	568.1	838.5	147.6
Komi Republic	23	28	121.7	1806	1981	109.7	1577.7	1655.2	104.9
Arkhangelsk Oblast	33	36	109.1	1148	1107	0.9	724.5	936.9	129.3
Vologda Oblast	17	18	105.9	482	541	112.2	286.8	291.6	101.7
Kaliningrad Oblast	11	16	145.4	1859	2128	114.5	1184	721.2	0.6
Leningrad Oblast	14	13	0.9	6477	7229	111.6	4400.2	5497.9	125.0
Murmansk Oblast	25	31	124.0	2097	2342	111.7	2006.6	1514.1	0.7
Novgorod Oblast	12	17	141.7	892	1638	183.6	708.6	998.6	141.0
Pskov Oblast	13	13	0.0	318	818	257.2	57.1	239.0	418.6
Saint Petersburg	338	299	0.9	7983	79076	0.9	59222.8	74129.4	125.2
Northwestern Federal District	502	493	0.9	95826	98062	102.3	70737.3	87199.1	123.3
Russia	3492	4195	120.1	736540	738857	100.3	593377.2	639628.4	122.2

Sources: *Russian regions. Socio-economic indicators. 2016: statistics book*. Moscow: Rosstat. 2016. Pp. 996, 998, 1008, 1290; author's calculations based on the statistics book.

Table 2.Innovation infrastructure in the regions of the Northwestern Federal District

Regions	Innovation infrastructure facilities
Republic of Karelia	Business incubator, Petrozavodsk State University IT-park, Ukko Innovation Center, Karelia Center for Technology and Innovation, Center for Scientific and Technical Information.
Komi Republic	Business incubator, technology park, innovation support center, scientific and technical information center.
Arkhangelsk Oblast	Business incubator, innovation and technology park, innovation center, center for scientific and technical information.
Murmansk Oblast	Business incubator, technology park, technology transfer center, scientific and technical information center.
Vologda Oblast	Business incubator, innovation and technology center, center for scientific and technical information, scientific coordination center.
Kaliningrad Oblast	GS technopolis, innovation park, science and technology center, innovation and technology center, technology transfer center, center for scientific and technical information.
Leningrad Oblast	Business incubator, technology park, technology transfer center, innovation and technology center.
Novgorod Oblast	Business park, technology park, innovation and technology center, research and coordination center, center for scientific and technical information.
Pskov Oblast	Center for scientific and technical information.
Saint Petersburg	Technological and promotional special economic zone, business incubators, technology park, innovation and technology center, technology transfer center, center for scientific and technical information.
Source: compiled by the author based on website data: regional innovation infrastructure (2016).	

Table 3. The location of institutions of higher education and their branches in the Northwestern Federal District

Region	City	Population according to the 2010 Census, people. City size.	Universities	Region	City	Population according to the 2010 Census, people. City size.	Universities
1	2	3	4	5	6	7	8
Republic of Karelia	Petroza-vodsk	263 540 Large	Petrozavodsk State University, Karelian State Pedagogical Academy, Petrozavodsk State Glazunov Conservatoire. 11 branches of Moscow and Saint Petersburg institutions of higher education	Leningrad Oblast	Vsevo-lozhsk	59 689 Medium-sized	Russian State University for the Humanities branch
Komi Republic	Syktyv-kar	235 006 Big	Syktyvkar State University, Komi State Pedagogical Institute, Komi Republican Academy of Public Administration, 9 branches of institutions of higher education from Saint Petersburg, Nizhny Novgorod, Ukhta		Gatchina	92 566 Medium-sized	State Institute of Economics, Finance, Law, and Technology. 2 branches: Saint-Petersburg State University of Industrial Technologies and Design, Saint Petersburg Institute of Foreign Economic Relations, Economics and Law
	Ukhta	99 642 Medium-sized	Ukhta State Technological University of Management, Information and Business, 4 branches of Moscow and Saint Petersburg institutions of higher education		Sosnovy Bor	65 901 Medium-sized	4 branches: Peter the Great Saint Petersburg Polytechnic University, Saint Petersburg State University of Aerospace Instrumentation, Saint Petersburg Institute of mechanic Engineering, North-West Institute of Management, branch of RANEPA
	Vorkuta	70 551 Medium-sized	Vorkuta Institute of Business and Law. 5 branches of Moscow, Syktyvkar, Saint Petersburg and Ukhta institutions of higher education		Kingi-sepp	48 667 Small	2 branches: A.S. Pushkin Leningrad State University, Saint Petersburg Institute of Foreign Economic Relations, Economics and Law
	Pechora	43 459 Small	Branch of Moscow Sate Academy of Water Transport		Ivan-gorod	9 797 Small	Branch of Saint Petersburg State University of Aerospace Instrumentation

End of Table 3

Region	City	Population according to the 2010 Census, people. City size.	Universities	Region	City	Population according to the 2010 Census, people. City size.	Universities
1	2	3	4	5	6	7	8
Arkhangelsk Oblast	Arkhan-gelsk	356 051 Large	Northern (Arctic) Federal University, Northern State Medical University, Northern Institute of Business, Institute of Management, 8 branches of Moscow and Saint Petersburg institutions of higher education	Murmansk Oblast	Mur-mansk	307 664 Large	Murmansk State Technical University, Murmansk State University for Humanities, Murmansk Academy of Economics and Management, Baltic Institute of Environment, political Sciences and Law. 13 branches of Moscow and Saint Petersburg institutions of higher education
	Severo-dvinsk	193 519 Big	4 branches of Saint Petersburg and Arkhangelsk institutions of higher education		Apatity	56 690 Medium-sized	3 branches: Petrozavodsk State University, Murmansk State Technical University, Saint Petersburg State University of Information, Technology, Mechanics and Optics
	Kotlas	60 562 Medium-sized	2 branches: Arkhangelsk State Technical University, Admiral Makarov Saint Petersburg State University of Maritime and Inland Shipping	Novgorod Oblast	Veliky Novgo-rod	218 724 Big	Novgorod State University, 9 branches of Moscow and Saint Petersburg institutions of higher education
	Mirny	30 135 Small	4 branches: Tomsk Polytechnic University, North-Eastern Federal University, Arkhangelsk State Technical University, Novosibirsk State University of Architecture and Civil Engineering		Staraya Russa	31 809 Small	Branch of Novgorod State University
Vologda Oblast	Vologda	301 642 Large	Vologda State Technical University, Vologda Pedagogical Institute, Vologda State Academy of Dairy Farming, Vologda Institute of Business, Vologda Institute of Law and Economics, 6 branches of Moscow and Saint Petersburg institutions of higher education		Boro-vichi	53 699 Medium-sized	Branch of Novgorod State University
	Chere-povets	312 311 Large	Cherepovets State university, 10 branches of Moscow, Saint Petersburg and Vologda institutions of higher education	Pskov Oblast	Pskov	203 281 Big	Pskov State University, Pskov State Polytechnic University, Pskov Pedagogical University, 7 branches of Moscow and Saint Petersburg institutions of higher education
Kaliningrad Oblast	Kalinin-grad	431 491 Large	Kaliningrad State University, Baltic State Academy of Fishing Fleet, Baltic Federal University, Baltic Institute of Law and Economics, Ин-т Европ. бизнес-школа, Kaliningrad Institute of Management, Kaliningrad Institute of Law, 19 branches of Moscow and Saint Petersburg institutions of higher education		Velikiye Luki	98 778 Medium-sized	State Academy of Agriculture, 2 branches: North-West Institute of Management, branch of RANEPA, Saint Petersburg State Transport University

Source: compiled by the author based on [13] and Internet resources.
Note. Large city – population from 250 to 500 thousand people; Big city– from 100 to 250 thousand people, Medium-sized city – from 50 to 100 thousand people, Small city– less than 50 thousand people.

Table 4. Main areas of research and innovation activity in the regions of the Russian North-West ("science and scientific support")

Region	Republic of Karelia	Komi Republic	Arkhangelsk Oblast	Murmansk Oblast	Vologda Oblast	Kaliningrad Oblast	Leningrad Oblast	Novgorod Oblast	Pskov Oblast
Design	+	+	+	+	+	+	+	+	+
Forestry	+		+						
Agriculture		+	+		+		+		+
Fisheries	+		+	+	+		+	+	
Economic research	+	+	+	+	+				
Information technology	+			+		+			
Medicine			+				+		
Amber resources						+			
Food manufacturing		+							
Problems of the North		+	+	+					
Gas extraction		+	+						
Geology	+	+		+	+				
Biology	+	+		+			+	+	
Marine science			+	+		+			
Geophysics		+		+			+		
Shipbuilding			+						
Space exploration			+				+		
Instrumentation technology				+			+		
Power engineering				+	+		+		
Electronics					+		+		
Television								+	
Automation		+							
Hydrology								+	
Hydrometeorology								+	
Software	+				+			+	

Source: compiled by the author according to data from websites: Science and scientific support – region; science – region; scientific research – region.

much related to its expansion, rather than to the need to improve the quality of its components, including the special economic zone of technical innovation type, technology parks, and business incubators.

3. In large, big and medium-sized cities of the macroregion there are operating institutions of higher education, and in a number of small cities – their branches (*Tab. 3*).

As follows from Table 3, science in the regions has a powerful educational support from local universities represented by young experts. Their migration to Saint Petersburg is limited by social barriers – low (for them) wages and the accommodation problem.

The formed educational potential demonstrates the regions' ability to train highly qualified personnel, including for their own scientific support. In addition to staff support, the location of universities in the regions' territories becomes the source of local innovation. The geographical proximity of firms and universities is considered as a key element of accessibility of companies to university research and the emergence of spatial channels of knowledge generation and dissemination [14, p. 117].

The research activity in the regions is represented by research aimed at obtaining new knowledge about the world around us. They can be fundamental, search, and applied. The peculiarity of the polycentric structure of the research activity is that along with fundamental research, applied research aimed at solving socio-economic problems of the territory are also implemented in the regions: the use of local resources, the development of productive forces and social sphere. If innovation from the center adapts to local conditions, the creation of the regions' own research base makes it possible to initiate and carry out R&D based on the region's needs. Based on own potential industrial, social, administrative and other facilities are designed, research on using local resources in forestry, agriculture, lake and river fisheries, mining (geology, etc.), sea resources (biology), etc. is conducted *(Tab. 4)*.

The design and research base established in the regions, characterizing the spatial aspect of R&D, is increasingly becoming a significant factor in the economic and social development of the territories.

However, the problem of increasing the overall level of innovation in the regions remains. *Table 5* presents indicators of innovative performance by region.

As can be seen from Table 5, the performance indicator of innovation activity – activity to bring the scientific result to practical use – is unacceptably low, meaning the course

Table 5.Share of innovative products, %

Region	2010	2015	Region	2010	2015
Republic of Karelia	1.3	0.2	Murmansk Oblast	0.5	1.7
Komi Republic	3.2	3.3	Novgorod Oblast	6.9	3.9
Arkhangelsk Oblast	0.4	2.7	Pskov Oblast	2.7	1.1
Vologda Oblast	1.6	21.6	Saint Petersburg	8.0	7.3
Kaliningrad Oblast	0.1	0.4	Northwestern Federal District	4.1	6.3
Leningrad Oblast	2.4	2.0	Russia	4.8	8.4

Source: Russian Regions. Socio-economic indicators. 2016: statistics book. Moscow: Rosstat, 2016. P. 1048.
Note. The "surge" of indicators for the Vologda Oblast in 2015 may be associated with the commissioning of a major innovation project.

[1] Indicators of innovation activity. 2015: statistics book. Moscow: Vyshaya shkola ekonomiki, 2015. Pp. 308-309.

of transition to an innovative economy. Even in Saint Petersburg, the center, it is twice as low as in industrialized countries (14–15%)[1]. The research potential generated in the regions is not sufficiently involved in innovation activities. The main reason for the low level of innovation activity is underdeveloped cooperation between companies and scientific institutions, as well as underdeveloped scientific and industrial relations in the Russian economy [15, p.10]. Organizational technological associations of research and innovation activity is characterized by the concept of "research and innovation activity", meaning the connection, the continuation of one activity in another one focused on achieving a real result – innovation.

The opportunities for regions' innovation development

The formation of scientific complexes in the regions makes the objective of strengthening innovation and overcoming the possible obstacles relevant. The barriers for scientific and industrial cooperation are analyzed in the economic literature on specific examples of relations between scientific institutions and business structures. The obstacles to effective interaction between research institutions and business repeated in the studies of different authors can be identified as typical:

– insufficient focus of research institutions on companies' needs, its inability to offer properly designed scientific results ready for practical application;

– weak companies' susceptibility to innovation;

– competition modes do not directly stimulate the transfer of scientific and technological developments, lack of financial resources of industrial enterprises;

– high economic risks in technology implementation;

– low level of management efficiency in scientific institutions, insufficient awareness of manufacturing enterprises of promising developments: the availability of results that can be commercialized;

– lack of motivation among innovation process participants, underdeveloped institutions of joint knowledge generation and dissemination, weak instruments to support cooperation between businesses, research institutions and higher education, lack of state's awareness of "soft" innovative tools, in addition to direct financial ones, which the state uses to compensate for insufficient signals of market environment.

In current economic, technological and infrastructural conditions, the reduced commercialization scale cannot radically change the technological state of the economy. Many commercialization processes are characterized by small output and investment volumes and a 2- or 3-year payback period. A technological breakthrough is possible if what has already been developed by the fundamental science is realized, at least as new theoretical knowledge with the prospect of solving the most important technological issues.

In Russia, the potential of fundamental scientific achievements is not exhausted by commercialization as a form of transfer of scientific results to practical activities. Along with the existing commercialization practice, the impulse of technological breakthrough can be created based on a much larger layer of fundamental scientific reserve than the relatively thin layer of scientific results currently used.

The implementation of technological breakthrough raises the question of developing the theory of innovation process, which would be more focused on the radical change in technology, acquire strategic aspiration with

access to fundamentally new innovations, that is, we can talk about the concept of strategic innovation. It can be based on the fundamental scientific results achieved so far, which can radically change the technological framework in the future and have large-scale consequences for the enterprise, industry and region. The essence or key feature of strategic innovation is the underlying fundamental scientific developments. Bringing them to innovation forms an innovative process that includes all the necessary steps and works, the continuation of both basic research if necessary, and applied research, engineering development, and industrial production.

Based on the above features of strategic innovation, the following definition can be given. Strategic innovation is the result of focused fundamental research, applied research, engineering development, embodied in a material object or service implemented in practice. The most novel is strategic innovation aimed at creating breakthrough, "closing" technology, when there may be no need for individual production. In general case, we can talk about the results of fundamental research in the field of critical technology and development of high-tech products by world standards in the future.

The term "strategic innovation" is not new. It is used as a means to achieve strategic goals of a corporation, in the concept of company's strategic innovation potential to ensure competitive advantage [16]. Strategic innovation is seen as disruptive in the creation of a new market [17], in the technological race of countries [18]. There is a similar term of "radical innovation", which is close in the meaning to the company's strategic focus [19] in relations with competitors [20]. The common feature of these terms with the term "strategic innovation" is the aspiration to the future, the solution of promising issues. The difference: the term used in the article is "tied" to the fundamental research and reflects the innovation of fundamental research.

An institutional form of strategic innovation can be the development of a fundamental or applied research of a specialized scientific and production program and achieving significant (for the enterprise, a group of enterprises, a region, a country) result. If the institution has research results which can become the core of a large-scale project with prospects on domestic and foreign markets, coordinated and accepted by the business assessment of the possibly demand, they can become the object for the development of a research and production program. The list of scientific results for the program implementation can be submitted to public administration (at the federal or regional level), which can help implement the program.

The program-target method of addressing complex scientific and production objectives is due to the need to organize interdisciplinary and inter-firm interaction of many enterprises, raising funds from different sources. In the context of a target program, an interdependent non-linear innovation process can be implemented, characterized by a more stable, trust-based correlation with the ability to transfer implicit knowledge, contained in experts, workforce, skills, abilities or organizational practices, which can be obtained through joint activity[2]. The program may include conditions encouraging the participation of business entities, when the state assumes the cost and risks of initial stages of the

[2] Pilyasov A.N. (Ed.). *Synergy of space: regional innovation systems, clusters, knowledge flows*. Smolensk: Oikumena, 2012. P. 449.

innovation process, which have a high degree of uncertainty. Private investment insured by state participation can be considered as reserve, with the possibility of gaining significant profit due to the emergence of new markets and the presence of intellectual rents in the price of new products. When developing it, the network process of work organization and partnership of the participants can be implemented, aimed at the overall result – the innovation of market demand. The program development should include two conditions: the identification by the scientific institution of potential market for new products together with the business structure, and mobilization of tools for state stimulation of innovations focused on the development of scientific and industrial cooperation, as well as the resources of development institutions and a special investment contract. So far, businesses are reluctant to enter innovation. Here, market relations do not full "work"; joint actions with the authorities are required. This opportunity is provided by the program method of executing the whole complex of works with the coordinating function of the state governing bodies. The program may implement the principle of balance between innovation demand and supply achieved through the participation of both scientific institutions and enterprises – producers of innovation focused on identifying markets for new products.

The program aimed at the implementation of a specific scientific result can be one of the tools for region's innovative development because it combines factors such as:

– integration of research and industrial enterprises, partnership of science, business and state;

– creating conditions for commercialization of scientific results by the program-based method;

– introducing a system of incentives for innovation process participants: subsidies for establishing high-tech industries, tax incentives, accelerated depreciation, etc., attracting subsidized loans of development institutions, which compensate for insufficient impact of market incentives.

Table 6 gives examples of projects as possible objects of development of specialized scientific and production programs.

Along with the initiative of scientific institutions to implement major scientific results in ensuring regions' sustainable economic development, the main role in this process may belong to local businesses as the main investors and integrators of innovation and investment. However, their contribution to innovative development is low: it is limited to a small number of innovation-active enterprises.

At the same time, the regions possess the opportunities to interest businesses in innovation and sustainable economic development. First, experience shows that business can be focused on using local resources in cooperation with scientific institutions. It is important that all participants be focused on the overall result – commercialization of innovation based on scientific results and inclusion of local resources in the economic turnover. In the meantime, these opportunities have not been fully exploited. Thus, the Kaliningrad Oblast even at the peak of its development (2000–s, the creation of a special economic zone) could not fully use its potential [21]. In the Komi Republic, the established scientific base is not fully used to meet the needs for the development of priority areas of the regional economy [22]. Secondly, success can be achieved if the local government realizes itself as an equal partner for science and business in solving innovation problems,

Table 6. Examples of projects for possible development of research and production programs

Region	Project	Implementation term	Required funds, mln RUB	Project implementation participants
Republic of Karelia	Industrial technology of complex enrichment of mineral components of rocks	2030	100	Institute of Geology Karelian Research Centre Russian Academy of Sciences, Karelia mining companies, OAO Kostomukshskii mining complex
Saint Petersburg	Creation of a complex of new materials and technology to ensure production of a series of high-power fast neutron reactors	2020	1200	Prometei central research institution of construction materials, OAO Afrikantov experimental design office, OAO Gidropress experimental design office, Nuclear Reactor Research Institute, State Scientific Center at Institute for Physics and Power Engineering, National Research Center "Kurchatov Institute"
	New technology for manufacturing nanostructured thermoelectric materials	2025	240	Ioffe Physical-Technical Institute of the Russian Academy of Sciences, State Scientific Center Gidromet, Federal State Institution technological Institute for Super-Hard and Novel Carbon Materials, Kryotherm, National Research Technological University MISIS
	Creation of new types of high-power generators and plasma chemistry and production of new materials	2020	4500	Institute of Electrophysics and power engineering of the Russian Academy of Sciences, OAO Silovye mashiny, OAO Iskra scientific production association, ZAO Soyuzteplostroi.
	Creation of industrial equipment for processing substances containing organic compounds in order to generate synthetic gas for producing power energy and liquid fuels	2025	7500	Institute of Electrophysics and power engineering of the Russian Academy of Sciences, OAO Iskra scientific production association, I.I. Polzunov Scientific and Development Association on Research and Design of Power Equipment", OAO Silovye mashiny, OAO Metallicheskii zavod

Source: Priorities of scientific and technological development of the North-West of Russia. Saint Petersburg: YPRES RAN, 2016. Pp. 277, 270, 212, 210.

if it constantly cooperates with science and business, contributes to the formation of a network structure of innovation activities in the region – joint activities of scientific institutions, universities, engineering centers, and innovation companies, creating stimulating conditions for using region's resources and ensuring its economic development. Third, one of components ensuring the participation of local authorities in innovation activities would be the determination of needs for participation of the scientific and business community in local resources exploitation and promotion of sustainable economic development. Being supported by local authorities, they would motivate businesses to participate in these processes. The program-based method and network organization of innovation activities can be activated in solving the problems of sustainable economic development of territories. Using the capacity of innovative development, "regions and municipal units may qualify for increased share in the innovative revitalization of the economy" [23, p. 287].

Along with traditional one-line links of technological innovation chains, it has become possible to use information resources related to innovation activities of other organizations. Under the new conditions, "the innovation process has become wider – as a

Table 7. Share of organizations assessing individual sources of information as fundamental in the total number of organizations engaged in technological innovation, %

Sources of information					
Suppliers of equipment, materials, components, and software	Competitors in the sector	Consulting and information companies	Institutions of higher education	Scientific and technical literature	Professional associations
13.5	9.6	2.6	3.2	15.2	5.5

Source: *Indicators of innovation activity. 2015: statistics book*. Moscow: Vysshaya shkola ekonomiki, 2015. Pp. 315–316.

process based on interactions"[3]. It is possible companies are aware of the need for cooperation and networking, trust based on the principle of volunteerism. "A necessary prerequisite is company's ability to find sui-table partners and use external knowledge"[4]. *Table 7* presents data on using separate sources of information in Russian companies' activities.

These data reflect the structure of information resources and their use in innovation.

In addition to informal networks, organizational forms of innovation with internal network potential are used: strategies, innovation development programs, clusters, technology platforms.

It is believed that "management network, including the relations between companies, can help overcome market shortcomings and inflexibility of the vertical hierarchy"[5]. The network form can, for example, be formed when implementing "The complex research technical program of the Northwestern Federal District of the Russian Federation for 2010–2030", whose projects unite actions and relations of many research and production enterprises. The share of institutions participating in joint projects in 2014 comprised 30.8% in the district[6].

Favorable conditions for network innovation are created for enterprises included in the cluster and the technological platform. Eight territorial clusters are classified as priority in Saint Petersburg [24]. In terms of the structure of production relations, clusters are divided into horizontal: similar companies by production of heterogeneous products of the same industry, for example, automotive and pharmaceutical clusters, and vertical: complementary companies, for example, power engineering cluster. Complementarity is a prerequisite for information channels and successful innovation. The mechanism of knowledge expansion here includes interaction, exchange, coordination, and cooperation. In horizontal clusters, companies can gain new knowledge by observing, comparison, selection, and competition. The technological platform is by definition a communication tool aimed at intensifying efforts to create advanced technology; it unites related enterprises from many Russian regions. The technological platform forms a network of information interaction between enterprises.

"Soft" components are becoming increasingly important in the organization and development of innovation. In regions, the

[3] Pilyasov A.N. (Ed.). *Synergy of space: regional innovation systems, clusters, knowledge flows.* Smolensk: Oikumena, 2012. P. 90.

[4] Pilyasov A.N. (Ed.). *Synergy of space: regional innovation systems, clusters, knowledge flows.* Smolensk: Oikumena, 2012. P. 348.

[5] Pilyasov A.N. (Ed.). *Synergy of space: regional innovation systems, clusters, knowledge flows.* Smolensk: Oikumena, 2012. P. 95.

[6] *Indicators of innovation activity. 2015: statistics book*. Moscow: Vysshaya shkola ekonomiki, 2015. P. 263.

proximity of enterprises can play a special role in providing useful information. The stimulating effect can be provided by:

– information on the spectrum of scientific knowledge of regional R&D organizations;

– information on possible cooperation partners;

– information on technological developments;

– initiation of networks and mediation in their formation[7].

The information aspect in the innovation process makes it possible to identify and use additional resources in creating innovations.

Conclusion

1. The scientific and innovation space of the macroregion – location on the territory of objects of research and innovation complex, unlimited by administrative and territorial entities, with intra-and inter-regional interactions mediated by economic relations operating in the social environment and focused on ensuring socio-economic development – is gradually transformed into a polycentric structure. The regions create their own research and educational base – the capacity for sustainable economic development: a set of scientific institutions, universities, innovation infrastructure.

2. The research reveals a new aspect in innovation production and dissemination of innovations in the spatial aspect – the formation in the regions of their own scientific base, which is a significant factor in the development of regional productive forces, mobilization of local resources, including the design of new production facilities, and revitalization of production processes.

The study confirms the hypothesis of the transformation of scientific and innovation space: the transition from a monocentric to a polycentric structure, which provides for the development of the research management format, focused not only on the center, but also on the solution of federal and local scientific problems in the regions.

3. The concept of "strategic innovation" is introduced as a result of using target fundamental research.

4. The article substantiates the necessity of strengthening the role of regional authorities in coordinating and stimulating innovation processes in the region with the focus on initiating innovations in using local resources, capacities, competencies, creating acceptable conditions for business structures, raising funds, due to the trend of the polycentric structure formation in the research and innovation space.

5. It is proposed to implement in major scientific results (for an enterprise, a group of enterprises, a region, a country) the development and implementation of a specialized target research and production program with joint cooperation of scientific institutions (scientific achievement), an engineering company (bringing the scientific result to a form suitable for practical use), business structures (serch for markets; production), government structures (organization, coordination of activities, gaining financial support for the project from development institutions, a special investment contract).

6. Attention is drawn to the development of regions' non-financial methods of expanding innovation, including its network organization managed by regional governments, when communication and information network enterprises gain experience and new

[7] Pilyasov A.N. (Ed.). *Synergy of space: regional innovation systems, clusters, knowledge flows.* Smolensk: Oikumena, 2012. P. 356.

knowledge to improve and create new products and technology. The network organization of innovation provides an opportunity to use information from other institutions. Spatial proximity in regions and technological proximity in clusters and technology platforms increases the opportunity to obtain useful innovation-related information. Information interaction of enterprises can become an additional resource in the development and implementation of innovation.

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