Innovation development of the North-Western Federal District

T G Popadyuk*, N K Popadyuk1, I A Rozhdestvenskaya1 and O V Panina1

1Financial University under the Government of the Russian Federation, 49 Leningradsky Avenue, Moscow, 125993, Russia

E-mail: TPopadyuk@fa.ru

Abstract. The aim of the study is to investigate and analyse the different aspects of the innovation development of the North-Western Federal District (the Russian Federation). The concepts of innovations, innovation development, innovative economy, knowledge-based economy, state innovation system, innovation ecosystem and regional innovation development have been defined. Also, author’s definition of the innovative development of a region was proposed. Documents regulating the innovation strategy and innovation policy of the North-Western Federal District have been analysed. The justification of the undertaken topic comes from the need for defining strong areas of the innovation potential of the North-Western Federal District and requirement for consideration of the regional innovation system elements of the North-Western Federal District such as knowledge-producing environment, knowledge transfer mechanisms, business environment and state, and its innovation infrastructure. The methodology of the study involves studying of the theoretical framework of the innovations, quantitative and qualitative indicators of the innovation development of the North-Western Federal District, and analysis and synthesis of these data. The main results of the study are: innovative development of the region correlates with the general direction of the country’s innovative development; the regional innovation system includes the same macroblocks as the national innovation system does; the North-Western region includes the well-developed innovation infrastructure and all elements of the innovation system. Conclusions on the direction of the innovation development of the North-Western Federal District towards the world’s advanced countries with innovative economy or economy of knowledge as well as on the role of the innovation factor in the regional development have been drawn.

1. Introduction

In the modern world, the role of innovation cannot be underestimated since it is innovations that have recently become the locomotive of competitiveness of the advanced countries of the world as they ensure safety, boost the standard of living of population, and are one of the key elements of the most progressive present-day economic systems – innovative and knowledge-based economy.

The innovative development of any country, region or city is based on the concept of innovation, which can look both as a process and as a phenomenon. In the study on investments and innovations [1], the concepts of innovations, novelties, and novation, are often identified but there are certain differences among them. Innovations are a set of technical, commercial and production activities that contribute to the appearance of new improved processes and equipment on the market as well as to the development of the best technologies and products and if the innovation is aimed at economic benefits, its appearance on the market may lead to additional income. So, to author’s mind, it is the most
comprehensive definition of the concept of innovation. The innovations can be represented in the form of a product, service, technology, production method, and business model, new market, i.e., in everything new that can provide qualitative changes in the economy and in conditions of life [2]. Obviously, it is a pretty all-round concept. The most complete definition of the innovative development is as follows: “Innovative development is a systemic and structural approach to the entire scope of innovative processes and their interaction based on the innovations, innovative products (innovative production), and innovative form of services (management, promotion and use of innovative product) [3]. This approach determines the development of the economy.

The innovative (intellectual) economy is a type of economy that is based on the flow of innovation, continuous improvement of the technologies as well as the production and export of high-tech products with very high added value and the cost of technologies themselves. It is the information sphere, the intelligence of scientists and innovators, but not material production or concentration of finance that create the profit [4]. Obviously, this type of economy needs highly-educated workers.

Famous scientists like Daniel Bell [5], Alvin Toffler [6], Francis Fukuyama [7], John Naisbitt [8], etc. believe that it is the innovative economy that provides the majority of developed countries in the present-day world with the world economic superiority.

The concept of the “innovation system” first proposed by Danish economist Bengt-Åke Lundvall is also based on this element which formulated the concept as follows: “An innovation system is the set of elements and connections between them that interact in the process of production, distribution, and use of economically useful (economically demanded) knowledge” [9]. Moreover, these elements must be located within national borders [10].

So, obviously, that problem of innovative development is gleaned by many scientists. The author has chosen definitions of the above-stated researches, because they are ones of the first scientists who studied innovations, besides, their definitions are the most comprehensive and up-to-date.

Today, countries with the innovative economy and a developed venture business (the most important element of an innovative economy) are the United States, Japan, Germany, Finland, Australia, Canada, Sweden, Israel, Singapore, etc. Besides, “the last fifteen or so years we have seen an apparent increase in the pace of technological innovation in modern industrial firms throughout much of the world” [11].

The knowledge-driven economy is the highest stage in the development of an innovative economy and a post-industrial economy characterized by a knowledge society or an information society. In fact, this is the next stage of a large development of the economy and society of the advanced countries of the world [12, 13].

Under the knowledge-driven economy, the main factors of production are knowledge and human capital. The process of its development is based on improving the living standard and human capital, as well as the production of knowledge, innovations, high technologies and high-quality services.

The knowledge-driven economy is mainly characteristic of the most developed countries of the world, such as the USA, Japan, Germany, the Republic of Korea, and the United Kingdom. It can be argued that the transition from the industrial economy to the knowledge-driven economy today is being carried out by the United States, Germany and Japan, while the United Kingdom and the Republic of Korea have already completed it.

It should be noted that neither the innovation economy nor the knowledge-driven economy, which all countries are eager to put at the forefront of the development of the world economy, cannot be imagined without such an element as knowledge.

The aim of the study is to investigate and analyze the different aspects of the innovation development of economy the North-Western Federal District (the Russian Federation).

The justification of the study comes from the fact the innovations are one of the key factors of the competitiveness of country as a whole and regions in particular. Today there are a lot of studies concerning innovation development of countries but innovation development of regions is not studied at a satisfactory level. That is why the following study is up-to-date.
Practical and theoretical significance of the study comes down to the comprehensive analysis of the innovative infrastructure of the North-Western region.

2. Materials and methods
The information base of the study was the works of Russian and foreign authors, articles, publications, notes on innovation and innovative management, normative and legal acts, including software-targeted ones. The methodology of the study involves studying the theoretical framework of the innovations, quantitative and qualitative indicators of the innovation development of the North-Western Federal District. The methodology of the study comes down to: analysis of educational and scientific literature on the topic, analysis and synthesis of quantitative and qualitative data, comparative analysis of theoretical findings. Stages of the study involved: selection of the theoretical sources, analysis of the theoretical sources, selection of the statistical data, analysis of the statistical data, making conclusions.

3. Results

3.1. National innovation system
In 1995, Stanley Metcalf proposed the concept of the “national innovation system” which is defined as a set of different institutions, jointly or separately contributing to the development and transfer of technologies, as well as developing a paradigm in which the state forms a policy of influence on the innovation process, or it is a system of various interrelated institutions that produce, transmit, and store the knowledge, skills and products, created and used in the process of developing new technologies.

The national innovation system is created jointly by the state (through legislation implementing a certain macroeconomic policy), the scientific sphere (basic research, training of research personnel), and the business environment (technology commercialization, applied research, production and marketing of innovative products). Consequently, the state innovation system consists of four subsystems (macroblocks) which are the state, the entrepreneurial environment, knowledge-producing environment, and knowledge transfer mechanisms.

The process of analyzing each subsystem allows singling out its structural components. Besides, the structure of the state innovation system often includes the so-called meta-institutions (legislation, culture, history and customs of the country) and the market in a broad sense which creates the conditions and resources for the production of knowledge and innovation (capital and labor markets) and develops the demand for new products and, consequently, for innovation.

The theory of the national innovation system has served as the basis for the present-day model of the innovation development of the economy which is described by the relatively young concept of the innovation ecosystem proposed in 2004 by Charles Wessner: “The innovation ecosystem is the environment produced by the participants in the innovation process in which they interact in order to create and develop innovation”.

The innovation process in the concept of an innovation ecosystem consists of such stages as fundamental research, applied research, development, and commercialization, each of which implies feedback that ensures the internal development of the link and the system as a whole.

The main properties of the innovation ecosystem are a high level of self-organization, mutual assistance and cooperation of participants regardless of their capabilities and status, decentralized decision-making, adaptability (ability to adapt to the changing external environment), coevolution (mutual development of subjects in the process of their interaction), and emergence (the integrity of the system, when its elements are not taken separately).

The impact of new technologies on firms and workers is fundamentally a global phenomenon that operates in a similar manner in different countries. In developed countries operating in the innovation economy or transitioning to the knowledge-driven economy, the development of the innovation ecosystem may result from the introduction of an innovation strategy of a state defined as a set of rules and regulations determining the procedure for changing the system of selection and implementation of innovations in technologies and its management development focus. The main task of the innovation
strategy is to maximize the harmonization of interests of the participants in the innovation process and multidirectional processes.

Besides, countries with an innovative economy type (or aspiring to become innovative economies) exercise the development of special economic zones, co-workings, business incubators, technology parks, technopoles, industrial parks, and silicon valleys, i.e. the objects that create the innovation infrastructure of a particular country (region, city) to carry out activities in the field of high technologies. Thus, technological innovation and organizational innovation do seem to be followed by increases in productivity in most countries, although there are some exceptions, partly due to a lagged response and the difficulty of measuring productivity in a world with rapid technical change.

3.2. Features of innovative development of the region

When transferring from the innovative development of the country to the innovative development of the region, it should be noted that the innovative development of the region differs from that of the country only territorially since it is very closely connected with the first, caused by it, and fits into the general direction of innovative development of the country. Besides, the state includes the development of regions in an innovation development strategy when creating it.

The region operates within the framework of both the national and regional innovation systems, existing in a given country and region. Similar to a national innovation system, a regional innovation system is developed by the state, scientific sphere and business environment, and includes such macroblocks as the state, business environment, knowledge-producing environment, and knowledge transfer mechanisms.

Thus, the following definition of innovative development of a region can be proposed: the innovative development of a region is a regional development strategy determined by the implementation of a systemic and structural approach to the entire scope of innovative processes organized as an integer stream and to their interaction based on innovations and innovative products; it is also an innovative form of services, which is a functionally determined intra-national division of labor, an element of innovative development of a state and it correlates with its innovation strategy, exists within the framework of the national innovation system, and is implemented through various objects of innovation infrastructure.

In other words, the innovative development of a region is a socio-economic process aimed at creating an innovation system in the region taking into account its place in the intra-national division of labor. As it was mentioned above, the regional innovation system has a certain infrastructure, including industrial enterprises, educational and research institutions, financial organizations, special economic zones, leasing, consulting, and engineering companies, business incubators, etc. Such a complex has the ability to increase the scientific and technological potential of the territory and implements it through the development knowledge-intensive industries which utilize high technologies.

The dependence on the place of labor division is due to the fact that despite the correlation of the innovative development of regions with the paradigm of the innovation strategy of the state, each of them has its own specific features in implementation and this determines the difference in regional policies in this area. The choice of a model of innovative development of a region is determined by the economic, cultural, scientific, and technical features of a given territory. Besides, in most industrial economies, the motivation behind the decision to innovate is more directly related to the expected effects on the profitability and productivity of the innovating firm.

3.3. Innovative development of the North-Western region

At present the regions, i.e. subjects of the Russian Federation, are solving the following tasks: 1) to form and develop infrastructure for inventive, innovative, and research activities; 2) to direct efforts and resources to the implementation of priority innovative projects of organizations and enterprises of the region; 3) to develop an attractive environment for investing in innovations; 4) to create a system of training and advanced training of personnel working in scientific and technical entrepreneurship in
order to increase activity in the field of creation and implementation of innovations as well as commercialization of the results of scientific research.

It may be said that the North-Western region, as adjusted for its specifics, follows a similar line of behavior in the field of innovative development. Documents regulating the innovation development of the North-Western region include the “Development Strategy of the Science-Education-Innovation Complex of the North-Western Federal District of Russia until 2030” and the “Comprehensive Scientific and Technical Program of the North-West Federal District of the Russian Federation until 2030 (2010-2011)”. These documents outline the strategic priorities of innovation and scientific and technological development of the North-Western Federal District as a whole and all the constituent entities of the Russian Federation located within its borders, and determine the basis for the development and implementation of the regional socio-economic policy.

“Development Strategy of the Science-Education-Innovation Complex of the North-Western Federal District of Russia until 2030” includes the following priority areas of research and development (figure 1):

1. deep processing of natural resources;
2. alternative energy sources;
3. the study of a human and a society;
4. environmental safety;
5. marine technology;
6. information technology;
7. the production of nanomaterials;
8. renewal of the energy complex of the Northwest of Russia;
9. new geotechnologies, technologies and materials for the development and production of gas on the Barents Sea shelf;
10. composite materials for turbines, nuclear and hydrogen energy;
11. development and creation of technologies, information technology base and automated systems for managing the production of milk and cattle meat in the conditions of the North-West of the Russian Federation

Figure 1. Priorate areas of research and development identified in the “Development Strategy of the Science-Education-Innovation Complex of the North-Western Federal District of Russia until 2030”.
Source: it is made by the author.

The comprehensive scientific and technical program of the North-Western Federal District of the Russian Federation until 2030 aims to develop the scientific and technological potential of the district in order to implement the priority directions of development of science and technology as well as the transition of subjects of the Russian Federation located in the territory of the North-Western Federal District to the innovative development path.

The projects of this program are grouped into two blocks (Figure 2). The first block correlates with the following priority areas of economic development in the Russian Federation. These areas, according to the government, are the key for Russia to reach a new technological level. The second block projects are intended to complement priority areas that are particularly important for the North-Western Federal District. It should be underlined that both programs are incorporated into the
‘Strategy for Socio-Economic Development of the North-Western Federal District up to 2020’ developed at the end of 2010.

| First block | Second block |
|-------------|--------------|
| 1) energy efficiency and energy saving; | 1) the development of the shipbuilding industry; |
| 2) nuclear technology; | 2) the development and implementation of new materials including nanomaterials; |
| 3) space technologies associated with telecommunications; | 3) development and application of new technologies; |
| 4) medical technology; | 4) ecological safety of the macro-region; |
| 5) strategic information technology. | 5) the study of a human and a society; |
| | 6) development and application of industrial complex technologies. |

**Figure 2.** Structure of projects of the Comprehensive scientific and technical program of the North-Western Federal District of the Russian Federation until 2030. Source: it is made by the author.

It should be noted that the North-Western Federal District is a territory in the north of the European part of Russia which includes 11 constituent entities of the Russian Federation. It officially exists since 2000 and consists of a city of the federal significance, St. Petersburg, seven regions, two republics, and one autonomous region. This region enjoys a powerful scientific and technical potential, innovative production specifics, and substantial competitive advantages in comparison with other macro-regions of Russia.

In this study, it is necessary to consider the elements of the regional innovation system of the North-Western region (knowledge-producing environment and knowledge transfer mechanisms, the business environment and the state) as well as highlight its strengths that contribute to the innovative development.

The concerned knowledge-producing environment includes scientific institutions belonging to the three regional scientific centers of the Russian Academy of Sciences (St. Petersburg Scientific Center of Sciences, Kola Science Center, Karelian Research Center, a number of institutions that are a part of the Komi Scientific Center of the Ural Branch of the Russian Academy of Sciences, and the remaining centers of the former Institute of Socio-Economic Development of Territories of the Russian Academy of Sciences. At the same time, the main research potential is concentrated in the institutions of the St. Petersburg Scientific Center of the Russian Academy of Sciences. It consists of over 60 institutions, organizations, and enterprises of all specialized branches of the Russian Academy of Sciences with a total staff of about 13,200 people.

The Karelian Research Center of the Russian Academy of Sciences includes 7 institutes and the Kola Science Center of the Russian Academy of Sciences unites 10 institutes and 2 centers (the Institute of the Physical-Technical Problems of the North and the Center for Humanitarian Problems of the Barents Region). The scientific institutions of the Komi Scientific Center of the Ural Branch of the Russian Academy of Sciences constitute 6 institutes.
The North-Western region is very successful in the area of the knowledge transfer mechanisms because it includes the city of St. Petersburg, traditionally considered the educational center of the whole country. According to some estimates, there are 100 higher educational institutions in St. Petersburg, employing about 22,000 professors and teachers, and this is about 10% of the total faculty members of Russia. Secondary education is not far behind: there are about 800 schools, lyceums, and gymnasiums in the city. The Komi Republic, which is a part of the North-West region, has three higher educational institutions and nine branches of higher educational institutions. The possibilities of managing an innovative economy within the framework of a large urban agglomeration, which is the Petersburg urban with the Leningrad Region, have not been properly implemented to date, although it has the potential of accelerated growth.

Let us discuss the connection between the state and the business environment in the North-Western region. The latter, in fact, is derived from the business environment of the country as a whole and reflects the economic, political, civil, and legal conditions that provide economic freedom to citizens to do business aimed at meeting the needs of all subjects of a market economy. In Russia, this is guaranteed by various articles of the Constitution of the Russian Federation through the unity of the economic space, free movement of goods, services and financial resources, and support for competition and freedom of economic activities.

Thus, if the knowledge-producing environment, the knowledge transfer mechanisms and the business environment form the innovation system, the region’s innovation infrastructure can be considered as a reflection, result, and environment of innovation development.

4. Discussion
Summing up, the results of the study are as follows:

1) The North-Western region enjoys the well-developed innovation infrastructure and all elements of the innovation system, with the highest level of development being in the city of St. Petersburg as the center of innovation development of the North-Western region. It is worth mentioning that the objects of innovation infrastructure of the North-Western region are concentrated mainly in St. Petersburg. They can be divided into the following categories:

- investment funds;
- business incubators;
- innovative educational structures;
- fablabs (fabrication laboratories);
- co-workings;
- technology platforms;
- prototyping centers;
- cluster development centers;
- technology and industrial parks;
- certification centers;
- regional development institutions;
- centers of collective use;
- territorial (innovative) clusters;
- engineering centers;
- technology transfer centers;
- consulting organizations;
- industrial areas;
- special economic zone.

To date, the total area of office space is 266,492 square meters, production space is 2,211,187 square meters, and the laboratory areas cover 13,671 square meters. In general, the innovation infrastructure of St. Petersburg as an element of the innovation structure of the North-Western region can be characterized as highly developed and providing many opportunities for the region’s innovative development.
2) Innovative development of the region correlates with the general direction of the country’s innovative development and is based on the country’s innovative strategy and innovative policy of the region.

3) The regional innovation system includes the same macroblocks as the national innovation system does (the knowledge-producing environment and knowledge transfer mechanisms, the business environment and the state).

4) Innovative development of a region is a strategy for the development of a region determined by the results of a systematic and structural approach to the entire scope of innovative processes and their interaction based on innovations, innovative products, and an innovative form of services that is part of the state’s innovative development and correlates with the innovation strategy as a result of the intra-national division of labor, as well as exists within the framework of the national innovation system and is implemented through various objects of the innovative infrastructure.

5) Documents regulating the innovation development of the North-Western region are the “Development Strategy of the Science-Education-Innovation Complex of the North-Western Federal District of Russia until 2030” and the “Integrated Scientific and Technical Program of the North-Western Federal District of the Russian Federation until 2030”. Both programs are incorporated into the “Strategy for Socio-Economic Development of the North-Western Federal District until 2020”, developed at the end of 2010 and include a number of development trends correlating with the strengths of the region.

Thus, results correlate with theoretical and empirical findings. The main and particular value of innovations is that they are the key driving force and the basis for the successful economic development of the state and its regions.

In addition, innovations are valuable because they determine the state’s competitiveness on the world market, and this has a positive effect on the state’s individual regions and areas, and contributes to the economic growth and is a necessary condition for a comfortable and safe life for people. It can be proved empirically. For example, Blanchflower and Burgess examined the impact of the introduction of new technology on employment growth and profitability in Britain and Australia in the 1990s and found some evidence that the introduction of a new technology is associated with a higher employment growth, at least in larger establishments. They found out that the introduction of a new technology is followed by employment growth for both manual and non-manual workers in British establishments by about 3 percent per annum. And this, in its turn, increases the living standard of people.

The idea of the need for the innovative development of the state has been topical for the researchers for over 100 years, and is still relevant. Moreover, it obtains increasingly more importance every year due to the spontaneous development of new technologies, especially if the activities of the advanced countries of the world in the innovation economy and their transition to a knowledge-driven economy are considered.

5. Summary
Innovations are one of the key factors of a developed economy that can provide leadership in the global market by increasing competitiveness. In order to continue the successful innovation development of Russia in general and the North-Western region in particular, both should adopt the experience of advanced countries and move towards an innovation economy, the first step towards which can be an emphasis on the strengths of the macro-region, a course on priority sectors, further investment and development of innovation infrastructure, especially in less developed areas of the region, as well as the transition of the state and the region to the innovative path of development.

6. References
[1] Zarayskaya S V 2009 Investments in Innovation. Collection of scientific articles «Socio-economic state of Russia: ways to overcome the crisis» Institute of Business and Law St. Petersburg. http://www.ibl.ru/konf/140509/35.html (date of the address: 21.05.2020)
[2] Makarov S 2014 What innovation is and why the state needs it. Review: ICT in the public sector http://www.cnews.ru/reviews/ikt_v_gossektore_2014/articles/chto_takoe_innovatsii_i_zachem_oni_nuzhny_gosudarstvu (date of the address: 18.05.2020)

[3] Zabolotko A A 2013 Innovative economic development: concept, problems and solutions (State and municipal administration. Scientists Notes) 1 192-196

[4] Fukuyama F 1999 The Great Disruption: Human Nature and the Reconstitution of Social Order. Free Press New York

[5] Bell D 1973 The Coming of Post-Industrial Society: A Venture in Social Forecasting Basic Books New York

[6] Toffler A 1980 The third wave: The classic study of tomorrow Morrow New York

[7] Fukuyama F 1992 The end of history of the last man Free Press New York

[8] Naisbitt J 1999 High Tech High Touch: Technology and Our Accelerated Search for Meaning Broadway Books New York

[9] What is STEM? STEM Education. Science, Technology, Engineering, Mathematics https://www.robo.house/ru/stem-osvita-copy/ (date of the address: 17.05.2020)

[10] Information and analytical materials on the results of monitoring the activities of educational organizations of higher education in 2015 Komi Republic Ministry of Education and Science of the Russian Federation Department of Public Policy in Higher Education http://indicators.miccedu.ru/monitoring/2015/material.php?type=2&id=10104 (date of the address: 19.05.2020)

[11] Hall B H, Kramarz F 1998 Effects of Technology and Innovation on Firm Performance, Employment and Wages Economics of Innovation and New Technology. Washington

[12] Korchagin Yu A 2009 Human capital and innovative economy of Russia CIRE Voronezh

[13] Poloskov C C 2019 Features and ways to improve innovation activity of high-tech knowledge-intensive enterprises (Modern Economy Success) 2 87-95