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Innovation Potential of the Arctic Regions of Russia

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Abstract. The paper provides a comparative analysis of foreign and Russian methodologies for assessing innovation potential. It is shown that foreign methodologies cannot be used to determine the innovation potential of the Arctic regions of Russia due to specific indicators that are not calculated by Russian statistics. It is determined that the use of Russian methodologies for an objective assessment of the Arctic regions in terms of innovation potential is difficult. In this regard, the authors developed a comprehensive methodology for assessing innovation potential, the principal novelty of which consists, firstly, in the use of specific indicators (in other methods, the authors use not specific, but absolute statistical indicators); secondly, only indicators that characterize innovation development are used; thirdly, expert research methods are excluded. According to the results of the analysis of statistical data, it is determined that the Arctic regions have low rates of innovation development and lag behind the average Russian values. Based on the proposed methodology, the innovation potential was calculated and the Russian regions were ranked for ten years, including 2011, 2013, 2017 and 2020, in order to compare the dynamics of the Arctic regions. It is shown that the Arctic regions are characterized by rather low values of innovation potential and are mostly below 50th place in the ranking of Russian regions.

Keywords: *innovation potential, Arctic region, methodology, ranking, assessment, rating*

Introduction

Innovative potential and implementation of innovative projects are of paramount importance for supporting sustainable economic growth and competitiveness of the Arctic regions [1].

Monitoring of innovative development of the Arctic economic systems is the basis for formation of innovative activities, taking into account the peculiarities of the territories.

Literature review and research methodology

Recently, much attention has been paid to the study and evaluation of the innovative development of countries and regions. Foreign organizations have developed various assessment methods at the country level, including the Commission of the European Communities — Innovation index¹, the World Bank — Knowledge index², the Organization for Economic Cooperation and

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¹ European Innovation Scoreboard 2021. URL: <https://ec.europa.eu/research-and-innovation/en/statistics/performance-indicators/european-innovation-scoreboard/eis> (accessed 12 April 2022).

² Knowledge economy index 2020. URL: <https://gtmarket.ru/ratings/knowledge-economy-index> (accessed 12 April 2022).

Development — Knowledge, Technology and Industry index³, the World Economic Forum — sub-index of the Global Competitiveness index⁴, INSEAD — Global Innovation index⁵. Some methods were developed by foreign specialists, such as B. Lundvall [2], M. Fisher [3], R. Nelson [4], K. Freeman [5].

Foreign methodologies use specific indicators that are not calculated by Russian statistics in a territorial context, for example, expenditures of private companies on research and development, industrial value added, total business density. Many indicators are based on the results of surveys of company executives, which are not included in the statistical reporting. Thus, the methodology cannot be used to determine the innovative potential of the Russian Arctic regions.

Foreign methodologies, due to specific indicators that are not calculated by Russian statistics, cannot be used to determine the innovative potential of the Russian Arctic regions. In this regard, organizations have developed appropriate Russian methodologies. Thus, the Higher School of Economics annually forms an innovation rating of regions based on 53 different indicators that characterize the scientific and technical potential, innovation activity, socio-economic status, export activity and the quality of innovation policy [6]. The regions were ranked in four groups within the framework of descending values from the leading region. According to the 2018–2019 ranking, the first group with the highest rating was made up of six regions: Moscow, St. Petersburg, the Republic of Tatarstan, Tomsk, Nizhniy Novgorod and Moscow oblasts. The second group includes the Murmansk Oblast, which occupies 41st place. The third group includes the Yamalo-Nenets Autonomous Okrug (61st place). The lowest fourth group includes the Nenets and Chukotka Autonomous okrugs, which occupy 84th and 85th place out of 85, respectively.

The Innovation Index, developed by the Center for Strategic Research “North-West”, provides for the calculation of 15 indicators combined into four groups on human capital, innovative products, creation of new knowledge, and application of knowledge⁶. According to the latest data for 2016, Moscow, St. Petersburg, Nizhniy Novgorod Oblast occupy the first three places. The next three places are occupied by the Republic of Tatarstan, Tomsk Oblast, Moscow Oblast. The Arctic regions occupy places in the second half of the ranking. Thus, the Murmansk Oblast ranks 44th, the Yamalo-Nenets Autonomous Okrug — 70th, the Chukotka Autonomous Okrug — 79th, the Nenets Autonomous Okrug — 83rd.

Expert RA rating agency calculates the investment potential innovation index according to 9 indicators that characterize the development of the scientific and technical sphere and innova-

³ OECD Reviews of Regional Innovation: Regions and Innovation Policy. URL: <https://www.oecd.org/innovation/oecdreviewsofregionalinnovationregionsandinnovationpolicy.htm#:~:text=Regions%20and%20Innovation%20Policy%20addresses,the%20innovation%20capacity%20of%20regions> (accessed 12 April 2022).

⁴ The Global Competitiveness Report 2020. URL: <https://www.weforum.org/reports/the-global-competitiveness-report-2020> (accessed 12 April 2022).

⁵ The Global Innovation Index. URL: <https://tind.wipo.int/record/42316> (accessed 12 April 2022).

⁶ Innovation ranking of regions. URL: <http://innovation.gov.ru/map> (accessed 23 May 2017).

tion activity⁷ [7]. According to the results of 2020, according to the criterion of innovative potential, Moscow takes the 1st place, the Moscow Oblast — the 2nd place, St. Petersburg — the 3rd place, the Nizhniy Novgorod Oblast — the 4th place, the Republic of Tatarstan — the 5th place, the Novosibirsk Oblast — the 6th place. As for the Arctic regions, the Yamalo-Nenets Autonomous Okrug ranks 49th, the Murmansk Oblast — 63rd, the Nenets Autonomous Okrug — 84th, the Chukotka Autonomous Okrug — 85th.

The Association of Innovative Regions of Russia calculates the rating of regions based on 29 indicators, which are divided in four areas: socio-economic, research and development, innovative activity, innovative performance⁸. The latest data on the ratings of regions is presented for 2018. St. Petersburg has the highest rating, the Republic of Tatarstan is the second, Moscow is the third, Tomsk Oblast is the fourth, Moscow Oblast is the fifth, and Novosibirsk Oblast is the sixth. The Arctic regions — the Murmansk Oblast, the Yamalo-Nenets, Nenets and Chukotka Autonomous okrugs — occupy 59th, 70th, 83rd and 84th place out of 85, respectively.

Russian scientists have developed original methods for assessing innovative potential. Thus, the work of A.A. Bykova and M.A. Molodchik [8] proposes an assessment of innovation potential on the basis of 13 indicators characterizing human resources, creation, as well as transfer and application of knowledge, implementation of innovation. The authors carried out the study only for ten regions, the Arctic regions were not included.

T.S. Zimnyakova [9] suggests applying the methodology based on 70 indicators, united in three blocks on formation, use, dissemination of innovation technologies and new knowledge to assess innovation potential of the regions, providing raw material specialization. Assessment of the innovative potential of 22 selected regions was carried out in 2016. The first three places were taken by the Republic of Tatarstan, the Samara Oblast and the Tyumen Oblast. The Arctic regions (Murmansk Oblast, Nenets, Yamalo-Nenets and Chukotka Autonomous okrugs) took 9th, 19th, 20th and 21st places out of 22, respectively.

I.S. Vladimirova [10] proposes to use a methodology of assessing innovative potential based on four blocks of indicators that characterize scientific personnel and the effectiveness of research, the effectiveness of innovative activities. The paper assessed and presented 10 leading regions in terms of innovation potential. The first place was taken by Moscow, the second — by St. Petersburg, the third — by the Republic of Tatarstan.

S.V. Makar and A.M. Nosonov [11] propose a typology of Russian regions in terms of innovative development based on three blocks of indicators: objects of innovative infrastructure, scientific and technical potential, and innovative activity. All regions are divided into four groups in decreasing order of innovative potential. Calculations were made for 2015.

⁷ Ratings of investment attractiveness of Russian regions 2021. URL: <https://raex-a.ru/ratings/regions/2020> (accessed 04 April 2022).

⁸ Rating of innovative regions of Russia 2018. URL: <https://i-regions.org/reiting/rejting-innovatsionnogo-razvitiya/> (accessed 12 April 2022).

The monograph [12] considers a methodology for assessing the scientific and innovative potential based on 19 indicators divided into 4 blocks (scientific personnel, research funding, formation of scientific personnel, innovative potential). According to 2000–2006 data, Northern regions are grouped into 4 clusters, the Murmansk Oblast is assigned to the second cluster with an average level of scientific and innovative potential, the Chukotka, Nenets and Yamalo-Nenets Autonomous okrugs — to the fourth cluster with a low level of potential.

V.K. Zausaev, N.Yu. Krivoruchko and S.P. Bystritskiy [13] propose a methodology that allows assessing the innovative potential of regions. The calculation is made according to five groups of indicators that have a direct impact on the implementation of innovative activities (legal, macroeconomic, economic, infrastructural, personnel).

S.V. Panikarova and M.V. Vlasov [14] suggest assessing innovation potential by three components, including the knowledge index, economic and social position of the region. The Northern and Arctic regions are divided into groups. The first group (with high potential) includes the Murmansk Oblast. The fourth group (with low potential) includes the other three Arctic regions.

E.S. Gubanova and O.S. Moskvina [15] propose to evaluate the investment and innovation potential on the basis of 7 evaluation blocks (labor, production, material and technical, financial, educational, scientific and technical, information and communication potential). According to the data for 2017, the regions of Russia are divided into 9 groups according to potential reduction. The Murmansk Oblast was in the sixth group “Problem regions”. Chukotka, Nenets and Yamalo-Nenets Autonomous okrugs were assigned to the last group “Crisis regions”.

I.L. Tukul, N.E. Egorov, G.F. Detter and G.S. Kovrov [16] propose a methodology for rating the regions of the North and the Arctic in terms of innovative development based on the triple helix model, which provides for determination of patent activity, share of innovative products in the total volume of shipped products and budget expenditures for scientific research in the expenditures of regional budgets. The calculations were carried out for eight northern regions. According to 2015 data, the Krasnoyarsk Krai ranked first, the Arkhangelsk Oblast — second, the Yamalo-Nenets Autonomous Okrug — third, the Murmansk Oblast — fifth, the Chukotka Autonomous Okrug — seventh, the Nenets Autonomous Okrug — eighth.

It should be noted that the reviewed methodologies provide for the calculation of various indicators, including socio-economic conditions, which, as a rule, indirectly affect innovative development. In addition, some methods use highly specialized data that are not available in the public domain, as well as expert research methods, which reduces the possibility of their application for an objective assessment of the Arctic regions in terms of innovative potential.

Analysis of the innovation development of the Arctic regions

The paper considers regions fully related to the Arctic zone of the Russian Federation⁹.

⁹ Ukaz Prezidenta Rossiyskoy Federatsii «O sukhoputnykh territoriyakh Arkticheskoy zony Rossiyskoy Federatsii» № 296 ot 02 maya 2014 g. (v red. Ukazov Prezidenta Rossiyskoy Federatsii ot 27.06.2017 № 287, ot 13.05.2019 № 220,

The study showed a positive dynamics of industrial production growth in the Arctic regions of the Russian Federation, as shown in Figure 1.

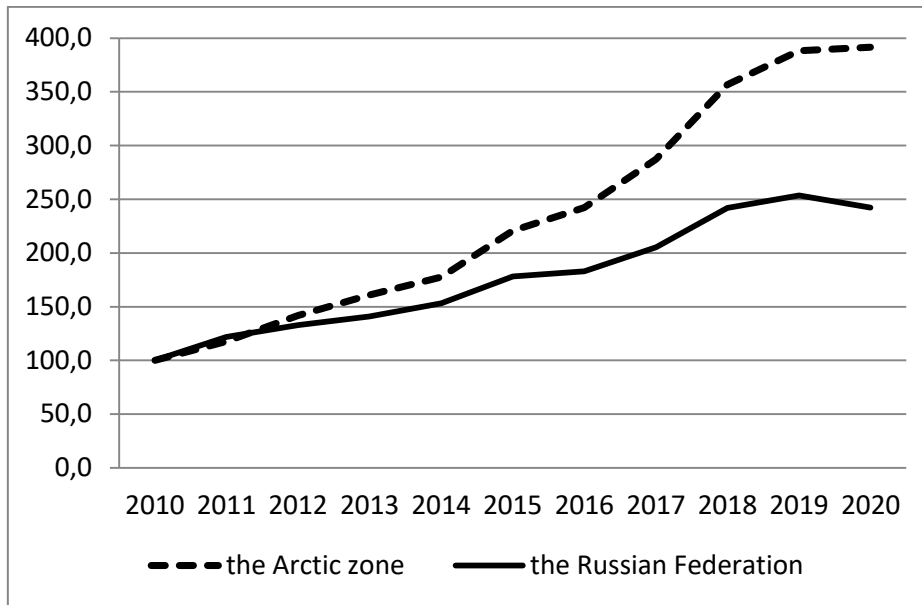


Fig. 1. Dynamics of industrial production growth in % compared to 2010.

Undoubtedly, the implementation of innovative technologies and projects affects the improvement of industrial production indices in the Arctic regions [17]. This applies primarily to the Murmansk Oblast and the Yamalo-Nenets Autonomous Okrug (Fig. 1).

Table 1
*Organizations implementing technological innovations (as a percentage of the total number)*¹⁰

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Chukotka AO	12.5	14.3	21.4	29.2	17.8	7.2	10.7	10.7	9.4	11.7
Nenets AO	8.6	5.3	4.7	3.1	5.0	3.1	4.6	2.8	5.3	4.9
Yamalo-Nenets AO	7.4	7.2	4.7	7.3	6.3	6.8	7.0	15.0	13.2	9.0
Murmansk Oblast	5.9	6.6	9.9	8.2	7.8	5.7	6.8	16.3	19.0	19.9
The Russian Federation	8.9	9.1	8.9	8.8	8.3	7.3	7.5	19.8	21.6	23.0

Only two regions (Nenets and Chukotka Autonomous okrugs) show a decrease in innovation activity.

Table 2 shows the share of innovative products as a percentage of total innovation output.

ot 05.03.2020 № 164) [Decree of the President of the Russian Federation "On the land territories of the Arctic zone of the Russian Federation" No. 296 dated May 02, 2014 (as amended by Decrees of the President of the Russian Federation No. 287 dated June 27, 2017, No. 164)]. URL: <http://pravo.gov.ru/proxy/ips/?docbody=&firstDoc=1&lastDoc=1&nd=102349446> (accessed 09 June 2022).

¹⁰ The share of organizations that carried out technological innovations in the reporting year in the total number of surveyed organizations. URL: <https://rosstat.gov.ru/folder/14477> (accessed 31 January 2022).

Table 2

*Share of innovative goods as a percentage of shipped products*¹¹

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Yamalo-Nenets AO	1.3	1.4	0.0	0.0	0.2	0.1	0.0	-	0.4	0.4
Murmansk Oblast	0.0	0.1	0.3	2.4	1.6	1.1	0.9	0.5	5.6	12.1
Chukotka AO	0.0	0.9	1.5	0.0	0.1	0.7	1.0	0.5	0.4	0.3
Nenets AO	0.0	-	-	-	-	0.0	0.0	0.0	0.0	0.0
The Russian Federation	6.1	7.8	8.9	8.2	7.9	8.4	6.7	6.0	6.1	6.4

In 2020, the Murmansk Oblast is characterized by an excess of the share of innovative products over the Russian Federation indicator. Despite the growth in the share of innovative products, the values of the Chukotka Autonomous Okrug lag behind the Russian average. The Nenets and Yamalo-Nenets Autonomous Okrugs are characterized by a negative trend in the volume of innovative products.

There is a serious backlog of the Arctic regions in terms of developed innovative technologies compared to the average Russian values (Table 3).

Table 3

*Developed innovative technologies (units)*¹²

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Yamalo-Nenets AO	4	1	4	16	13	22	12	12	15	20
Chukotka AO	-	-	-	2	2	-	-	-	-	0
Nenets AO	-	1	1	-	-	-	-	-	-	0
Murmansk Oblast	-	-	-	-	-	-	-	-	-	0
The Russian Federation	1138	1323	1429	1409	1398	1534	1402	1565	1620	1989

Among the Arctic regions, only the Yamalo-Nenets Autonomous Okrug is characterized by positive dynamics of innovative technologies development.

Meanwhile, it should be noted that there is a serious imbalance in the number of developed and used production technologies in the Arctic regions (Table 4).

Table 4

*Innovative technologies in use (units)*¹³

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Yamalo-Nenets AO	3769	3920	3971	3930	4052	3627	4354	4242	5178	4288
Murmansk Oblast	1557	1154	1106	1135	1201	1236	1145	1380	1375	1535
Nenets AO	18	25	8	n/d	25	36	63	78	103	143
Chukotka AO	-	-	-	392	402	410	221	247	142	189
The Russian Federation	191650	191372	193830	204546	218018	232388	240054	254927	262645	242931

In the Arctic regions, there is a significant lag in the implementation of developed innovative technologies compared to the average indicators for the Russian Federation. Many of the im-

¹¹ The share of innovative goods, works, services in the total volume of shipped goods, works, services. URL: <https://rosstat.gov.ru/folder/14477> (accessed 31 January 2022).

¹² Developed advanced manufacturing technologies. URL: <https://rosstat.gov.ru/folder/14477> (accessed 31 January 2022).

¹³ Advanced manufacturing technologies in use. URL: <https://rosstat.gov.ru/folder/14477> (accessed 31 January 2022).

plemented technologies at industrial enterprises in Russia can be effectively used for resource enterprises in the Arctic regions.

A serious lag is observed in the Arctic regions in terms of the number of patent applications (Table 5).

Table 5

Number of patent applications in the Russian Federation (per 10.000 people)¹⁴

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Murmansk Oblast	0.55	0.74	0.40	0.40	0.47	0.38	0.40	0.24	0.36	0.31
Yamalo-Nenets AO	0.45	0.31	0.26	0.48	0.60	0.62	0.58	0.70	0.62	0.77
Nenets AO	-	-	-	-	-	0.23	-	-	-	-
Chukotka AO	-	-	-	-	-	0.20	-	-	-	-
The Russian Federation	1.85	2.00	2.00	1.65	2.00	1.83	1.55	1.70	1.59	1.63

It should be noted that inventive activity in the Arctic regions is below the average Russian level. The Murmansk Oblast is characterized by a decrease in patent activity by 43%, which is incommensurable with a decrease in the number of scientific personnel by 10% (Table 6).

Table 6

Number of researchers (persons)¹⁵

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Murmansk Oblast	984	1030	1007	1029	1023	977	923	876	873	885
Yamalo-Nenets AO	27	45	49	52	55	59	62	69	68	65
Nenets AO	20	23	25	26	27	24	20	22	18	24
Chukotka AO	11	11	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d
The Russian Federation	374746	372620	369015	373905	379411	370379	359793	347854	348221	346497

According to statistics, the Murmansk Oblast had the largest decrease in the number of researchers among the Arctic regions and in relation to the average Russian values.

There is neither know-how nor industrial designs in the Arctic regions among the intellectual activities presented in Table 7.

In the Arctic regions, certain types of intellectual property are typical for the Murmansk Oblast and the Chukotka Okrug.

¹⁴ Coefficient of inventive activity. URL: <https://rosstat.gov.ru/folder/11186> (accessed 31 January 2022).

¹⁵ Number of staff involved in research and development. URL: <https://rosstat.gov.ru/folder/11186> (accessed 29 April 2022).

Table 7

*Intellectual property indicators (2020)*¹⁶

	Type of intellectual property				
	Inventions	Utility models	Industrial designs	Databases	Computer programs
Murmansk Oblast	5	3	-	25	39
Chukotka AO	-	-	-	-	2
The Russian Federation	20636	7098	2825	2517	16920

Comprehensive ranking of the Arctic regions by innovation potential

The authors of the article have developed a comprehensive methodology for assessing the innovative potential according to statistical data [18]. The fundamental novelty of the comprehensive methodology lies, firstly, in the use of specific indicators (in other methods, the authors use not specific, but absolute statistical indicators). The methodology uses only indicators that characterize innovative development (in most methods, in addition to these indicators, indicators of socio-economic conditions are calculated, which, as a rule, indirectly affect innovative development). The proposed methodology does not use expert methods (for example, when determining the significance of factors). The rating is based on an assessment of all specific indicators, for which the Russian regions were ranked in descending order of values.

Based on a comprehensive methodology, indicators were calculated and the Russian regions were ranked for 2011, 2013, 2017 and 2020 in order to compare the dynamics of the innovation potential of the Arctic regions.

Table 8 presents the ranking of the Arctic regions by patents per person employed in the economy, calculated according to the comprehensive methodology.

Table 8

*Ranking of the Arctic regions by patents per person employed in the economy*¹⁷

	Place among Russian regions			
	2011	2013	2017	2020
Murmansk Oblast	64	57	68	71
Yamalo-Nenets AO	78	69	67	65
Nenets AO	81	81	83	84
Chukotka AO	81	81	85	84

The Arctic regions rank below 57th in terms of patents employee. The Nenets Autonomous Okrug, the Murmansk Oblast and the Chukotka Autonomous Okrug are characterized by negative dynamics by 3, 7 and 3 points. The Yamalo-Nenets Autonomous Okrug moved up 13 places in terms of patent activity due to an 8-fold increase in the number of issued patents.

Table 9 presents the ranking of Arctic regions in terms of developed technologies per person employed in the economy.

¹⁶ Information on the use of intellectual property objects by constituent entities of the Russian Federation. URL: <https://rosstat.gov.ru/folder/14477> (accessed 31 January 2022).

¹⁷ Calculated by the authors.

Table 9

*Ranking of the Arctic regions by developed technologies per person employed in the economy*¹⁸

Arctic regions	Place among Russian regions			
	2011	2013	2017	2020
Yamalo-Nenets AO	28	40	18	9
Nenets AO	62	16	65	52
Murmansk Oblast	62	67	65	52
Chukotka AO	62	67	65	52

In terms of technologies, the leader among the Arctic regions is the Yamalo-Nenets Autonomous Okrug, which improved its position from 28th place in 2011 to 9th place in 2020 due to a 5-fold increase in the number of developed technologies, while the growth in the number of employees was 12.6 %. The Chukotka Autonomous Okrug and the Murmansk Oblast are below 50th place, although these regions are characterized by a positive trend of the indicator by 10 points due to a decrease in the number of people employed in the economy. The Nenets Autonomous Okrug in 2020, compared to 2013, improved its position by 10 points, but in 2013 the region ranked 16th among all Russian regions in the presence of developed advanced technology.

Table 10 presents the ranking of Arctic regions in terms of technologies used per person employed in the economy.

Table 10

*Ranking of the Arctic regions by technology used per person employed in the economy*¹⁹

Arctic regions	Place among Russian regions			
	2011	2013	2017	2020
Yamalo-Nenets AO	1	1	2	3
Murmansk Oblast	23	35	39	27
Nenets AO	75	77	63	23
Chukotka AO	82	81	8	10

It should be noted that the Yamalo-Nenets Autonomous Okrug and the Murmansk Oblast have reduced their indicators in terms of the advanced production technologies used by 2020. The Chukotka and Nenets Autonomous okrugs improved their rating by 72 points (from 82nd to 10th place) and 52 points (from 75th to 23rd place), which can be explained by a significant increase in the number of advanced technologies used in industry.

Table 11 presents the ranking of Arctic regions in terms of innovative products per person employed in the economy.

Table 11

*Ranking of the Arctic regions by innovative products per person employed in the economy*²⁰

¹⁸ Calculated by the authors.

¹⁹ Calculated by the authors.

Arctic regions	Place among Russian regions			
	2011	2013	2017	2020
Yamalo-Nenets AO	23	68	78	35
Nenets AO	71	79	77	79
Murmansk Oblast	76	60	55	1
Chukotka AO	77	32	35	51

In terms of the volume of shipped innovative products, the Murmansk Oblast and the Chukotka Autonomous Okrug showed a positive trend by 75 and 26 positions due to the growth in the volume of innovative products by 381 and 66 times and a decrease in the number of employees by 18% and 2%, respectively. The Yamalo-Nenets and Nenets Autonomous Okrugs are characterized by negative dynamics by 12 and 8 points.

Table 12 presents the ranking of Arctic regions in terms of expenditures on technological innovations to GRP.

Table 12

*Ranking of the Arctic regions by expenditure on technological innovation as a percentage of GRP*²¹

Arctic regions	Place among Russian regions			
	2011	2013	2017	2020
Yamalo-Nenets AO	61	73	71	81
Murmansk Oblast	68	55	67	59
Chukotka AO	74	70	53	79
Nenets AO	81	79	82	85

The Arctic regions are below 50th place in terms of expenditure on innovation. The Yamalo-Nenets, Chukotka and Nenets Autonomous okrugs are characterized by a decrease in the rating by 20, 5 and 4 points, respectively, due to a larger growth in GRP compared to the costs of technological innovation. Only the Murmansk Oblast is characterized by a positive trend of 9 points due to a 4-fold increase in costs compared to the GRP, which increased by 2 times. Table 13 presents the ranking of Arctic regions in terms of research and development costs to GRP.

Table 13

Ranking of the Arctic regions by research and development costs (as a percentage of GRP)

Arctic regions	Place among Russian regions			
	2011	2013	2017	2020
Murmansk Oblast	24	24	37	41
Chukotka AO	76	78	82	83
Nenets AO	82	82	85	84
Yamalo-Nenets AO	83	83	84	85

In terms of research and development costs, the Murmansk Oblast has the best rating — 24th place in 2011 and 41st in 2020, which is explained by the functioning of the Federal Research Center in the region, specializing in scientific research and problems of the Arctic [19, 20]. The de-

²⁰ Calculated by the authors.

²¹ Calculated by the authors.

crease in the rating of the region by 17 positions can be explained by the fact that costs increased by 36%, and GRP doubled. Chukotka, Nenets and Yamalo-Nenets Autonomous okrugs also lowered their ratings by 7, 2 and 2 positions, respectively, mainly due to the growth of GRP.

Table 14 presents the ranking of Arctic regions in terms of the number of organizations that implement technological innovations.

Table 14

Ranking of the Arctic regions by the share of organizations implementing technological innovations (as a percentage of the total number)²²

Arctic regions	Place among Russian regions			
	2011	2013	2017	2020
Chukotka AO	16	1	12	48
Nenets AO	22	53	59	60
Yamalo-Nenets AO	28	53	31	50
Murmansk Oblast	38	21	33	36

According to the implementation of technological innovations among the Arctic regions, only the Murmansk Oblast improved its rating by 2 positions. The Nenets, Chukotka and Yamalo-Nenets Autonomous okrugs are characterized by negative dynamics by 38, 32 and 22 points due to a decrease in innovation activity by 72%, 46% and 41%, respectively.

Table 15 shows the place of the Arctic regions in the rating of innovative potential, calculated using a comprehensive methodology.

Table 15

Rating of the Arctic regions by innovative potential, calculated using a comprehensive methodology²³

Arctic regions	Place among Russian regions			
	2011	2013	2017	2020
Yamalo-Nenets AO	40	56	54	44
Murmansk Oblast	57	37	56	33
Chukotka AO	74	62	50	60
Nenets AO	75	68	83	70

The Arctic regions are mostly ranked below 50th place by innovation potential. Only the Yamalo-Nenets Autonomous Okrug is characterized by a negative dynamics of the innovation development rating by 4 positions during the period under consideration, mainly due to a decrease in the rating of innovation activity and costs for technological innovation. In the Murmansk Oblast, the Chukotka and Nenets Autonomous okrugs, there is an improvement in the rating of innovative development by 24, 14 and 5 positions.

Conclusion

Foreign and Russian methodologies for assessing innovation potential have been analyzed. It has been determined that foreign methodologies, due to specific indicators that are not calculated by

²² Calculated by the authors.

²³ Calculated by the authors.

Russian statistics, cannot be used to determine the innovative potential of the Arctic regions of Russia. The considered Russian methodologies provide for the calculation of various indicators, including socio-economic conditions, which, as a rule, indirectly affect innovative development. In addition, some methods use highly specialized data, as well as expert research methods, which reduces the possibility of their use for an objective assessment of the Arctic regions in terms of innovation potential.

According to the results of the analysis of statistical data, it was determined that the Arctic regions have low rates of innovative development and lag behind the average Russian values.

The authors of the article developed a comprehensive methodology for assessing the innovative potential. Based on the methodology, the indicators were calculated and the Russian regions were ranked for 2011, 2013, 2017 and 2020 in order to compare the dynamics of the innovation potential of the Arctic regions. The analysis of the innovation potential of Russia's Arctic regions according to the developed comprehensive methodology has shown that the Arctic regions are characterized by low values of innovation potential and are mostly below 50th place in the overall ranking of Russian regions.

The practical significance of the work is due to the fact that the developed methodology allows assessing the level of innovative potential of the regions, which can help in choosing a development strategy for the territories and formulating science-based solutions to increase innovation activity, which is several times lower in the Arctic regions of Russia compared to the subarctic countries.

Further scientific research is required to increase the innovative potential of the Arctic regions, especially those with resource enterprises.

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