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THE INNOVATIVE INFRASTRUCTURE DEVELOPMENT IN THE RUSSIAN ARCTIC

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ABSTRACT

The formation and development of innovative infrastructure in the regions of Arctic zone of the Russian Federation is one of the priority lines of these territories complex development. Structural analysis of the concept of regional innovative infrastructure, its basic subsystems, international experience of innovative infrastructure formation in the Arctic countries (Canada, the USA, Norway and Denmark) are presented in the paper. The typology of Arctic countries is realized on the basis of analysis of innovative development features and factors. Trends as well as problems of the innovative development of the Russian Arctic zone during the period from 2011 to 2015 are revealed. In conclusion, the model of effective formation of innovative infrastructure development in the Russian Arctic zone is presented, as well as basic prospects of its development are identified.

Keywords: innovation ecosystem, innovative development, Arctic.

INTRODUCTION

The idea of the Arctic territories development acts as one of the most priority directions in the world economy evolvement today. Deliberate attention to the circumpolar region can be largely explained due to significant reserves of hydrocarbon resources. By the way, there are also a number of other strategically important issues, such as presence of globally important biological resources, cross-polar flights and Northern Sea Route development, impact on the world environment. More efficient use of the Arctic potential involves an appliance of new technologies. The Arctic zone upon the whole is a unique mechanism of internal innovation processes development, which are carried out through the functioning of innovative infrastructure. In such a situation the need for its formation and furthermost effective operation has definitely increased, as well in the Russian Arctic regions.

METHODOLOGY

Analysis of classical and up-to-date interpretations of the term innovation environment stipulates the necessity to clarify definition in the context of regional development. Innovation environment must be seen as a set of socio-economic, organizational, legal, political and other conditions and factors, integrating mechanisms and tools in order to enable and facilitate implementation of innovations and development of innovation infrastructure, as well as introduction and implementation of effective and innovative projects aimed to improve regional socio-economic development rates [1]. In its turn, an efficient innovation infrastructure should be an open, coordinated, focused, dynamic

and flexible system of institutions providing structural consistency, optimal proportions, which promote the most efficient use of natural and productive resources, research and financial potential; implementation of all the innovation process stages (from technological development to an output of a new high-tech product to a market); inducing of innovation activity and susceptibility to enhance a territory competitiveness and quality of peoples' lives ultimately.

Arctic territories are the parts of eight countries: Russian Federation (Russia), USA, Canada, Denmark, Iceland, Norway, Sweden, and Finland. As a result of the matrix, Russia acts as a leader in the degree of differentiation in the industrial specialization. Overall, today Arctic territories play a role of raw materials net exporters in the global labor division. They are generally defined as the countries that are highly depended on import finished products supply. Service sector can be distinguished as a strategically important developing sector. At the same time, many countries of the circumpolar area are the leaders in terms of innovation development (see Table. 1).

Table 1. Arctic countries' Global Innovation Index (GII) dynamics, 2007-2015 [2].

Country	2007	2008	2009	2011	2012	2013	2014	2015
Sweden	12	3	2	2	2	2	3	3
USA	1	1	11	7	10	5	6	5
Finland	13	13	6	5	4	6	4	6
Denmark	11	8	5	6	7	9	8	10
Canada	8	11	12	8	12	11	19	13
Iceland	20	20	1	11	18	13	12	16
Norway	25	14	10	18	14	16	14	20
Russia	54	68	64	56	51	62	49	48

During the period all the countries, except the US and Canada, have improved their position in the ranking. The analysis of GII dynamics allowed us to draw some conclusions, such as: (1) Sweden is in the top 25 countries on all parameters constituting GII. That demonstrates its high level of innovation. (2) The strength of the US is first-class universities and active research investments. (3) Innovation support infrastructure in Finland and Denmark requires a significant change, since recently there has been a regression in this sector. (4) Public expenditure on secondary education in Canada is an aspect that is worth paying attention to, because Canada took only 65th position within this indicator in 2015. (5) The value of investors' protection index and the percentage of graduates in science and engineering in Iceland has definitely increased. (6) Similar trend was observed in Russia, when the level of employment in knowledge-intensive service sector, the share of women with higher education and the number of national patent applications grew up [3].

In order to identify positions of the Arctic countries zone on the level of innovation development there was carried out cluster analysis using statistical software product «PASW Statistics 18» by means of «K-means» method including 7 indicators, characterizing the state of research capabilities, innovation activity of enterprises and a quality of innovation policies. Top-group with high levels of innovation development involves six countries, excluding Canada (above average level) and Russia (world average level).

Results of the analysis on research activities and strategies for the Arctic development lead to the conclusion that natural resources, scientific activities, environment preservation discussed in [4], protection of indigenous population's interest are the most priority lines of development in the Arctic states [5]. In addition, Nordic countries are characterized with convergence strategy [6] in the implementation of innovation policy and encouraging an extension of international scientific and technical cooperation forms inside the Arctic Council. Divergence strategy is typical for the United States and Canada.

Russia takes the position of an outsider in terms of innovative development among the Arctic countries. We have studied the papers considering socio-economic development in the Arctic by Romashkina [7], Rudenko [8], [9]. The Russian Arctic zone includes territories or parts of 8 regions: Murmansk region (MR); Nenets Autonomous District (NAD); Chukotka Autonomous District (CAD); Yamalo-Nenets Autonomous District (YNAD); Komi Republic (KR); The Republic of Sakha (Yakutia, RS); Krasnoyarsk region (KR); Arkhangelsk region (AR) (see Table 2).

Table 2. The matrix of the main specialization sectors in the Arctic

Region / Industry	MR (10)	YNAD (7)	CAD (6)	AR (6)	RK (5)	KK (5)	RS (5)	NAD (4)
1. Mining	+ 17%	+ 53%	+ 35%					+ 71%
2. Manufacturing	+ 13%							
3. Production and distribution of electricity, gas and water	+ 6%		+ 12%					
4. Wholesale and retail trade, repair of motor vehicles, household goods and personal items	+ 10%	+ 11%						+ 6%
5. Transport and communications	+ 9%	+ 9%						+ 5%
6. Real estate, renting and business activities	+ 8%	+ 8%						
7. Public administration and military security	+ 10%		+ 11%					
8. Health care and social services	+ 8%		+ 5%					
9. Construction	+ 9%	+ 9%	+ 11%					
10. Other industries	+ 12%	+ 10%	+ 16%					+ 9%
11. Heavy shipbuilding				+				
12. Fisheries				+			+	
13. Diamond mining				+			+	
14. Pulp and paper industry				+				
15. Food Industry				+	+	+		
16. Timber industry, woodworking				+				
17. Fuel industry					+	+		
18. Light industry					+			
19. Electricity					+	+		
20. Production of building materials					+		+	
21. Non-ferrous metallurgy						+		
22. Reindeer, fishing and hunting						+	+	

% - share of industry in the total GRP; + - presence of an industry in the GRP structure.

The most differentiated structure of GRP is typical to Murmansk region. The mining industry leads in four Arctic regions. The following Arctic regions' innovative development (2011-2015) ratings were considered: (1) the Russian Presidential Academy of National Economy and Public Administration (RANEPA), (2) the National Association of Innovations and Development of Information Technologies (NAIDIT), Higher School of Economics (HSE) [10]. As a result, it was concluded that current level of Russian Arctic development could be defined as uneven and multi-directional differentiated (see Figure 1).

Fig. 1. Typology of Russian Arctic zone regions on the level of innovation development

Krasnoyarsk Region takes the leading position among the Russian Arctic zone regions due to its industrial specialization (96 percent of Russia's nickel production, 95 percent of the Russian cobalt production, 55 percent of Russia's copper production, 35 percent of global palladium production) and high level of expenses intensity for technological innovations (4.9 percent, which is more than twice as many as an average one in Russia). In addition, Krasnoyarsk Region boosts figures on volume of attracted grants from federal budget aimed to the development of innovation support infrastructure for small and medium-sized innovative enterprises.

Krasnoyarsk Region is also worth paying attention to by reason of its mechanism for implementing science, technology and innovation development policy. The last one is differed in having rules for examination of scientific and technical programs and projects, innovative projects financed by regional budget, monitoring of innovative activity, effectiveness assess of spending allocated for state support of scientific, technical and innovative activity, the presence of the Provincial registry of scientific and technological development and innovation projects.

The second group of regions showing positive dynamics of innovative development includes Murmansk Region and Yamalo-Nenets District. The greatest increase is observed in the position of Murmansk Region – this one coordinates 100% of Russian apatite and nepheline production, 45% of nickel volume in Russia, 16.2 percent of Russia's fish catch. Despite the fact that the level of innovation behind the average for the Russian Federation, the region distinguishes an efficient use of existing capacity (Russian-average indicators of publication activity and technology export) and the presence of port special economic zone "Murmansk". Yamalo-Nenets Autonomous District has a relatively stable level of basic innovation indicators' development; share of enterprises, which are aimed at solving problems and saving material costs of fuel

and energy resources is higher here than the average for Russia. Nevertheless, one of the features of YNAD is low research capacity [11].

The third group includes all other regions of the Russian Arctic, excluding CAD and NAD, in spite of huge natural resources availabilities. Inertia of the enterprises in the implementation of innovations, low social conditions of innovative development, lack of scientific testing facilities, lack of relevant regional development institutions, generally poor conditions of high-tech companies' development and unformed or passive innovative environment in whole could serve as the reasons for such changes.

The analysis shows that there are various factors influenced on the creation of special innovation climate. Complex composition of the Arctic and especially regions of the Arctic zone dictates the use of a differentiated approach to an innovation environment formation for each of the Arctic region.

An analysis of the relationship between total volume of innovative goods and services in the Russian Arctic regions from the one side and the history of the formation and current level of innovation infrastructure development from another one has shown that the quality indicator – an effectiveness of an innovation infrastructure functioning is a fundamental, but not their number (see. Table 3).

Table 3. The structure of Innovation support infrastructure facilities in the Russian Federation Arctic regions

Region	IDPC	TP	TIC	FSI	BI	CC	EPC	TP	CUC	IEC	BSC	CTT	Total
KR	1	1	1	1	4	0	1	2	2	1	1	1	16
NAD	0	0	0	0	2	0	0	1	2	0	0	0	5
MR	1	0	0	0	2	0	0	1	2	0	0	1	7
KR	0	0	0	0	1	0	0	1	1	0	0	0	3
AR	0	0	2	1	2	1	0	1	2	0	0	1	10
RS	0	0	0	0	2	0	0	2	1	0	0	0	5
NAD	0	0	0	0	0	0	0	0	0	0	0	0	0
CAD	0	0	0	0	0	0	0	0	0	0	0	0	0

IDPC – State-owned companies implementing Innovation Development Programs; TP – technology platforms; TIC – Territorial innovation clusters; FI – Financial support institutions; BI- Business incubators; CC – Certification Centers; EPC – Engineering & Prototype Centers; TP – technoparks (including science parks); CUC – Common Use Centers; IEC – Information Expertise Centers; BSC – Business Support Centers for small and medium enterprises; CTT – Center for Technology Transfer.

The relationship between total volume of innovative goods and services in the Russian Arctic regions and the history of the formation and current level of innovation infrastructure development presented in the Figure 2.

MODEL

To improve the innovative development it is necessary to create an efficient innovation infrastructure by means of such conceptual principles as consistency, purposefulness, collaboration, flexibility, adequacy, alternativeness, publicity, legal security, accessibility, regional identity [12]. The formation of the target innovation infrastructure should include the following steps: the global innovation trends and world practice analysis; the identification of the key problems and advantages of regional innovative development; the formation of long-term competitive position in the world; setting goals and objectives of target innovation activities; the formation and realization of

regional innovation ecosystem development programs. It is especially important to monitor and efficiency control the program realization by measuring the results of entities' innovation activities.

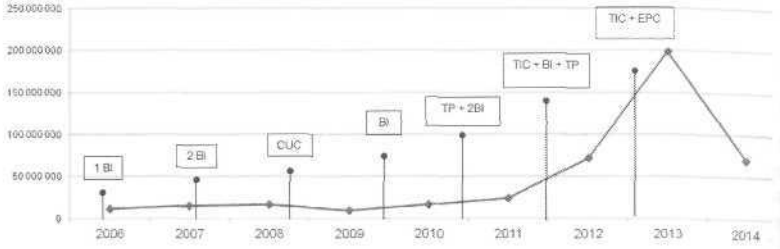

Fig. 2. Dynamics of the total volume of innovative goods and services produced in the Russian Arctic regions, 2006-2014

At the moment, Russia has created a lot of innovation support tools and innovation infrastructure facilities. However, some of them operate inefficiently due to a lack of coordination between them, poor cooperation, horizontal and vertical integration [13]. The regional innovation support infrastructure system should correspond to the regional strategic plan, aimed to improve regional socio-economic development (see Figure 3).

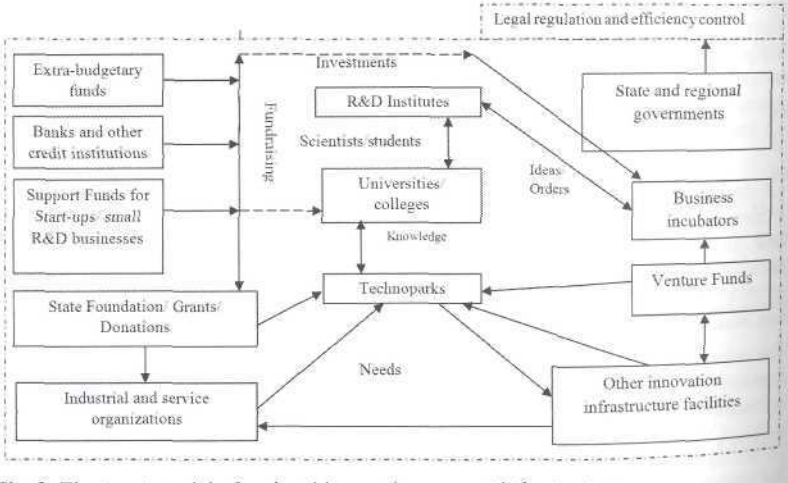

Fig. 3. The target model of regional innovation support infrastructure

The innovation enterprises are the main participants of the innovation process, so their problems should be solved as a high-priority project. Firstly it means the fundraising problems. The research of the world practice shows that one of the most efficient sources of the innovation business financing abroad is the Venture Funds that are such undeveloped in Russia [14]. Another problem is to market a new product. So-called integrators or brokers do not only connect the buyers and sellers, but what is more

important they should collaborate with another regional and international innovation support institutions. Benchmarking should be used to coordinate the scientific research in the Arctic zone, including the international cooperation. Despite the arctic countries there are a lot of others (for example, Asian countries) are interested in participating in further exploration of Arctic areas in partnership with the Russian Federation.

CONCLUSION

An efficient regional innovation infrastructure as a coordinated system should be formed to promote the most efficient use of natural, human, financial, marketing and productive resources, research and development potential; implementation of all the innovation process stages; inducing of innovation activity and susceptibility to enhance a territory competitiveness and quality of peoples' lives ultimately. The usage of authors' models will provide the creating of favorable conditions for innovations growth in the region. Intensive research and development activities in the regions of the Russian Arctic will allow efficient use of rich natural resource potential of the territory, which in the future can have a positive influence on the development of the national economy as a whole, to strengthen its position in the global area.

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