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The innovative vector of the Nordic countries' competitiveness: case of Sweden*

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Abstract. Innovation and competitiveness are among key research topics in the social, economic and humanitarian fields. This article describes specific aspects of innovation policy in Sweden, one of the dynamically developing Northern European countries. This development is confirmed by the position of the country in the global innovation and competitiveness rankings. It is shown that high position of Sweden arises from the successful use of its geographic location, the “welfare state” model put into practice, the effective interactions of the state, science, and business, the implementation of research policy, according to which universities and research, and educational centers, involved in technology clusters formation, play an important role. The existing Arctic strategy developed in Sweden adds relevance to the research. The Arctic strategy states that “growth and competitiveness based on overcoming trade barriers, research and education system, as well as on international cooperation within the Arctic Council, the EU and the UN” will have crucial significance for the sustainable social and economic development of the state. From a practical point of view, the Swedish experience in the formation of an innovation economy, which includes northern regions as well, is of interest for the Russian subarctic areas. The article can be used for the educational process at universities. It is relevant for civil servants and researchers, economists and geographers involved in forecasting and territorial development of the northern regions.

Keywords: *innovation, competitiveness, research, Sweden, the Arctic, international cooperation.*

Introduction

Innovations are now recognized as one of the driving forces of economic development for both developed and developing countries. The scientific community has accumulated experience in assessing the level of innovative development and competitiveness of economic systems at the macro-, meso- and micro- levels of the economy and individual industries [1, de Oliveira H.H.N., de Carvalho Z.V., p. 4074; 2, Hall P., Lofgren K., p. 306; 3, Healy A., p. 12; 4, Hintsala H., Niemela S., Tervonen P., p. 77; 5, Lucchi N., Ots M., Ohlsson J., p. 191; 6, Martin R., Trippel M., p. 268; 7, Ylinenpaa H., p. 57].

Sweden is one of the leaders in innovative development and economic competitiveness. In 2011 the Parliament adopted the Arctic strategy¹. However, the country is not actively declaring its opportunities to develop natural resources and use transport communications in the Far North and the Arctic, but at the same time, it is a part of the Arctic Council and the Barents Euro-Arctic

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¹ Sweden's Strategy for the Arctic region/Government Offices of Sweden. Ministry for Foreign Affairs. Department for Eastern Europe and Central Asia. Arctic Secretariat, Stockholm, Sweden. 2011. 52p.

Council (BEAC). Studying these features is of scientific and practical interest for the northern and subarctic areas of the Russian Federation.

General characteristics of the North European region

Based on the quantitative parameters, the population of Northern Europe and its constituent countries (with a continuing low population growth) slightly exceeds 25 million people, which is about 0.5% of the world population. In this sense, the closest analogs are Australia (22 million people, 2017) and North Korea (24 million people, 2017). The territory differs by larger. Sweden, e.g., is on the 5th place on the continent by area².

The specialization of the Nordic countries was initially been formed on the basis of advantages in natural factors of production determined by the availability of wood resources (all countries of Northern Europe, except Denmark and Iceland), iron ore (Sweden), non-ferrous metal ores (Iceland, Norway and Finland), water biological resources (Iceland, Denmark and Norway), favorable conditions for agriculture (Denmark). But the technical and economic progress increased the degree of natural raw materials processing, new branches of the economy developed, and the quality of life of the population increased. The foreign trade is a distinctive feature for the economic systems of the Nordic countries: the export quota in Sweden and Norway exceeds 45%³.

In 1980–2017, in the UN Quality of Life Index by the country of the region, the first places: Norway — 1st place, Denmark — 4th, Sweden — 14th, Iceland — 16th, Finland — 24th (cf., the USA — 8th and Russia — 50th)⁴.

Innovation policy tools of Sweden

The growing openness of national economies makes circumpolar states feel the need of institutional transformations of economic systems adequate to changing conditions. In this regard, the Nordic countries are in transition to the post-industrial development accompanied by the modernization of public administration and the introduction of innovative processes in industry and energy.

Since 1940s, Sweden has been building up a system of governmental tools and a set of measures to implement technology policies, ultimately determining the country's position on the global R&D market. It could be achieved with innovation policy based on the principles of strategic planning, program-target methods, cooperation of the state and industrial enterprises, scientific, educational and public organizations and instruments of international cooperation.

The concept of a “national innovation system” (B.O. Lundvall), developed in Sweden, formed the background of the EU economic, scientific, technical, technological and innovation policy. The ideas of innovative development and the concept of “learning regions” were developed by the Norwegian economic geographers B. Asaim and A. Isaksen. The widely used concept of “knowledge society” was introduced by the American economist M. Castells. A significant contri-

² Data on the area and population of countries. URL: www.cia.gov/factbook (Accessed: 28 September 18).

³ Ibid.

⁴ UN Human Development Report 2016. Human Development for Everyone. UNDP. NY. 2017.

bution was made by the Norwegian researcher K. Sogner by developing the concept of “innovative culture” – a distinctive feature of the Northern European model of socio-economic development. Human resources in Northern Europe are distinguished by the ability not only to receive and analyze new information but also to acquire new competencies that reinforce the creative nature of work [8, Severnaya Evropa..., p. 16–18].

In Sweden, a self-regulating system of innovative development was formed. It is described in the form of a “triple helix” [9, Etzkowitz N., Leydesdorff L., p. 200] with interrelated “turns” and excluded dominant links. This model includes the state, business, research, educational and civil society institutions.

A feature of the Swedish innovation strategy is the high share of private companies, especially transnational corporations (TNCs), in the R&D financing. Alfa Laval, Electrolux, Ericsson, IKEA, Scania, Tetra Pak and Volvo, as well as the banking sector (Skandinaviska Enskilda Banken, Handelsbanken and Swedbank) play a significant role in generating innovations. Large Swedish companies have such extensive opportunities for in-house research and established links with research institutions within the country that, in addition to public investments, are not very interested in innovation strategy. This position may be contrary to the interests of small and medium-sized Swedish enterprises. In Sweden, in 2016, the share for small and medium-sized enterprises in R&D was 17.8%, accounting for 17.7% of government R&D spending. Approximately the same ratio is observed for state R&D subsidies for small and medium-sized companies in Norway in 2016: 9.8% and 49.1% respectively. The effective development of knowledge-intensive industries in global TNCs poses a risk to the development of the innovation systems. The system of the R&D commercialization is characterized by the insufficient application of stimulating tax policy measures. It hinders the development of high-tech sectors of the economy. The relatively high level of taxation provides a high level of education, health, social welfare through human capital and network connections that determine the quality of the innovation economy — ability to assimilate new knowledge [10, Pchelintsev S.V., p. 122].

The work on the formation of innovation and science policy in Sweden is mostly carried out by the Government (Fig. 1).

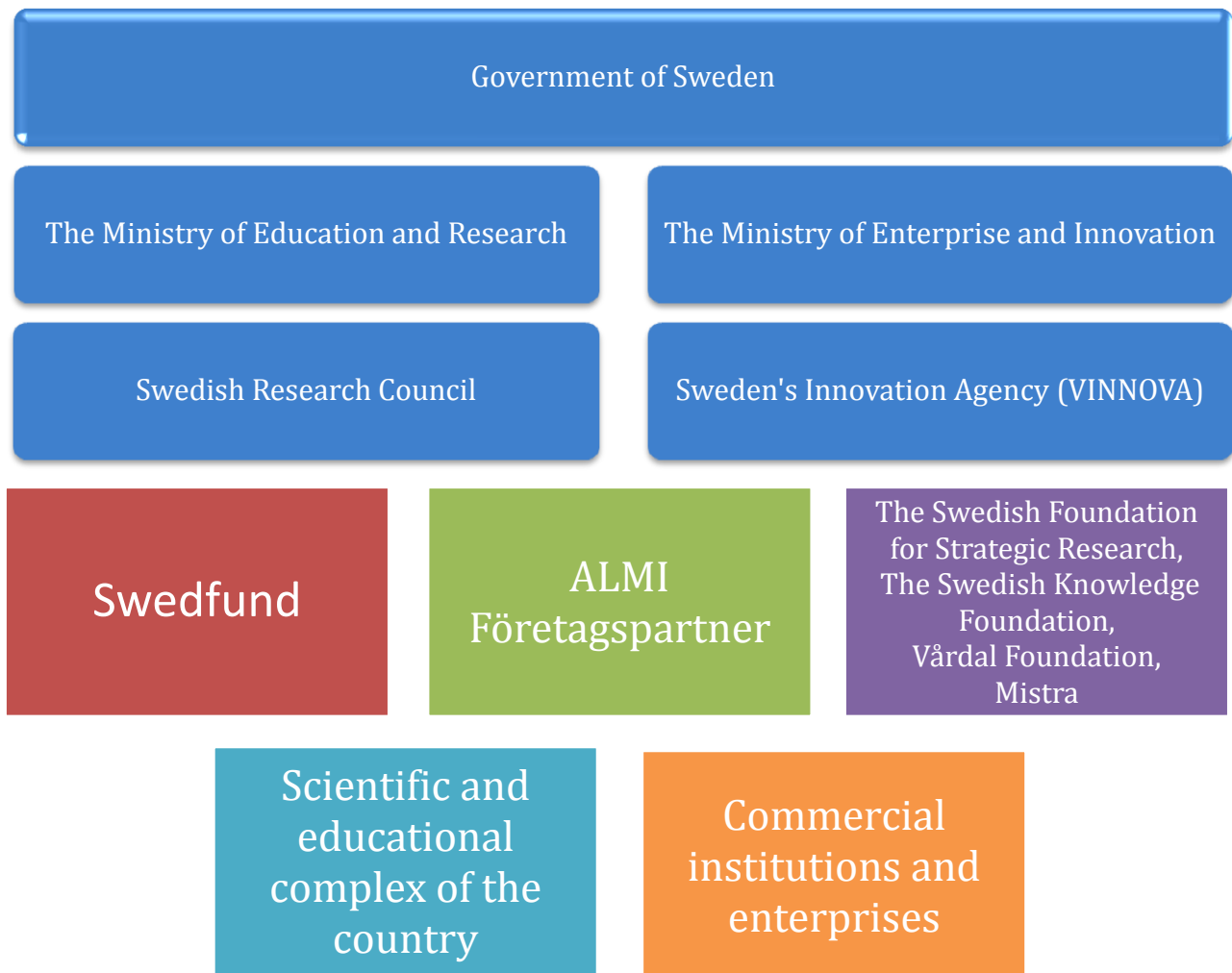


Fig. 1. Innovation system in Sweden

The Government of Sweden approved the Swedish Innovation Strategy 2020⁵ developed by social dialog. The Strategy's three main principles:

- Better conditions for innovations (people, education and infrastructure);
- People, enterprises and institutions systematically involved in innovations;
- integrity via coordination at the political level and dialogue with industry, public sector, civil society and education.

In Sweden, the priority innovation areas are medicine, biotechnology, information and communication technologies (ICT), sustainable development and the environment. Within the EU, Sweden actively promotes the idea of "smart specialization", i.e. innovative activity focus in sectors with comparative advantages to strengthen the country's position in the international division of labor. [3, Healy A., p. 30].

A part of the Ministry of Enterprise and Innovation is the **Sweden's Innovation Agency (VINNOVA)**. Its goal is to provide Swedish leadership in research and innovation attractive to businesses. The Agency facilitates collaboration between companies, universities, research institutes

⁵ The Swedish Innovation Strategy 2020. URL: <https://www.government.se/contentassets/the-swedish-innovation-strategy> (Accessed: 26 September 2018).

and the public sector, incl. international level. The government provided the Agency with authority to develop and implement innovative strategies and programs in ICT, biotechnology, transport, development of new products, materials and areas of work. VINNOVA is a leading actor in Sweden's industrial policy. It finances the regional innovation and cooperation projects of universities and economic agents. VINNOVA supports innovative systems by participating in the R&D financing focused on the needs of competitive industries and spheres of public life, and the strengthening of networking as an element of this work. [10, Pchelintsev V.S., p. 120].

The Swedish Agency for Economic and Regional Growth (NUTEK) is responsible for entrepreneurship, the economy of the regions and the support of local companies. The task of the Agency is to provide business with information, consulting and finances. The Agency also works to develop starting conditions for new enterprises and to support their entrance to the international tourism market. NUTEK participates in regional clusters as a scientific consultant and financial administrator.

County councils of Sweden work for the development of private sector enterprises. At the regional level, coordination councils are operating. They are responsible for regional development programs.

The Ministry of Education and Research of Sweden runs Research Council responsible for defining research areas for strategic investment, R&D analyzing and financing, and facilitating communication between researchers from various academic fields. The innovation activity is supported by the Agency for Economic and Regional Development. Since 1919, the Royal Academy of Engineering (IVA) has participated in innovation activity. The Swedish Research Council for Health, Working Life and Welfare (FORTE) promotes R&D in the field of labor management, health, and social services.

In Sweden, some state structures are aimed at the interaction of scientific institutions and industrial enterprises. Their purpose is to contribute the commercialization of R&D and support of small enterprises at research centers and universities: the Swedish Network for Support of Innovation & Technology Transfer (SNITTS), the Small and Medium Business Support Fund (Almi), the Strategic Research Foundation (SSF), the Health Research Foundation (Vårdal), the International Research Foundation for Educational Cooperation (STINT), Foundation for Strategic Environmental Research (MISTRA) [10, Pchelintsev V.S., p. 121].

Innovation policy practice in Sweden

Due to the innovation policy practice at the beginning of the 21st century, the Nordic countries occupy a high position in international rankings of global innovation and competitiveness. Every year, the Harvard University School of Business publishes the Innovation Capacity Index. In 2017, among 173 countries of the Index, Finland was the second after the United States, Sweden - 8th, Norway - 18th, Denmark - 19th, and Iceland - 20th. In 2017, Sweden was the second after Japan by the share of specialists with higher technical education in the total population. The Global

Innovation Index of the INSEAD, Cornell University and the World Intellectual Property Organization in 2013–2018: Sweden, Finland, and Denmark were in the top ten (Table 1, Fig. 2).

Table 1

*Russia and The Nordic states in the Global Innovation Index 2013-2017.*⁶

| Country | 2013 | 2014 | 2016 | 2017 |
|---------|------|------|------|------|
| Denmark | 9 | 8 | 8 | 8 |
| Sweden | 2 | 3 | 3 | 3 |
| Finland | 6 | 4 | 5 | 7 |
| Iceland | 13 | 19 | 13 | 23 |
| Norway | 16 | 14 | 22 | 19 |
| Russia | 62 | 49 | 43 | 46 |

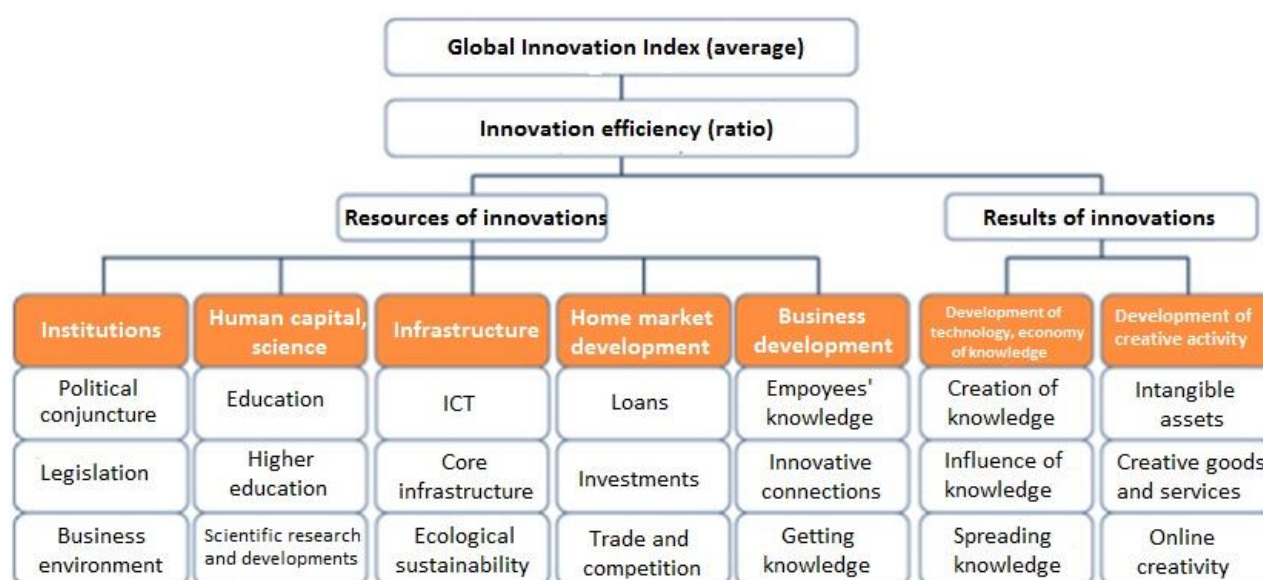


Fig. 2. Innovation Index structure, 2018.

North European countries demonstrate high rates in the EU Innovation Union Scoreboard and the World Economic Forum (WEF) global competitiveness rating, first published in 2004. The WEF rating considers the opinion of partners and experts, i.e., TNCs and public institutions that assess the situation in 160 countries on 120 indicators. The data set is divided into 12 groups: **primary factors** (public institutions, infrastructure, macroeconomic stability, health care, and primary education), **factors that increase the efficiency** (higher education, the effectiveness of goods and service markets, labor market efficiency, financial market development, technology development, and market size), and **innovation factors** (level of business development and innovation). No single factor can ensure the competitiveness of the state in the rating. Thus, the effect of an increase in spending on education may be reduced due to the low efficiency of the labor market and the lack of opportunities for graduates to be employed. The most competitive will be a state or states able to pursue a policy that considers the maximum number of factors and the connection between them. Leading countries in the ranking are not among the world leaders regarding GDP and income per capita, which indicates the importance of quality indicators in assessing competitive-

⁶ Global Innovation Index. INSEAD, Cornell University, World Intellectual Property Organization. 2013, 2014, 2016, 2018. URL: <https://www.globalinnovationindex.org> (Accessed: 26 September 2018).

ness. Since 2000, Finland, Sweden and Denmark (until 2011–2012) were among the top ten countries with the most (Table. 2)⁷.

Table 2

Position of countries in the Global Competitiveness Index, World Economic Forum, 2008-2017.

| Country | Position in the rating | | | | | | | | |
|-------------|------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | 2008–2009 | 2009–2010 | 2010–2011 | 2011–2012 | 2012–2013 | 2013–2014 | 2014–2015 | 2015–2016 | 2016–2017 |
| Switzerland | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| USA | 1 | 2 | 4 | 5 | 7 | 5 | 3 | 3 | 3 |
| Singapore | 5 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 |
| Finland | 6 | 6 | 7 | 4 | 3 | 3 | 4 | 8 | 10 |
| Sweden | 4 | 4 | 2 | 3 | 4 | 6 | 10 | 9 | 6 |
| Iceland | 20 | 26 | 31 | 30 | 30 | 31 | 30 | 29 | 27 |
| Denmark | 3 | 5 | 9 | 8 | 12 | 15 | 13 | 12 | 12 |
| Norway | 15 | 14 | 14 | 16 | 15 | 11 | 11 | 11 | 11 |
| Russia | 51 | 63 | 63 | 66 | 67 | 64 | 53 | 45 | 43 |

The analysis of ratings proves the scientifically discussed issue of “Swedish paradox” [11, Edquist C., McKelvey M., p. 134]: Sweden occupies a leading position among European countries regarding R&D investments (ratio to GDP), but it has a low share of high technologies in production, i.e., demonstrates low liquidity of investments. It worsens the innovative potential of the country. Although, according to Detter G.F., the commercialization of research results is one of the main activities for Swedish corporations [12, Detter G.F., p. 28]. The Swedish innovation system devotes considerable attention to fundamental research compare to applied research and develops innovative activity in TNCs, but it has been unable to achieve significant results in supporting small and medium-sized business, especially at the stage of their startup. On the other hand, statistics show that over the past ten years, the corporate sector accounts for the largest share in the R&D financing: from 69 to 75%. The second largest segment is education. In 2015, its stock was about 27% of total expenditures. Cf.: in Norway, 46% of R&D expenditures are from the public sector and 43% — entrepreneurial one.⁸

Using statistical data, we can present the positions of the North European countries in the EU ranking of the share of innovative goods, activities and services in the total volume of products shipped, activities and services (Table 3).

Table 3

The share of innovative goods, activities, services in the total volume of goods shipped, activities and services in the countries of Northern Europe and Russia, 2005–2015, %

| Country | 2005 | 2007 | 2009 | 2011 | 2013 | 2015 |
|---------|------|------|------|------|------|------|
| Denmark | 11.0 | 7.8 | 11.4 | 15.0 | 13.9 | 7.0 |
| Iceland | 12.7 | - | 11.9 | 6.1 | - | - |
| Norway | 7.2 | 4.8 | 4.6 | 6.1 | 5.2 | 6.2 |
| Finland | 14.9 | 15.7 | 15.6 | 15.3 | 11.1 | 9.3 |
| Sweden | 13.4 | 15.0 | 9.2 | 8.4 | 6.1 | 6.9 |
| Russia | 5.2 | 4.6 | 4.5 | 6.3 | 9.2 | 8.4 |

⁷ The Global Competitiveness Report 2017–2018. URL: <https://www.weforum.org> (Accessed: 26 September 2018).

⁸ The Nordic Institute for Studies in Innovation, Research and Education (NIFU). URL: <http://www.fouostatistikbanken.no/> (Accessed: 26 September 2018).

Table 3: it follows that for a long time, the economy of Sweden and neighboring Finland has been characterized by a higher share of innovative goods and services in the total production of products and services, in contrast with other countries of Northern Europe and especially with the Russian Federation⁹.

The European Commission review *The European Commission. Eco-Innovation Observatory* provides data on the Eco-Innovation Index. Eco-innovations bring new or improved products, services and technologies that reduce the use of natural resources, pollutants or noise, they help to reuse production and consumption waste, and provide additional economic, social and environmental benefits. Among 28 countries (as of 2015), Denmark, Finland, and Sweden occupy the 1st, 2nd and 5th places respectively. Table 4 represents the proportion of institutions engaged in environmental innovation among the total number of organizations that used innovations in 2013–2015 in the countries of Northern Europe and Russia¹⁰.

Table 4

The share of organizations engaged in environmental innovation in the total number of organizations that had ready-made innovations in the past three years, by type of innovation in the Nordic countries and Russia in 2013–2015, %

| Country | Improving environmental safety in the production of goods, works, services | | | | | Improving environmental safety as a result of consumer use of innovative products, works, services | | |
|---------|--|---|---|---|--|--|--|--|
| | Reducing material costs per unit of production | Reducing carbon dioxide emissions into the atmosphere and energy costs for the production of a unit of production | Replacing raw materials for safe or dangerous | Reduction of environmental pollution (atmospheric air, land water resources, noise reduction) | Recycling of industrial waste, water and materials | Reducing energy consumption or loss of energy resources | Reduction of environmental pollution (atmospheric air, land water resources, reduction of noise level) | Improving the possibility of secondary processing of goods |
| Denmark | 13.4 | 12.2 | 8.3 | 8.5 | 4.6 | 11.5 | 7.1 | 16.2 |
| Iceland | 24.7 | 22.2 | 18.4 | 15.0 | 16.3 | 16.1 | 20.9 | 24.1 |
| Norway | - | - | - | - | - | - | - | - |
| Finland | 36.9 | 29.1 | 23.5 | 25.7 | 23.9 | 25.8 | 20.6 | 37.7 |
| Sweden | 28.9 | 18.2 | 22.9 | 23.5 | 15.7 | 23.0 | 22.0 | 28.6 |
| Russia | 6.4 | 13.9 | 5.7 | 11.2 | 6.5 | 7.5 | 8.7 | 3.6 |

The data in Table 5 demonstrate that about half of enterprises in Northern Europe (more than 50% in Iceland in 2015) carry out technological innovations, while Sweden was not a regional leader in 2015, but its rating is higher than than Russian more than 5 times¹¹.

⁹ *Indikatoriy innovacionnoj deyatel'nosti: 2017: statisticheskij sbornik* [Indexes of innovative activities: 2017: statistic collection]/eds. N.V. Gorodovnikova, L.M. Gohberg, K.A. Ditkovskij et al.; Nac. issled. un-t "Vysshaya shkola ehkonomiki". M. NIU VSHEH. 2017. 328 p.

¹⁰ Eurostat. *Pokazateli Evropa* [Data on Europe] 2020. Research and Development and Innovation, 2015.

¹¹ *Indikatoriy innovacionnoj deyatel'nosti: 2017: statisticheskij sbornik* [Indexes of innovative activities: 2017: statistic collection]/eds. N.V. Gorodovnikova, L.M. Gohberg, K.A. Ditkovskij et al.; Nac. issled. un-t "Vysshaya shkola ehkonomiki". M. NIU VSHEH. 2017. 328 p.

Table 5

The proportion of organizations implementing technological innovations in the total number of organizations of Northern Europe and Russia in 2013–2015.

| Country | 2013 | 2015 |
|---------|------|------|
| Denmark | 38.1 | 38.0 |
| Iceland | - | 50.1 |
| Norway | 31.2 | 46.2 |
| Finland | 44.6 | 48.3 |
| Sweden | 45.2 | 44.3 |
| Russia | 8.9 | 8.3 |

The analysis of statistical data shows that in 2013–2015, the intensity of costs (the proportion of technological innovation costs in the total volume of goods, activities, and services) in Northern Europe and Russia for technological innovations changed under the influence of external and internal socio-economic and political reasons. In Sweden, it shows steady growth. According to this indicator, the country is the EU leader in 2015 (Table 6)¹².

Table 6

The intensity of technological innovation costs in the Nordic countries and Russia in 2013–2015.

| Country | 2013 | 2015 |
|---------|------|------|
| Denmark | 3.45 | 1.90 |
| Iceland | - | - |
| Norway | 0.90 | 1.59 |
| Finland | 2.93 | 2.30 |
| Sweden | 2.98 | 3.86 |
| Russia | 2.90 | 2.66 |

Currently, about 3.4% of GDP goes for R&D in Sweden. R&D occurs in all sectors and all regions of Sweden but with a different degree (Fig.3).

¹² Ibid

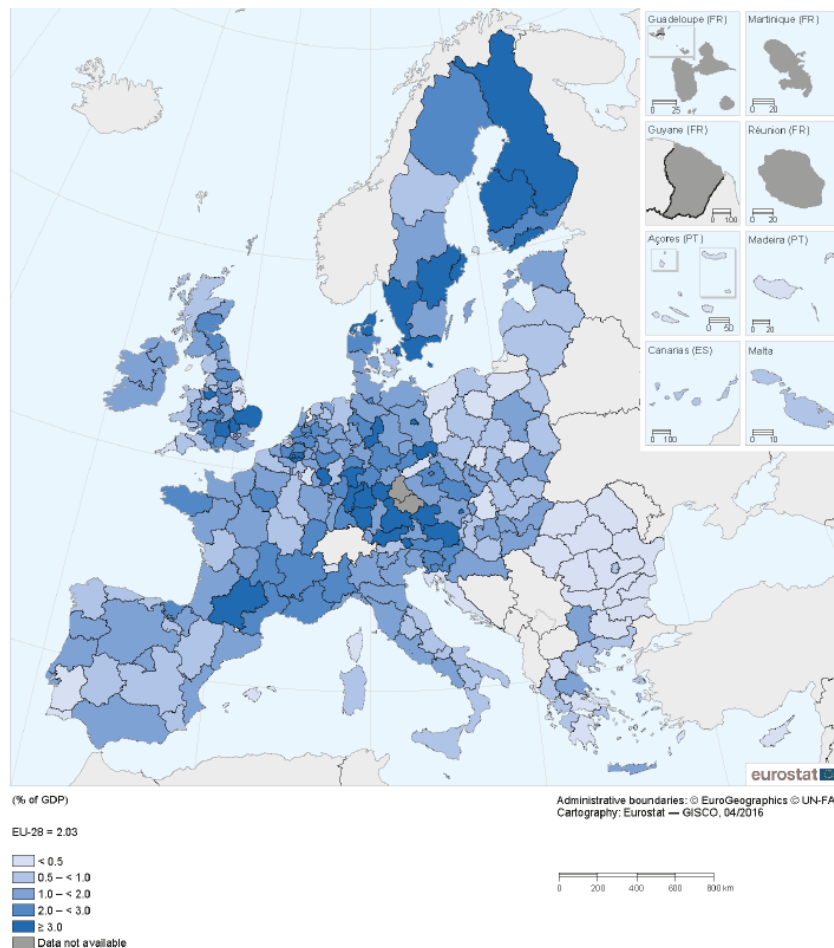


Fig. 3. R&D costs in Europe, 2017

The Swedish innovation strategy focus is research in an academic (university) context. Its aim is transforming research results into innovations and transferring them to the regional level. At the same time, the amount of research carried out with state support in Swedish technological institutes is smaller than in other Scandinavian countries — the state finances higher education and the research sector, which mainly consists of state universities and colleges. Its value is 20% of all R&D in the country. In Sweden, 36 universities and colleges offer higher education. Governmental R&D concentrates in major universities, e.g., the Karolinska Institute, Uppsala University, the University of Gothenburg, the Royal Institute of Technology, the University of Linköping, etc. [10, Pchelintsev V.S., p. 130].

Research funding is provided by universities, government agencies (councils), research foundations, private foundations, and other non-commercial organizations. A unique feature of the Swedish innovation development experience is the Innovation Bridge initiative - a national program for creating incubators that provide a technology transfer for start-ups of innovative companies that stimulate creative activities of small and medium-sized enterprises. This program uses the potential of universities in Linköping, Luleå, Lund, Stockholm, Umeå, etc.

The platform for cooperation between higher education and the community is regional development programs. They are built on public-private partnership and networks between actors of the sectors concerned (state, municipal authorities, universities, corporations, and small business).

In this regard, an interesting example is the participation of the Chalmers University of Technology in the development of the Gothenburg district. This district is in second place (after Stockholm) with the rank of European innovation areas according to the innovation rating of the European Commission [10, Pchelintsev V.S., p. 129]. Despite its modest size, the Chalmers University can strengthen its role in the local innovation system of Gothenburg through some structures and centers aimed at interaction with local companies. Such structures: the Chalmers Science Park, founded in 1984 in partnership with the municipality and the Regional Chamber of Commerce, and the Science Park Lindholmen, established in 1999, which is a business incubator aimed at creating innovative firms. Local businesses, incl. TNK Volvo and the University of Chalmers are partners of venture capital companies offering business support services at an early stage of development, incl. subsidies and training. The Chalmers University pays particular attention to economic and legal aspects affecting the innovation process. The university has a center for research of intellectual property rights and a school of entrepreneurship engaged in research programs aimed at developing business plans for high-tech companies. Gradually, the university has mastered all the tools necessary to manage each phase of the innovation process. It job consists of developing an idea, scientifically justifying it, protecting the rights to an invention, help in obtaining sources of funding for the initial non-competitive phases of productions, or, in partnership with other actors, the creation of new enterprises to develop a strategy for market sales. Many of these activities have become possible due to the status of the “foundation university,” which is permissible under national legislation. Transformation of the status allowed to increase the degree of autonomy of the University (while maintaining the public administration and financing) and to simplify administrative procedures. The letter had a positive impact on the development and investment policy practice (incl. infrastructure) [10, Pchelintsev V.S., p. 130].

Another example of a knowledge-based region is the Öresund region formed on the border of Denmark and Sweden after the construction of a bridge across the strait between the cities of Malmö and Helsingborg. The value of this point of economic growth, located at the intersection of Central, Northern, Eastern and Western Europe, is great. Here, dozens of universities exist. In the Danish Roskilde and Swedish Lund, thousands of researchers are concentrated. Due to the efforts of local governments, civil society, and business, Öresund is an economic region, a center for ICT, pharmaceuticals, and biotechnology. The Öresund region is of great importance in the context of “green” technologies (based on alternative wind energy), which enhances the image of the Nordic countries as the “cleanest” in the world, improves the environmental performance of local companies, and contributes to the sustainable development of the region and its immediate neighbors. Great importance has the creation and development of regional clusters. Financial support and the participation of the European Commission, Vinnväxt program in Sweden, helped the development of following clusters: Uppsala BIO (biotechnology), Robotdalen (automation and robotics), ProcessIT Innovations (automation of industrial production), GoteborgBIO (biomedicine), Triple Steelix (metallurgy), Fiber Optic Valley (fiber optics), Peak Innovation (sports and tourism), Printed Electronics

Arena (electronics), Skåne Food Innovation Network (food and packaging), Smart Textiles (light industry), Smart Housing Småland (housing and utilities, smart home)¹³. Among clusters is the ICT one located in the town of Kista and formed by the Royal Institute of Technology and the University of Stockholm. This cluster is considered as a prototype of Silicon Valley in the United States. Here are Swedish and foreign TNCs and their branches (SonyEricsson (telecommunications), Tele2 AV (telecommunications), Tieto (IT– service, Finland), IBM (the US), Microsoft (the US), Intel (the US), and Oracle (the US)).

Research policy of Sweden

Swedish innovation strategy is related to R&D activities carried out at universities. **Ministry of Education and Research, Research Council, Council for Scientific Research** (funds basic research in the natural sciences, technology, medicine, humanities and social sciences), **Council for Scientific Research in Environment, Agriculture, Forestry and Spatial Planning** (defines research mathematics and funding for environmental, industrial and spatial planning research), **the Council for Labor Relations Research and Social Security** (supports research of the labor market, activities of organizations in healthcare and welfare), **the International Cooperation Agency** (SIDA, provides international cooperation in research) – the state institutions responsible for the research policy in Sweden

The competence of the Research Council is to determine the priorities of research, administer funds, advise government and corporations on scientific policy issues, ensure interaction between scientists, and promote cooperation at the national and international levels. The scope of support is wide: from perfecting the research infrastructure at the national level to supporting research in specific fields of knowledge.

The national research strategy identifies the priority areas of knowledge for optimizing research activities: the development of society, ICT, medical technology, biodiversity, welfare of the population: its work, lifestyle and health.

The strategy secures:

- development of a new funding system that stimulates the improvement of qualitative indicators of research programs and allows universities to implement long-term research and development strategies, creating optimal working conditions for researchers;
- creation of requirements for the innovations in higher education and the increase in the autonomy of universities;
- promotion of the quality of applied research activities of universities;
- development of international cooperation, incl. academic mobility, especially in the EU;
- consolidation of corporate, public and university resources to cooperate between them and increase competitiveness. Cooperation programs should have clear objectives, based on attracting international partners and the efficient use of existing infrastructure.

¹³ VINNVÄXT. A programme renewing and moving Sweden ahead. URL: http://www.vin-nova.se/upload/14_04.pdf (Accessed: 26 September 2018).

The Arctic strategy and the scientific and educational policy in Sweden

In Sweden, in the first half of the 21st century, an essential block of research policy is associated with the Arctic region. Despite the fact that Sweden has no direct access to the Arctic Ocean, in contrast to Denmark and Norway, it does not have technologies for offshore and especially sub-oil production of oil and natural gas (but Sweden is always ready to participate in Arctic projects as a subcontractor), the country is a member of the Arctic Council and other regional institutions together with other states. Also, Sweden is dealing with the challenges in a changing Arctic region, the most important of which are climate change and globalization. Therefore, the desire of the Swedish government to influence policy in the Arctic region seems to be justified. In 2011, Sweden developed the Arctic Strategy to present national interests in the Arctic¹⁴. In this document, the Swedish government declares goals that all Arctic states share: development of research in sustainable development, “clean production” and alternative energy, studying and predicting climate change, its impact on the Arctic Ocean and the coast, indigenous people. When working in these areas, the potential of the UN, UNESCO, the Arctic Council, BEAC, the EU's Northern Dimension program are important. The Strategy substantiates the need to bridge the gaps in the knowledge of the features of the Arctic natural systems, expand expeditionary activities, strengthen the transfer of experience and technology, network cooperation and academic mobility (University of the Arctic), create a regional information center for environmental monitoring. In the conditions of depletion of mineral reserves on a global scale, the accents in different strategies for the development of the polar territories have changed. So, if the concept of conservation of the Arctic environment was proclaimed 15–20 years ago, in modern strategies, incl the Swedish one, the emphasis is on rational use of natural resources with international participation. An environment is being created for the innovation activities of corporate subcontractors of corporations on the Arctic shelf, and marine (aqua-territorial) clusters are developing. An important task is to transform the experience of developing the shelf during the development of deeper water areas.

Particular attention is drawn to the “ecosystem management” based on the principles of biodiversity conservation, considering the values of indigenous cultures, ecologically balanced, safe, consistent with the norms of international law, and the use of shelf energy resources. The authors of foreign strategies are aware of the fact that preservation of the Arctic environment is possible in partnership with state authorities, local governments, corporate, non-profit and other structures of civil society [13, Pilyasov A.N., p. 14–15].

Thus, the main provisions of the Swedish strategy in the Arctic are concentrated in three directions: observation of climate change and environmental protection, sustainable economic activities, improvement of the living conditions of the indigenous population.¹⁵ [14, Antyushina N.M., p. 212]. The program of the Swedish chairmanship of the Arctic Council in 2011–2013 was

¹⁴ Sweden's Strategy for the Arctic region /Government Offices of Sweden. Ministry for Foreign Affairs. Department for Eastern Europe and Central Asia. Arctic Secretariat, Stockholm, Sweden. 2011. 52 p.

¹⁵ Ibid.

built around similar priorities: climate and environment, economic development, human dimension, and international cooperation.

Roadmaps for research activities in the Arctic region have been developed to address the priorities in Sweden. The most important of them is the Swedish National Polar Research Program 2014 and its later variants and the Priority Projects of the Swedish Arctic and Antarctic Research Programs. These documents do not contain specific goals, objectives, priorities, mechanisms for science policy. They occupy a prominent place in research in the natural sciences: studying the biogeochemical parameters of the Arctic Ocean (heavy metals), studying polar ecosystems, climate change trends, glaciers, the morphology of the underwater landscapes of the Arctic Ocean, and monitoring environmental pollution.

The state body responsible for coordinating research activities in the polar areas is the **Swedish Polar Research Secretariat**, which operates under the Ministry of Education and Research. The Secretariat organizes scientific forums on the development of the Arctic, supports research expeditions, manages research infrastructure (satellite information, data obtained from the icebreaker Oden and the station on Svalbard). Together with the research council, the Secretariat provides logistic support competitions (field work) for polar studies (Operational Support for Polar Research).

Even though the research policy of Sweden in the Arctic was formulated recently, the Kingdom achieved success in this direction. Sweden is one of the leaders in polar research due to the articulated priority areas, the presence of a coordinating body and financial support programs. It should be noted that the approaches and results of Arctic studies are used in determining geopolitical aspirations and the innovative technological policy of Sweden. It provides breakthrough solutions for fast financial and organizational support, which leads to progress in research and use of its results in production.

The scientific and educational potential of the Arctic areas of Sweden

In the Arctic, we observe rapid and irreversible transformations. A complete understanding of their prerequisites and consequences have not yet existed. An example of systemic changes is a climate change, which entails a maximum decrease in seasonal sea ice minimums for the past 40 years, an improvement in the conditions for exploration and mining, and the use of transport. The challenges of the Arctic development encouraged Sweden to create research infrastructure in the Extreme North areas, located at the Arctic Circle in the Västerbotten and Norrbotten counties. Both territories have educational and research potential due to the presence of higher scientific and educational institutions and colleges participating in international educational cooperation.

The Umeå University stands out among the universities in Västerbotten. It was opened in 1965 and is a town-forming one: a significant part of the population in Umeå are teachers and students of the university. The university has the faculties of arts, social sciences, science and technology, and a medical faculty. The university has a design institute, a technological institute, an architec-

ture school, a school of business and economics, a pedagogical college, an academy of arts, a school of sports, and a school of the restaurant and culinary arts. Since 2012, the ARCUM (The Arctic Research Center) has been functioning. It unites about 200 researchers. In 2017 over 30 thousand students studied at the university and more than 2000 teachers worked. The University of Umeå concluded about 900 agreements on the international exchange of students and teachers and developed 37 programs in a foreign language.

In Norrbotten, in 1971, the Luleå University of Technology was founded. It got the following institutions: economics, technology, and society, health, arts, communications and education, social and natural resources, computer science and space, engineering and mathematics. The university has about 15,000 students and employs about 1,700 people. The university cooperates closely with companies in the field of mining, metalworking, and nature conservation (e.g., Bosch, Ericsson, Scania, LKAB, and SKF), and leading Swedish and foreign universities. The main areas of research are mining, alternative energy, transport in the North, computer technology, and the environment.

Some more educational and research institutions of Norrbotten:

- Abisko Research Station (founded in 1912); it studies climate change in the High North. The station has repeatedly been the venue for field summer and winter schools for young teachers and employees of four leading universities in the Barents Euro-Arctic Region: UiT, Oulu, Umeå, and NArFU;
- Sami educational center (founded in 1942); It specializes in Sami language and culture studies;
- Svefi Folk School in Haparanda on the Swedish-Finnish border (established in 1973) works for studies related to the culture and art of Northern Europe.

International science and education cooperation in the Arctic region

The fundamental policy principles of international cooperation in science and education in the Arctic region are laid down in the Arctic strategy of Sweden¹⁶. The document notes that research and educational initiatives are essential to the sustainable development of the Arctic. The priority directions of the strategy include the tasks directly related to the international scientific and educational cooperation in the region: the development of knowledge and activities on adaptation and reducing the effects of climate change; improvement and interaction between research resources in the area in favor of the sustainable management and development of the region.

It identifies the need of Sweden for specialists in the mining and sustainable management of natural resources in the North, incl. the attraction of international cooperation resources. The starting points are the network programs of the magistracy "Engineering for Natural Resources" and "Northern Mining School," developed jointly with the University of Oulu and the University of Luleå and suggested the exchange of students and teachers.

A useful tool for the implementation of the Swedish Arctic strategy is the Network University of the Arctic - an international network of educational and research institutions (altogether it

¹⁶ Sweden's Strategy for the Arctic region /Government Offices of Sweden. Ministry for Foreign Affairs. Department for Eastern Europe and Central Asia. Arctic Secretariat, Stockholm, Sweden. 2011. 52 p.

includes more than 200 organizations from 8 Arctic and 11 other states with more than 1 million students), carrying out research and educational activities in the North. The primary objective of the consortium is the production of knowledge and the development of scientific potential for ensuring the sustainable development of the circumpolar region and favorable conditions for the people of the North. The interaction of scientists and students takes place in the framework of expert thematic networks in various fields of science and technology (a total of 33, incl. environmental, energy, geopolitics, management of the northern territories, commercialization of scientific research in the North). Swedish universities and scientific organizations take part in 12 thematic networks. Students and teachers of universities — members of the consortium receive financial support for training, internships, exchanges, participation in field schools and other forms of mobility (e.g., in the framework of the North2North academic mobility program).

The consortium participants provide analytical and expert support to the work of the Arctic Council Working Groups. In particular, this is studies for the monitoring and assessment programs in the Arctic, and support for the International Arctic Scientific Committee on the priority areas for the Arctic research. The Swedish Polar Research Secretariat is working to promote international cooperation, being involved in negotiations along with the Ministry of Foreign Affairs.

The Swedish Research Council finances sizeable international research projects in the Arctic through, e.g., European Incoherent Scatter Scientific Association in Kiruna, the center of the mining industry in Sweden and Northern Europe, located beyond the Arctic Circle. The Foundation for International Cooperation in the Field of Science and Higher Education (STINT) is the state fund for the support of internationalization at Swedish universities. STINT funds are allocated for short-term (up to 12 months) projects aimed at international cooperation of Swedish universities with organizations outside of Europe.

The Swedish Institute (Svenska Institutet, SI) is a governmental department, and its goal is to promote Swedish culture, education, and promote international development. The institute administers several scholarship programs that allow foreign students and researchers to visit Swedish universities for study or research. The Swedish Institute provides scholarships at the University of the Arctic and Swedish universities for Russian students.

Sweden, like other Scandinavian countries, is a part of international cooperation in the Arctic research. A scientific school of polar research, infrastructure, financial support for national and intergovernmental research programs, academic mobility and development of education allows the Kingdom to build effective interaction with many countries active in the Arctic. Sweden is one of the founders of the Arctic Council (founded in 1996 on the initiative of Finland) - a ministerial forum on sustainable development of the Arctic. The Council is an example of international scientific cooperation in the region: working and task groups collaborate with the Ministries of Foreign Affairs, the UN, the EU and others on assessment reports and case studies of socio-economic development in the region. In the Arctic strategy, Sweden stands for the institutional and political strengthening of the Arctic Council through the inclusion of security issues, infrastructure devel-

opment, and socio-economic development in the focus of the Council. Also, Sweden supports the idea of more active involvement of non-regional countries in the Arctic Council activities, primarily Asian countries: China, India, Singapore, and the Republic of Korea. Pan-arctic legally binding documents developed with the participation of Sweden are of great importance: the Agreement on Cooperation in Aviation and Marine Search and Rescue in the Arctic (Greenland, Nuuk, 2011) and the Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic (the 8th ministerial session in Kiruna, 2013). The Secretariat of the Arctic Council's Working Group on Arctic Pollution Management (Arctic contaminants Action program, ACAP)¹⁷ is in Sweden.

Sweden is one of the founders of **the BEAC** (founded in 1993 on the initiative of Norway) — a regional association aimed at promotion of the sustainable development of the North Europe, bilateral and multilateral cooperation in economy, transport, infrastructure, trade, environment, science, education, cultural exchange, and tourism, and projects that contribute the improvement of the indigenous people's life and culture. In 2017–2019, Sweden was the chairman of the BEAC. The priorities of the chairmanship are in the program Regional Sustainable Development for the Future based on the UN Agenda 2030 sustainable development goals SDG 13 (Climate Change) and SDG 15 (Life on land) and provisions of the Paris Climate Agreement. In the environmental protection, the objectives of the program include eliminating “hot spots” of the environmental pollution in the Far North of Europe, developing network strategies for cooperation in climate change, preserving biodiversity and ecosystems through knowledge sharing and transboundary cooperation, sustainable forest management and cooperation in border water management. In economic development, the program prioritizes the development of innovations, “green technologies,” infrastructure and logistics for border cooperation, integration between universities, academic institutions and business in the Barents region. Work in these areas should be done by the UN Sustainable Development Goals: SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities) and SDG 12 (Responsible Production and Consumption).

The priorities are defined in the field of prevention and emergency response. Sweden is to adopt joint regional rescue drills for Barents rescue exercise in 2019 and to continue to work according to the Joint Regional Transport Plan and the development of sustainable tourism in the region. The priorities of the social policy are youth, culture, health, education, science, development of mobility and academic exchange, and indigenous representation. The social policy reflects the objectives of the UN Agenda: SDG 3 (Health and Well-being), SDG 4 (Gender Equality) and SDG7 (Partnerships). In 2013, the Barents Program 2014–2018 was approved in Kirkenes. The following cooperation priorities were fixed:

- supporting the development of entrepreneurship;
- expansion of cross-border cooperation, development of transport infrastructure and mobility;
- implementation of the Action Plan for the Prevention of Negative Impacts of Climate Change;

¹⁷ About ACAP. URL: <https://www.arctic-council.org/index.php/en/acap-home> (Accessed: 26 September 2018).

- support co-management and conservation of natural resources;
- cooperation in culture.

Sweden is one of the founders of **the Nordic Council of Ministers** (established in 1971, NCM), established to coordinate collaboration between the Nordic countries. A practical embodiment of the participation of Sweden in the work of the NCM is seen in the organization of Nordforsk, whose goal is the financing and development of scientific cooperation between the Nordic countries. The NCM implements programs aimed at strengthening scientific cooperation on Arctic issues. The aim of the Arctic Cooperation Program (The Nordic Council of Ministers' Arctic Cooperation Programme)¹⁸ is support for the sustainable development of the region in priority areas: peoples, sustainable economic development, the environment, nature and climate, education and advanced competences. Nordforsk also funds the Nordic cooperation program with Russia (the Nordic-Russian Cooperation Programme)¹⁹, aimed at supporting academic mobility, network cooperation, and joint educational programs (courses). The Nordic cooperation supports educational activities (projects, and academic mobility) through the Nordplus program.

Following the Arctic Strategy and the EU policy, Sweden supports the EU in the Arctic cooperation projects through **the Northern Dimension** policy. The Swedish Council for Higher Education is the national center for European programs EURAXESS and Erasmus +, supporting mobility in education, youth and sports. The University of Malmö and the University of Lund are members of the Northern Dimension Institute, which is network university and research institute that brings together experts in the Northern Dimension priority programs (partnerships): energy, health, logistics, culture, and higher education.

Conclusion

The Nordic countries stand out for the development and use of innovative technologies in all sectors of the economy and non-production sphere. They occupy leading positions in global rankings of innovation and competitiveness. Development models of the North European states are dominated by the rule of law, sustainable development, openness, stability, equality, collective responsibility, and active social movements. An essential prerequisite for the transition to an innovative type of development has become a change in the state economic policy. In the early 1990s, it was reflected by the decline in the share of primary industries in GDP, in the sphere of international specialization, in the transition to the provision of services based on high technologies and informatization. A qualitative difference between the North European states and Russia was relevant that time. The Arctic innovation policy in the Russian Federation, with rare exceptions, was developed in similar

¹⁸ Sovet ministrov severnyh stran [The Nordic Council of Ministers]. URL:<http://www.norden.org/en/nordic-council-of-ministers/ministers-for-co-operation-mr-sam/the-arctic/the-nordic-council-of-ministers-arctic-co-operation-programme-2015-2017> (Accessed: 26 September 2018). [In Russian]

¹⁹ Sotrudnichestvo severnyh stran i Rossii. [The Nordic-Russian cooperation]. URL: <http://siu.no/eng/Programme-information/Nordic-Russian-cooperation> (Accessed: 26 September 2018). [In Russian]

geographic conditions, but it demonstrates a lag in the ratings of innovation activity [15, Zaikov K.S., Kalinina M.R., Kondratov N.A., Tamickiy A.M., p. 60].

Over the past 50 years, the state in collaboration with private companies in Sweden has created a system of R&D support and innovation. It contributed to a high level of socio-economic and environmental development of the country and North Europe. The strategy of innovation development and the choice of institutions for its implementation depend on labor resources, government regulation measures, geographical location, world markets of goods and services and Sweden's positions there. The success of the innovation policy is seen in active connection with the real sector of the economy. Also, it directly dependent on the R&D carried out by companies, clusters (incl. those with international participation) and universities. Transferring the Swedish innovation experience to Russia cannot be resolved unequivocally.

On the one hand, it is essential to consider similar geographical and climatic conditions, resource potential, population, sectoral and territorial economic systems of the northern areas of Europe and Russia. On the other hand, the mechanical transfer of the most progressive foreign experience is ineffective. Intensive cooperation of Russian and the North European countries contributed to the rational use of natural resources, expanding and modernizing the infrastructure, intensifying industrial and investment cooperation, and acquiring new competencies. It seems to be more beneficial for the economy of our country to get foreign trade expansion in the domestic market of the Russian Federation. Under creating macroeconomic prerequisites (incl., strengthening investment processes, preventing capital flight abroad, simplification of administrative issues), this will help support the economic development of our state.

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