The evolution of economic models of the Arctic regions - from a resource model to an innovative socially oriented one

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Abstract. The study was conducted with the aim of developing scientifically sound methodological foundations for managing the formation of regional innovation systems in the Arctic countries as a tool to help overcome traditional geographic and economic determinism, stimulating economic growth and development by expanding the basic factors that determine the development of the macro-region. As a result of the study, patterns of the spatial development of innovation ecosystems have been identified. They determine the thesis of the invariant condition for the sustainable development of the Arctic regions. The Arctic regions, considered only as raw materials appendages, inefficiently use their potential, do not achieve the economic growth that could have been achieved in the case of innovative development of the territories, and as a result they get backward industry. The study made it possible to identify the prerequisites and key factors for the creation and development of effective innovation ecosystems.

1. Introduction

1.1. Prerequisites for research
In recent years, there has been a lively discussion at international conferences and forums about modern ways of the Arctic development. Key stakeholders of the Arctic countries discuss topics and challenges of the Arctic which are important to discuss in a public setting in frame of large international events such as International Symposium on Arctic Research [1], Arctic Frontier [2], Arctic Futures Symposium [3] and others. Traditional topics discussed at these events are the Arctic institutions; transport and logistics; culture, innovation and entrepreneurship; blue Growth and Biodiversity etc. The main driving force behind these discussions is the combination of the following two circumstances. On the one hand, huge reserves of raw materials are concentrated in the Arctic regions, which are of strategic importance for the future sustainable development of the world economy. On the other hand, due to the peculiarities of their geographic location, these regions have limited potential.

1.2. Literature review
In conjunction with strategic analysis of general issues of the Arctic development, which is carried out in the framework of events mentioned above, specific issues of the use for Arctic zone of common approaches and methods applied for regional development management, innovation management, human development and knowledge management are considered within separate sections of specialized conferences and in scientific publications. Some scientists evaluate innovative circumpolar countries by specific indicators reflecting both convergence and divergence of innovative and technological processes [4]. Barabadi define Globalization, migration, technological development along with other
aspects of developments as an important challenge and study this topic in Arctic countries [5]. In many publications, the main focus of research is limited resources for industrial in the Arctic zone. Bennett offers a comprehensive framework for rethinking the resource boundaries of the Arctic. It differs from modern claims of the region as untouched, untapped and recently discovered by climate change [6]. Tsukerman with coauthors analyze main topics of modernization and innovation industrial development of the Russian Arctic regions under the conditions of resource restrictions, first of all investment and financial ones [7]. Stepien with coauthors consider psychological knowledge as important element and propose to stimulate innovation processes in the Northern rural villages using workshops centred on building social capital [7]. Schjetne and Andersen analyze the Arctic sociocultural landscape, highlighting innovative and growing Arctic cities, thinning-out rural areas, demographic challenges, and dependence on extractive and primary industries [8]. Aware the importance of innovation for regional development, many Russian researchers pay attention to analysis of various aspects of the formation of innovation system for regions of the Russian Arctic. Pilyasov selects and studies paradoxes of Russia’s Transpolar territories, related to transformation of the Arctic from a global periphery to a global frontier [9]. Some scientists study legal regulation of the Russian Federation as the basis of innovative activity and regulatory framework for the Arctic development [10, 11].

Methodical aspects of innovation ecosystem development for the Arctic regions are in the focus of a number of Russian researchers. Some of them propose the concept of sustainable development of the Russian Arctic zone energy shelf within the framework of the Quintuple Innovation Helix Model. It focuses on university-industry-government relations, public and civil society, and the natural environment [12]. Others consider cluster as effective form of stakeholders cooperation for innovation development of the Russian Arctic regions [13].

I.3. The problem definition

The concept of long-term socio-economic development of the Russian Federation for the period up to 2020 provides transition of the Russian economy from the raw materials export to innovative socially oriented development [14]. The chosen type of the country’s development path requires the creation the Russian national innovation system (NIS) as a mechanism for formation and dissemination of innovations. The problems of formation of a competitive regional economy in the context of the federal principle of the country's organization pose to regional authorities the task of creating effective regional innovation systems.

The most important strategic planning document in the Arctic zone of the Russian Federation is the Strategy for development of the Arctic zone of the Russian Federation and ensuring national security for period up to 2020 [15]. The Strategy establishes the main purpose of the Arctic development as the resource extraction which seems to us insufficient. Based on the socio-economic situation, the scale of major challenges and the geopolitical position of Russia, along with the resource goal of developing the Arctic, it is necessary to put forward a spatial goal. This goal should include the scientifically based formation of the territorial structure of the Arctic regions and creation of a basic framework of the Russian Arctic with uniformly distributed settlement structure. The cities of the Arctic should focus on basic life infrastructure, designed not only for city residents, but also for rural settlements and shift production in the zone of influence. Small cities of the Arctic, which support frame nodes, will act as storage places for experience, skills, history, incubators of intelligence and competences, places of comfortable living for people. They should also preserve territory and nature for present and future generations and produce goods for the benefit of Russia and the world. The State Program of the Russian Federation “Socioeconomic Development of the Arctic Zone of the Russian Federation” updated in 2017 establishes a key mechanism for achieving Russia's strategic interests and ensuring national security in the Arctic, supporting development zones, recommends that the Arctic regions create an innovative infrastructure [16]. However, the results and forms of socialization of the development models implemented today by the state will ultimately depend on the reliance on humanistic values in the practice of human activity and, above all, in the innovation management.
Analysis of the regulatory framework for creation of national and regional innovation systems in Russia done by authors and in studies mentioned above, shows that the national innovation policy lacks a clearly defined concept of regional innovation development. In modern conditions, this leads to increase in the attractiveness of developed economic centers and the weakening of remote regions, blocking the most creative human and investment resources.

Previous studies of the authors of this article show the renewal of the regional innovation strategy of the state. Conditions for more effective economic cooperation with partners, favorable prerequisites for implementation of innovative projects can be created [17, 18]. For these purposes, a methodology for grouping the subjects of the Russian Federation according to their specific characteristics has been developed [19, 20].

Evolutionary economic theory points to the dependence of the development of the region on previous periods (trajectories). Previously used technologies, norms and rules create a “path dependence”. Avoiding them is quite costly, both economically and politically [21, 22], but the effect of the crisis becomes positive, and the costs become justified in this particular case.

“The level and dynamics of regional development are largely determined by industrial specialization [23]. At the same time, favorable specialization (with an increase in external demand) will obviously have a positive impact on the region's economy”. However, specialization can also have a negative effect on the development of territories if it is not based on the concentration of producers and consumers in a local area [24]. For the emergence of a positive effect, localization should be the result of internal factors of development (innovation), along with clustering, the territorial level of costs, labor productivity, and the advantages of the spatial and economic proximity of economic entities [25].

The purpose of the article is to show the possibility of transformation of the economic model of the Arctic region as a controlled evolution based on new knowledge and technologies, talents and competencies of the endemic population.

2. Methodology

2.1. Conceptual analysis

Significant contradiction has arisen in the Russian Arctic. The energy (raw materials) sector is producing more and more resources creating additional opportunities for the regions and developing more high-tech economy. It provides budget revenues increasing and more companies profits. At the same time, the life quality of the population in the Arctic and northern regions are declining (population outflow, steady decline in real income). Arctic cities and towns awaits a transformation. However, the choice of the transformation directions will depend on the government, business and population. If we assume that the oil and gas (raw materials) sector will completely switch to the shift production method, and there is every reason for this, then the only sources of tax revenues in the region that can be used for the life support of the population in localities will be agriculture, tourism and social services for major industries.

Considering the problem of complex restructuring of the Arctic regions, some scientists determine the sustainability of spatial systems as their ability to maintain their functional purpose under the destabilizing effects of exogenous and endogenous factors. It is of particular relevance with significant changes in the structure and strength of such effects, including those caused by climate changes [26]. Not to mention the possibility of a different strategy for development of the northern territories, which does not imply their intensive industrial development. Such a strategy, possibly regarded as an alternative to those described above, can be attributed primarily to areas with low, less than 0.5 people / km², population density, and consists in a well-considered reservation and saving these areas for future generations. For example: population density in the province of Nunavut, Canada is 0.02 people / km², in the autonomous region of Chukotka, Russia is 0.07 p / km², while on the planet Earth as a whole is 3.4 people / km².
Taking the last two statements - spatial development and humanistic values as a basis, it seems possible to resolve the growing crisis of mutual relations in the Arctic community, formed by the post-industrial era and the development of high technologies (technology - population) [27].

2.2. Innovation systems analysis

According to approach proposed by Skvortsova, an innovation system could be described as interconnected set of elements:

\[ S = <A E N P U > \]  \hspace{1cm} (1)

where \( \{A\} \) is a set of innovation actors (innovative SMEs and entrepreneurs, universities and research institutes which provide knowledge for innovation, organizations which make applied research); \( \{E\} \) is a set of elements of innovation infrastructure (technoparks and technopolisces, business incubators, innovation centers and coworkings, centers of fast prototyping etc); \( \{N\} \) is a set of normative documents which create a legal framework for innovation activity; \( \{P\} \) is a set of innovation priorities selected for innovation development and \( \{U\} \) is a set of financial and other mechanisms for support of innovation activity [28].

Traditionally, researchers identify national, regional and corporate types of innovation systems which have nested structure: \( S_c \subset S_r \subset S_n \) where \( S_c \), \( S_r \) and \( S_n \) are corporate, regional and national innovation systems respectively. Based on the (1), the following approach to selection of types (or levels) of innovation systems was formulated as follows: any new type of the system could be selected in case if for each sets \( \{A\} \), \( \{E\} \), \( \{N\} \), \( \{P\} \) and \( \{U\} \) there are some elements which belong only to this new type. By other words, none of the sets of new type of the innovation system should be empty [29]. This approach was used for further analysis of innovation systems in the Arctic.

3. Results and discussion

In modern models of economic development, creativity, innovation and markets are the keys to achieving a high level and quality of life of the population [30, 31]. Research in the field of the theory of innovation and innovation systems provides additional opportunities for the formation and maintenance of the ability of regions to use new knowledge and technologies for economic development [32]. The evolution of economic models usually occurs naturally as a result of the improvement of economic relations in society. There is a need for accelerated development, when there is a significant lag behind advanced economic models, stagnation or sluggishness of the economy.

An innovative way of changing the trajectory of the previous development of the regional economy [33] is possible through technological innovation and interregional ties. This study proposes three stages: 1) the emergence of new industries; 2) development of established industries; 3) adaptation to innovative processes, openness to technological solutions and innovation implementation.

The possibility of managing the evolution of economic models will be shown using a conditional example in relation to the export-oriented, raw materials producing Arctic region. The model is simplified as much as possible to show the lines of force of the regional economy, and possible sources of growth.

The model of the resource-based economy of the region, compiled on the basis of the information presented in the previous section, taking into account the historical analysis of the formation of the economies of the Arctic regions, is shown in Figure 1.
Figure 1. Simplified model of the resource-based economy of the Arctic region.

The center is an exogenous space and its subjects that are objective in relation to the region. The region and the center are separated by a symbolic border: administrative, economic, and transport one. A conditional investor who has information about the resources of the territory, a non-resident (since residents of the Arctic region do not have the necessary financial and intellectual capabilities), invests in exploitation project sites and production facilities that become his property. The produced goods in the form of raw materials are exported to the markets where they are sold. The investor receives income. Initially, the society and infrastructure of the region practically do not participate in commodity-money relations. Enterprises that operate within the framework of civil and tax legislation return part of the receipts to the region in the form of taxes and social programs. In the interests of society, consumer goods are imported. Over time, with the development of the settlement structure and population growth, the employment of the resident population of the region in the basic sector of the economy becomes another important source of income in the region. A decrease in the number of interregional shift workers and an increase in the employment of the resident population in the basic sector will contribute to economic growth. Thus, the region forms its own financial and labor resources, but its dependence on imported consumer goods, food, and other things continues. Through this channel, funds leave the region. Small and medium-sized businesses (SMEs) are emerging in the sphere of goods turnover and services for the population, but their turnovers are small in comparison with basic production and are tied to the population size and paying capacity. Agricultural industries are not taken into account in the model, since they are incomparable with the economies of basic industries and are unprofitable.

If the task is to ensure economic growth and increase the wealth of the region, then it is necessary to reduce the flow of funds leaving the region. Accordingly, the region should develop its own production. This requires investment in the production of high-demand consumer goods with a good sales market. Investments should be directed to residents of the region. Therefore, it is necessary to create regional financial funds and development programs. To achieve the profitability of projects, investments must be made in advanced, energy efficient and information technologies. This requires obtaining special competencies, implementing programs to develop human resources, creating regional universities, and increasing the level of human capital. Human resource [34], financial and technological infrastructures will form the core of the regional innovation system (RIS). The creation of an innovation system will reduce the volume of imported goods. This will ensure an increase in the region's self-sufficiency and economic growth.
Industrial enterprises of the basic sector rarely have a full cycle of production of goods; some of the processes are transferred to outsourcing and service. In technologically undeveloped regions, extraterritorial enterprises are attracted, increasing the inflow of temporary labor force. Since RIS develops in the model region, and a technology business appears, it can also be focused on the industrial sector, on providing various services to basic industries, and performing work. A regional industrial policy is being formed, and another source of development and growth appears.

The next source of economic growth is investment in fixed assets, which previously came to the region as property, equipment and services. Through the development of RIS, they can come in the form of orders to regional business and generate income. The ratio of investments directed to regional business to the total amount will show how fully the source is used.

At this stage, the economic model of the region “turns from a resource model into a resource-innovative one. This is a model that combines the resources of the basic industries of the region and new technologies in the interests of the regional community and business for innovative modernization and sustainable economic growth of the region” (Fig. 2).

Figure 2. Simplified model of a resource-innovative economy.

The growth in the level and manufacturability of production will make it possible to sell the products produced in the region to foreign markets. This may be due, among other things, to the development of SMEs in the extractive industries. This creates a new growth factor.

A step towards the independence of the economy will be the regionalization of the assets of the basic sectors of industrial production, which means the transfer (privatization) of assets, shares and stakes of industrial enterprises to the ownership of residents of the region. This will increase the income of the population and enterprises.

A non-economic factor of economic growth will be a change in the concept of living in the region that has formed in recent decades – a rotational way of organizing the work process, a “lifelong shift work” for management and qualified personnel, focused on permanent migration of the population. With such a concept, throughout life, people invest in future places of residence, export the accumulated capital to another region. With such a concept, it is not possible to create a sustainable society in the region, or to form a modern socio-cultural space in cities, or to accumulate wealth. A change in the concept and culture of living in the North, focused on permanent residence, fixing people in the territory, will increase the economic potential of the region. It seems wrong to say that keeping people in the North is very expensive. Losses from the constant outflow of population and capital are much more expensive. In addition, an innovation-oriented society will minimize the costs associated with northern specifics.

The implementation of the last three steps and the achievement of the goals set for them form an innovative socially-oriented model of the economy. In this model social well-being and consensus, improvement in living standards and quality of life of the population, competitive economy, balanced
spatial development, and safety are achieved. A region that has formed an innovative socially-oriented model of the economy can be considered a “smart region”. Taking into account the local nature of the Arctic economy, low connectivity of territories and actors, the formation of a region in the concept of a “smart city” should begin with cities with a sufficiently high human and administrative potential: “smart cities” – “smart region” [35].

4. Conclusions
1. In modern conditions, the creation of successful regional innovation systems in the Arctic is not only a feasible task, but also an invariant condition for sustainable development of the Arctic regions.
2. The article shows the creative transformation of the economic model of the Arctic region from resource model to resource-innovative one and then to an innovative socially-oriented model or “smart region”. This means a region that has ensured stable economic development by rational investments in human and productive capital, the involvement of the population in the formation and positive transformation of the socio-economic space, involving companies and the state in projects related to the self-development of the region.

An interconnected sequence (regularity) of the strategy for conducting economic policy has been revealed. It ensures the transformation of the economic model of the Arctic region:
- the accumulation of human capital, maintenance and development of intellectual and technological potential, the ability to create and implement new technologies that increase the sustainability of development;
- the accumulation of intellectual and technological potential is achieved by creating a functionally complete innovation system in the region;
- the formation of an innovation system is possible only with a purposeful policy of regional authorities, rejection of a socially oriented budget in favor of the development budget.
3. The main factors of economic growth of the Arctic region were revealed: tax legislation, regional social programs of basic industries, regional shift team, development of the domestic market, supply of goods and subcontracting of services and works for basic industries, development of foreign markets, regionalization of assets of basic industries, concept of residence.
4. The patterns of transformation of economic models and factors of economic growth show that experiments on economic development in the region through the implementation of large projects will achieve only limited goals, namely, an increase in regional budget revenues. At the same time they will not contribute to economic growth, technological and intellectual potential, if they do not provide participation of regional business and population in projects. The population and business, in turn, must have the necessary competencies, technological and financial capabilities.
5. Restrictions associated with northern specifics with properly aligned economic relations are an additional incentive and potential for economic prosperity. From this point of view, the countries that use their northern regions only as raw materials appendages and territories compactly inhabited by indigenous peoples do not use effectively their potential, do not achieve the economic growth that could be achieved in the case of harmonious development of the territories, and will get as result backward industry and socially disadvantaged human settlements.

5. Acknowledgements
The study was carried out with the support of the RFBR-Yamal project No. 19-48-890001 “Formation of the principles of optimization and modernization of multicomponent energy systems based on a priori multi-agent modeling of hybrid power supply systems for the Russian Arctic”.

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