Innovation development of industry as the basis of socio-economic growth of the regions of the Arctic zone of the Russian Federation

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Abstract. It is shown that there is a need of scientifically based technologies and a significant increase in the innovation activity of resource enterprises aimed at the transition to modern progressive industries as the most important mechanism for improving the socio-economic development of the Arctic. Studies and calculations of innovation susceptibility, innovativeness, activity, economic and social development, state of the budgets of the Arctic regions, financial results of organizations, sources of investment financing in fixed assets, costs for developing and implementing innovation projects across the entire spectrum of industrial enterprises was carried out. The analysis of innovation susceptibility, innovativeness, activity, economic and social development showed that there is a differentiation of indicators of the Arctic regions associated with differences in innovation development. As a result of research it is determined that the budgets of the Arctic regions in different periods are characterized by a deficit and are not able to provide effective innovation activity and consequently economic growth. The main source of investment is the own funds of enterprises which are not enough for the development and implementation of innovation technologies. State stimulation of industry for the transition to a scientific and innovation development path is required.

1. Introduction

Strategic directions of the development of the Arctic zone of the Russian Federation (Arctic) are associated with large resources of hydrocarbons and solid minerals. According to experts the shelf reserves are consist of 90 billion barrels of oil, 44 billion barrels of gas condensate and 47.3 trillion cubic meters of gas. By 2050 the Arctic macroregion will be able to provide at least 20% of world oil production including about 50% of hydrocarbon production on the Arctic shelf. The Arctic is characterized by unique ore reserves including containing nickel, copper, rare earth elements, precious metals, phosphorus, iron, chromium, tantalum, manganese, molybdenum, vanadium, niobium, titanium, tungsten, polymetals, diamonds, gold, tin, cobalt, apatite, mercury and coal. Specialists estimate mineral raw materials at more than 30 trillion dollars [1].

It should be noted that despite all the diversity of mineral and hydrocarbon resources their exploitation in the Arctic is associated with a number of climatic, technological, environmental, socio-economic and other problems.

The relevance of the study is determined by the objective variety of strategic goals of the innovation development of the Arctic economy and by the need to develop ways to coordinate the
interests of the state, regions which are the main bases of innovation development and resource corporations for their mutually beneficial interaction. Issues of formation and functioning of the territories of priority social and economic development in the Arctic are of particular importance. Their creation, primarily in the Arctic single-industry towns, and development should be aimed at ensuring the comprehensive development of the macrorregion.

There is a need of scientifically based technologies and a significant increase in the innovation activity of resource enterprises aimed at the transition to modern progressive industries as the most important mechanism for improving the socio-economic development of the Arctic. Scientific and technological development of enterprises exploiting hydrocarbon resources is of particular importance. Innovation exploitation of solid minerals is also begins to be included into the state policy. The increase in commercial interest by the corporate sector when exploiting Arctic deposits should be combined with the objective interest of the state and the Arctic regions in innovation, scientific and technological development. The extraction and exploitation of natural raw materials are high-tech processes that stimulate industrial innovation projects, contribute to their implementation and increase competitiveness. In this regard "raw" orientation of the Arctic industries and their innovation development are fully correlated with the strategy of transition of the Russian economy to modern innovation, scientific and technological development paths.

Innovation development is required for almost all sectors of the economy, organizations and objects of the Arctic, including industrial, infrastructural, social and environmental. Scientific and innovation development serves as a key factor of increasing the competitive advantages and competencies of specialists in the macrorregion and accordingly creating the necessary conditions for socio-economic growth including that of for indigenous peoples.

2. Materials and Methods
In the work available analytical studies and official statistics on socio-economic growth and the level of innovation and technological development were used. Theoretical basis of the study are fundamental works and corresponding methodology of domestic and foreign researchers in the field of strategic management, planning and forecasting, economics and management [2], [3], [4], [5], [6], [7], [8].

For the study several methodologies for assessing innovation and socio-economic development were selected, including:
- methodology for a comprehensive assessment of the innovation development of the regions of the Russian Federation proposed by D.A. Ilyina and I.S. Simarova [9];
- assessment of the conditions for innovation development of regions proposed by Yu.V. Slepneva [10];
- comparative assessment of the innovation development of the regions of the Russian Federation proposed by O.I. Rashidov [11].

In the framework of methodological approaches a set of indicators such as innovativeness, susceptibility to innovation, innovation activity, economic and social development was used.

To calculate the index the indicators are reduced to a comparable form using the formula (1):

\[ x_c = \frac{x_i - x_{min}}{x_{max} - x_{min}} \]

where \( x_c \) – comparable indicator of a particular region,
\( x_i \) – value of an indicator of a particular region,
\( x_{min} \) – minimum value of a specific indicator for the Arctic regions,
\( x_{max} \) – maximum value of a specific indicator for the Arctic regions.

The arithmetic average of comparable indicators allows to determine the indices of innovativeness, susceptibility, activity, economic and social development of the Arctic regions at the beginning and the end of the considered period of 2015-2018.
3. Results
Studies and calculations of innovation susceptibility, innovativeness, activity, economic and social development, state of the budgets of the Arctic regions, financial results of organizations, sources of investment financing in fixed assets, costs for developing and implementing innovation projects across the entire spectrum of industrial enterprises was carried out.

Innovation susceptibility assessed by indicators of efficiency of capital productivity, labor productivity and environmental friendliness of production in the Arctic regions is shown in table 1.

| Table 1. Index of innovation susceptibility of the Arctic Regions |
|---------------------------------|----------------|----------------|
| Murmansk region                  | 0.008          | 0.047          |
| Nenets Autonomous District      | 0.715          | 0.863          |
| Chukotka Autonomous District    | 0.723          | 0.549          |
| Yamalo-Nenets Autonomous District | 0.642        | 0.450          |

The maximum values of innovation susceptibility are typical for the Nenets Autonomous District, the minimum values - for the Murmansk region. Range of variation in 2015 and 2018 is 90 and 18 times which indicates a significant interregional differentiation by susceptibility to innovations.

Yamalo-Nenets Autonomous District and Chukotka Autonomous District are characterized by negative susceptibility to innovations.

Innovativeness of the Arctic regions is calculated by the number of personnel engaged in research and development (in percent of the number of employees), the number of students in educational institutions of higher education (per 10 thousand people) and the number of patents granted per 10 thousand people employed in the economy. Index of innovativeness of the Arctic Regions is shown in table 2.

| Table 2. Index of innovativeness of the Arctic Regions |
|---------------------------------|----------------|----------------|
| Murmansk region                  | 1.000          | 1.000          |
| Nenets Autonomous District      | 0.091          | 0.028          |
| Chukotka Autonomous District    | 0.177          | 0.199          |
| Yamalo-Nenets Autonomous District | 0.265        | 0.316          |

The maximum values of innovativeness are typical for the Murmansk region, the minimum values – for the Nenets Autonomous District. Range of variation is 11-36 times which indicates significant differences between the regions. Only the Nenets Autonomous District is characterized by negative dynamics of the innovativeness index which was due to a decrease in the number of personnel engaged in research and development by 57%.

Innovation activity is calculated on the basis of unit costs for research, development and technological innovations as well as the production of innovation products per capita. Index of innovation activity of the Arctic Regions is shown in table 3.

By index of innovation activity the maximum values are typical for the Murmansk region, the minimum values – for the Nenets Autonomous District. Range of variation for the period under consideration is 8 and 37 times which indicates a significant increase of the gap by innovation activity between the Arctic regions. It should be noted that for most regions except the Murmansk region negative dynamics of innovation activity is typical.
Table 3. Index of innovation activity of the Arctic Regions

| Region                              | 2015  | 2018  |
|-------------------------------------|-------|-------|
| Murmansk region                     | 0.705 | 0.777 |
| Nenets Autonomous District          | 0.086 | 0.021 |
| Chukotka Autonomous District        | 0.492 | 0.362 |
| Yamalo-Nenets Autonomous District  | 0.335 | 0.114 |

Economic development of the region was calculated on the basis of specific indicators per capita of gross regional product and investments in fixed assets as well as the level of employment of the population. Index of economic development of the Arctic Regions is shown in table 4.

Table 4. Index of economic development of the Arctic Regions

| Region                              | 2015  | 2018  |
|-------------------------------------|-------|-------|
| Murmansk region                     | 0.084 | 0.060 |
| Nenets Autonomous District          | 0.667 | 0.338 |
| Chukotka Autonomous District        | 0.404 | 0.420 |
| Yamalo-Nenets Autonomous District  | 0.550 | 0.948 |

The leader in economic development in 2015 was the Nenets Autonomous District. In 2018 the Yamalo-Nenets Autonomous District became the leader due to the growth of GRP, investment and employment. The minimum values are typical for the Murmansk region (mainly due to low GRP per capita). Range of variation is 8 and 16 times which indicates significant interregional differences and an increase of the gap between regions by economic development.

Nenets Autonomous District and Murmansk region are characterized by negative dynamics of the index of economic development by 49.3% and 28.6% respectively mainly due to a decrease of gross regional product per capita.

Social development of the regions was calculated on the basis of the ratio of the average monthly accrued salary to the living wage, life expectancy at birth and an indicator that determines the natural population growth per 1000 people. Index of social development of the Arctic Regions is shown in table 5.

Table 5. Index of social development of the Arctic Regions

| Region                              | 2015  | 2018  |
|-------------------------------------|-------|-------|
| Murmansk region                     | 0.269 | 0.282 |
| Nenets Autonomous District          | 0.809 | 0.478 |
| Chukotka Autonomous District        | 0.448 | 0.230 |
| Yamalo-Nenets Autonomous District  | 1.000 | 1.000 |

According to the index of social development the Yamalo-Nenets Autonomous District is characterized by maximum indicators and is the leader among the Arctic regions by population income, life expectancy and population growth in the region. Minimum indicators are typical for the Murmansk region (in 2015) and the Chukotka Autonomous District (in 2018). Range of variation is 4 times which may indicate interregional differentiation.

In the Nenets Autonomous District there is a decrease of the index of social development by 40.9%, in the Chukotka Autonomous District - by 48.7%. This can be explained by the decrease of cash income of the population and natural population growth in the regions.
In modern globalizing economy significant financial resources for the implementation of innovation activities and the socio-economic development of the regions are required. At the same time the budgets of the Arctic regions which characterized by a deficit (table 6) are not able to provide effective innovation economic growth.

Table 6. Surplus (+) / deficit (-) of budgets of the Arctic Regions, million rubles [12]

| Region                          | 2015     | 2018     |
|--------------------------------|----------|----------|
| Murmansk region                 | -1470.90 | -337.30  |
| Nenets Autonomous District      | -2185.40 | 1828.60  |
| Chukotka Autonomous District    | 2115.10  | 433.60   |
| Yamalo-Nenets Autonomous District| -876.60  | 45797.00 |

The analysis showed that own funds currently are the main source of investment for enterprises and organizations of the Arctic regions (table 7).

Table 7. Sources of investment financing in fixed assets, percent (2018) [12]

| Region                          | Own funds | Involved funds | Including Funds of budgets of all levels |
|--------------------------------|-----------|----------------|-----------------------------------------|
| Murmansk region                 | 46.40     | 53.60          | 2.20                                    |
| Chukotka Autonomous District    | 75.20     | 24.80          | 5.20                                    |
| Yamalo-Nenets Autonomous District| 41.40     | 58.60          | ...                                     |
| Yamalo-Nenets Autonomous District| 23.90     | 76.10          | 52.10                                   |

Balanced financial performance result of the organizations of the Arctic regions is shown in table 8.

Table 8. Balanced financial performance result of the Arctic organizations, million rubles [12]

| Region                          | 2015      | 2018      |
|--------------------------------|-----------|-----------|
| Murmansk region                 | 81501.00  | 80341.00  |
| Nenets Autonomous District      | -8928.00  | -8237.00  |
| Chukotka Autonomous District    | 22029.00  | 17189.00  |
| Yamalo-Nenets Autonomous District| 43882.00  | 528322.00 |

All Arctic regions except the Yamalo-Nenets Autonomous District show negative dynamics by financial performance result of organizations.

The proportion of unprofitable organizations in all Arctic regions is growing except the Yamalo-Nenets Autonomous District (table 9). These data confirm the results of studies on the lack of financial opportunities for northern enterprises to develop and implement innovation technologies [13], [14].

Analysis of the structure of expenditures for technological innovations showed that a large share is occupied by the acquisition of machinery and equipment (table 10).

Table 9. The proportion of unprofitable enterprises and organizations, percentage of total [12]

| Region                          | 2015      | 2018      |
|--------------------------------|-----------|-----------|
The expenditures for research and development that ensure the innovation and technological development of industry are typical for the Nenets Autonomous District, Yamalo-Nenets Autonomous District and Murmansk region. The expenditures for acquisition of new technologies are typical only for the Murmansk region and Yamalo-Nenets Autonomous District.

### Table 10. Expenditures of enterprises and organizations on technological innovations in 2018, percent

|                         | Research and development | Acquisition of machinery and equipment | Acquisition of new technologies | Acquisition of software tools | Engineering | Other expenses |
|-------------------------|--------------------------|----------------------------------------|---------------------------------|-------------------------------|-------------|----------------|
| Murmansk region         | 2.60                     | 89.30                                  | 0.30                            | 0.80                          | 4.70        | 2.20           |
| Nenets Autonomous District | 2.20                   | 97.00                                  | 0.00                            | 0.80                          | 0.00        | 0.00           |
| Chukotka Autonomous District | 0.00                  | 87.10                                  | 0.00                            | 2.20                          | 4.50        | 6.30           |
| Yamalo-Nenets Autonomous District | 7.70              | 51.20                                  | 0.10                            | 24.10                         | 1.90        | 14.90          |

4. Conclusion

The performed analysis of innovation susceptibility, innovativeness, activity, economic and social development showed that there is a differentiation of indicators of the Arctic regions associated with differences in innovation development. Scientifically based proposals for the development of industry and consequently improvements in the socio-economic situation are required.

As a result of research it is determined that the budgets of the Arctic regions in different periods are characterized by a deficit and are not able to provide effective innovation activity and consequently economic growth. The main source of investment is the own funds of enterprises which are not enough for the development and implementation of innovation technologies. State stimulation of industry for the transition to a scientific and innovation development path is required.

The accumulated unsolved and emerging new problems and threats to the development of the Arctic under the influence of specific natural features, limited budget funds, climate change as well as other internal and external and restrictions, require further fundamental scientific research in the direction of innovation development as the basis for the socio-economic growth of the Arctic regions.

To increase the efficiency of economic activity primarily of industrial enterprises, infrastructure and the social sphere an orientation not only on changing socio-economic indicators but also on protecting the environment and improving the quality of life is required. Large industrial corporations demonstrate the ability to solve these problems provided the availability of investment resources. In this regard it is necessary to develop a long-term policy of stimulating the economic sector and social development of the Arctic by the state.

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