# Innovative Potential of Russian Regions: Analysis of Formation of Regional Clusters Connected by Technological Chains

Migunova Galina Stepanovna *[1], Andrei V. Polyanin *[2], Tatyana G. Popadyuk *[3], Svetlana V. Poltoryhina*[4]

[1,2] *Mid-Russian Institute of Management – branch RANEPA, Orel Victory boulevard 5a, Russia,*
[3] *Financial University under the Government of the Russian Federation, Moscow Leningradsky prospect 49, Russia,*
[4] *Kazan Innovative University named after VG Timiryasov (IEML), Kazan Moscow st.42, Russia*

[1]gsmigunova@gmail.com, [2]polyanin.andrei@yandex.ru, [3]tgpopadyuk@fa.ru,
[4]poltoryhina@chl.ieml.ru

***Abstract* - In the conditions of increasing competition in the national markets of goods, labor and capital, the economic priority for the subjects of the Russian Federation is to increase the competitiveness of regional farms. The relevance of the development of theoretical concepts that allow to justify and implement effective forms of territorial organization of the economy and competitive strategies of socio-economic development of regions is growing. The cluster concept is a relatively new approach to the territorial organization of the economic system, focusing on the relationships between firms and the presence of clusters of interrelated industries. The effectiveness of cluster formation in various sectors of the economy is achieved by using the geographical localization of interconnected companies and combining the efforts of business, government and science. As practice has shown, the cluster form of territorial organization of the economy allows increasing labor productivity and production efficiency, reducing transaction costs, and stimulating innovation.**

**Thus, the relevance and practical significance of the chosen research topic is due to the urgent need to determine the potential and justify the directions of cluster development as a form of organization of the economy of Russian regions, adequate to the ongoing changes in the global economy, as well as the imperatives and priorities of implementing an innovative model of economic development of Russian regions in order to strengthen its international competitive positions.**

***Keywords* -** *global supply chain, cluster, innovation potential, innovation, innovative development program, real economy, regional economy.*

## 1. INTRODUCTION

In the conditions of strengthening of globalization the global economic system continuously increases the need for scientific-technical progress as the main factor quality civilizational transformation, which promotes the development of certain territorial areas of the world and identifies strategic directions for continued evolution of innovation [1].

In the last decade, the practice of regional management has seen the intensification of innovation, which is considered as one of the most effective mechanisms to improve the competitiveness of both regions and Russia as a whole.

At present, the basis of the successful development of the economy of the regions of Russia in General and individual industries and industries in particular is a constant innovation [2]. This is due to the growing globalization of the world economy. Innovation refers to the development, research and use of modified manufacturing processes. It is expected to introduce new equipment and methods of organization of production processes. Economists suggest that GDP growth of 50 to 80 percent depends on technological progress and innovation [3].

In the era of globalization, when regions compete with each other, supply chain management plays a very important role. The research issues of forecasting practice in supply chain management are covered in the works of Mamun Habib [4].

Thanks to a comprehensive study of the motives of global supply chains, recommendations for creating innovative clusters to improve the economy of Russian regions are formulated.

The aim of this study is to assess the innovative potential of the regions of Russia on the basis of the analysis of the formation of clusters connected by technological chains.

## 2. METHODOLOGY

It is known that the author of the methodological foundations of the cluster approach in economic activity is the American economist Porter [5]. Under the cluster, he understands a group of geographically adjacent interconnected companies operating in a certain area, characterized by a common activity and complementary to each other. Reflecting the dynamics of changes in the socio-economic system, clusters are formed, expanded, deepened, but can also shrink over time, collapse, collapse. Such dynamism and flexibility of clusters is one of their advantages in comparison with other forms of organization of the economic system. At the heart of the cluster formation process is the exchange of information on needs, techniques and technologies between sectors – buyers, suppliers and related industries [6].

The cluster in the economic literature is defined as an industrial complex formed on the basis of the territorial concentration of networks of specialized suppliers, main producers and consumers connected by the technological chain, and acting as an alternative to the sectoral approach [7].

However, this is not the only approach to the interpretation of this phenomenon. A. A. Migranyan defines the cluster as the concentration of the most effective and interrelated types of economic activities, that is, as a set of interrelated groups of successfully competing firms that form the "Golden section", in the Western interpretation of "diamond" – a diamond of the entire economic system of the state and provide a competitive position in the industry, national and world markets [8].

Although the founder of the cluster approach Porter, this approach to the study of the processes of formation of competitiveness is used in a number of other theories [9]. In particular, E. Leamer, J. Tolenado and D. Soulie considered the necessity of formation of the entities of the cluster type with the purpose of realization of competitive technological, export and other advantages of the companies included in their composition. The difference between their approach and the above is a narrower understanding of the essence of the cluster.

The cluster approach is also typical for Scandinavian economists, primarily Swedish and Finnish, due to the specific structure of the economies of these countries. The Swedish and Finnish economies are characterized by the formation of powerful multi-sectoral cluster formations. An example of such a meta-industrial cluster is the Finnish timber cluster, which combines all economic activities related to forestry, logging and woodworking.

Let us turn to E. Dahmen concept of "development blocks", according to which the basis of competitiveness is the gradual development of economic blocks, or sectors. At the same time, the actively developing sector gives impetus to the development of related industries and sectors, ensuring overall progressive development and the formation of competitive advantages. This approach deserves special attention in the analysis of prospects of formation of the regional economic policy based on the cluster approach as allows to concentrate stimulating influences on the key sectors ("blocks") of the economy possessing potential of development and providing the coupled progress in the contacting spheres of economy.

Also noteworthy are the theoretical developments of V. Feldman, who conducted empirical studies of the processes of formation of cluster education in different countries and paid considerable attention to the problems of ensuring competitiveness on the basis of the cluster approach.

One of the main tasks of the modern Russian economy is the activation of innovative processes, and in the future – the transition to innovative development [10]. In this regard, it is impossible to bypass the issues related to the allocation of innovative clusters as an independent phenomenon. A.A. Migranyan gives the following definition of an innovation cluster: "Innovation cluster, being the most effective form of achieving a high level of competitiveness is an Association of various organizations (industrial companies, research centres, public administration bodies, public organizations, etc.), which allows to use the advantages of the two methods of coordination of the economic system – internal hierarchy and the market mechanism that makes it possible to more quickly and efficiently distribute new knowledge, scientific discoveries and inventions" [11].

Innovation is the driving force of economic development. The study of foreign experience shows that more than 80% of the budget of the developed countries of the world is formed by the transfer of high technologies, while 80% of the revenue of the national budget is made up of raw materials industries. This determines the need to build a qualitatively new innovation system in Russia, based on a set of effective regional scientific and technological infrastructures [12].

The relevance of the development of theoretical and methodological basis for the formation of an effective regional infrastructure for the development of innovative business is justified by the following statements:

- firstly, innovative business in Russia is a priority direction of development of the country's economy and a way of transition from a raw material model to an innovative one. The development of innovative business by expanding the innovation and technological basis contributes to the formation and expansion of markets for innovative products, the growth of competitiveness of the national economy;
- secondly, the enterprises have the greatest degree of motivation to innovative activity and show special flexibility at commercialization of results of scientific and technical activity that defines their significant role in development of priority directions of modernization of domestic science and technology. However, in the early stages of development, such enterprises need special specific support, which must be provided through appropriate infrastructure in the regions [13];
- thirdly, there is an objective need for the introduction of modern mechanisms for managing the elements of innovation infrastructure, based on the specifics of the development of the region, as well as taking into account the stages of the life cycle, industry orientation and the level of competitiveness of innovative goods and services;
- fourthly, the development and implementation of the mechanism of innovative lift, based on the well-orchestrated interaction of the functional elements of the innovative infrastructure of the region to promote early stage innovative firms, will contribute to filling the infrastructure with new objects and build sustainable relationships between them, creating the necessary basis for active development and effective functioning of innovative enterprises.

These circumstances indicate the need to improve the theoretical and methodological aspects of the formation of the regional infrastructure of innovative business.

## 3. RESULTS AND DISCUSSION

The real sector of the economy is a branch of the economy in which intangible and tangible goods and services are produced. It includes not only directly production, but also services, science and trade.

If we consider the innovative structure of the Russian economy, we can see a significant lag of our country from the economic leaders. This can be partly explained by the fact that Russia is still at the level of the fourth way of life, while many developed countries are at the fifth or sixth level. Thus, in developed countries, nano - and biotechnology, molecular technologies and other nanoscale production are already widely used, and we are still at the level of industrial development [14]. Under the technological order, in this case, refers to such a system of production, in which there is a single technical level and

synchronously developing production. Therefore, Russia cannot take a competitive position in the world market. The economic policy of Russia as a whole, and of each of its regions in particular, should be aimed at the innovative development of the real sector of the economy.

Russian regions have a huge resource potential, however, in terms of production, Russia is far behind the developed countries. About 80% of GDP growth in these countries depends on innovative production. In Russia, this figure is 4 times lower.

In the conditions of formation of innovative economy of modern Russia an important task is to build the appropriate infrastructure support. The first elements of the modern innovation system in the form of technology parks and business incubators were formed in the early 1990 [15], and the total number of infrastructure facilities, such as technology parks, engineering centers, business incubators, research organizations, nanotechnology centers is systematically increasing (Table 1).

**Table 1.** Objects of the Russian innovation infrastructure as of the end of 2018

| The object of the innovation infrastructure the | Number of units |
|---|---|
| Research organizations (center) | 4169 |
| Testing laboratories (center) | 1901 |
| Centers for collective use of scientific equipment | 573 |
| Coworking | 321 |
| Laboratory complex | 311 |
| The centers of prototyping | 161 |
| Business incubator | 82 |
| Regional business support centers | 78 |
| Centers of youth innovative creativity | 72 |
| Engineering center | 68 |
| Technoparks | 63 |
| State research center | 45 |
| Accelerators | 39 |
| Science and technology centers | 33 |
| Children's technoparks | 25 |
| International scientific and technical organizations | 18 |
| Science city | 13 |
| Nanotechnology centers | 13 |
| The centers of development of territories | 2 |
| Innovation center | 1 |
| Science and technology valley | 1 |
| Innovation and production centers | 1 |
| Regional development institutions | 1 |

The issue of determining the targets of competitiveness should be addressed in line with the concept of sustainable development of the regional system, which involves the simultaneous coordinated change of social and economic subsystems. In this regard, we have carried out a multidimensional classification of the main financial, socio-economic, production and territorial indicators of competitiveness of the regions of the Central Federal District (CFA) in order to compare the positions of the Oryol region with other subjects of this macroregion and substantiate the directions of increasing its competitiveness (Table 2).

**Table 2.** Classifier and codifier of key indicators of regional competitiveness in cluster analysis models

| Indicator | Designation of indicator - variable |
|---|---|
| **1. Financial and economic indicators** | |
| Revenues of consolidated budgets of the subjects of the Russian Federation, mln. rub. | X3 |
| Expenses of consolidated budgets of subjects of the Russian Federation, mln. rub. | X2 |
| Average per capita cash income (per month), rub. | X31 |
| Average per capita cash expenses (per month ), rub. | X32 |
| Net financial result, mln. rub. | X34 |
| Gross regional product per capita, rub. | X18 |
| Consumer price index, % | X1 |
| **2. Socio-demographic indicators** | |
| Population, thousand people | X36 |
| Population density, people per 1kV.km | X25 |
| Natural population growth rates (per 1000 population) | X23 |
| Number of registered unemployed (thousand people) | X22 |
| The share of population with monetary income below the regional subsistence level (%of the total population of the region) | X21 |
| Number of higher education institutions | X20 |
| Number of hospital beds per 10000 population | X19 |
| The proportion of the urban population in the total population (%) | X35 |
| **3. Production figures** | |
| The cost of agricultural products, million rubles. | X11 |
| Production of livestock and poultry for slaughter( in slaughter weight), thousand tons | X10 |
| Milk production, thousand tons. | X9 |
| The amount of work performed by the type of activity "construction", mln. rub. | X8 |
| Indices of industrial production (in % to 2017) | X12 |
| Production and distribution of electricity, gas and water, mln. rub. | X13 |
| The volume of shipped goods of own production, performed works and services on their own, mln. rub. | X14 |
| Investments in fixed capital of small enterprises (mln. rub.) | X15 |
| Number of small enterprises, ths. | X16 |
| Number of enterprises and organizations, ths. | X17 |
| Investments in fixed capital of large and medium-sized enterprises, mln. rub. | X5 |
| Indices of physical volume of investments in fixed capital (in % to 2017) | X4 |
| Retail trade turnover, mln. rub. | X7 |

| | |
|---|---|
| The wholesale trade turnover, mln. rub. | X6 |
| Indices of physical volume of investments in fixed assets in full circle (in % to 2017) | X4 |
| Territory, thousand km | X24 |
| Commissioning of the housing stock, thousand sq. m. | X26 |
| Number of cities | X27 |
| The volume of paid services to the population | X28 |
| Production of processing industries, mln. rub. | X29 |
| The population employed in the economy, thousand people. | X30 |
| Fixed assets at residual value, billion rubles | X33 |

Calculations are made on the basis of materials of the Federal State Statistics Service of the Russian Federation [16].

In accordance with the calculated values of six financial and economic indicators, we have formed three clusters of regions of the Central Federal district with a clearly distinguishable difference between the centroid values of these indicators (Table 3, 4).

**Table 3.** Cluster analysis of financial and economic indicators of competitiveness of the Central Federal district

| **Centroid values of indicators (variables) in the cluster** | **Cluster** | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| | **Number of elements cluster (regions)** | | |
| | 3 | 4 | 10 |
| **X3** | 25819,7 | 87334,5 | 23834,1 |
| **X2** | 25749,7 | 93655 | 23898,3 |
| **X31** | 8324 | 10848 | 7882,9 |
| **X32** | 7658,7 | 9922 | 7458,6 |
| **X18** | 87708 | 134681 | 73008,6 |
| **X1** | 116,1 | 113,2 | 113,4 |

The group of conditionally best by the calculated values of financial and economic indicators is formed by four regions, ten regions that make the most part of the district, belong to the group of conditionally worst, including the Oryol region and three regions, make the group of average regions.

**Table 4.** Distribution of regions of the Central Federal district by clusters (based on the values of financial and economic indicators)

| **Region number** | **The cluster number** | **Region** |
|---|---|---|
| 1 | 1 | Kursk region |
| 2 | 2 | Belgorod region |
| 3 | 3 | Bryansk region |
| 4 | 3 | Vladimir region |
| 5 | 3 | Voronezh region |
| 6 | 3 | Ivanovo region |
| 7 | 3 | Kaluga region |
| 8 | 3 | Kostroma region |
| 9 | 2 | Lipetsk region |
| 10 | 2 | Moscow region |
| 11 | 3 | Oryol region |
| 12 | 1 | Ryazan region |
| 13 | 3 | Smolensk region |
| 14 | 3 | Tambov region |
| 15 | 3 | Tver region |
| 16 | 1 | Tula region |
| 17 | 2 | Yaroslavl region |

The regions of the Central Federal district form two well-defined clusters in the space of variables representing socio-demographic indicators of competitiveness (Table 5, 6). The first cluster includes ten conditionally best regions in these parameters, which include the Oryol region.

**Table 5.** Cluster analysis of socio-demographic indicators of competitiveness of the Central Federal district

| **Centroid values of indicators (variables) in the cluster** | **Cluster** | |
|---|---|---|
| | 1 | 2 |
| | **Number of cluster members (regions)** | |
| | 10 | 7 |
| **X36** | 1221 | 2067 |
| **X25** | 35 | 56 |
| **X23** | 2,1 | 1,5 |
| **X22** | 2,3 | 10,7 |
| **X21** | 15,9 | 17,6 |
| **X20** | 48,9 | 41,5 |
| **X19** | 117,2 | 114,5 |
| **X35** | 65,7 | 78,7 |

**Table 6.** Distribution of the Central Federal district regions by clusters (based on the values of socio-demographic indicators)

| **Region number** | **The cluster number** | **Region** |
|---|---|---|
| 1 | 1 | Kursk region |
| 2 | 1 | Belgorod region |
| 3 | 1 | Bryansk region |
| 4 | 2 | Vladimir region |
| 5 | 1 | Voronezh region |
| 6 | 2 | Ivanovo region |
| 7 | 2 | Kaluga region |
| 8 | 1 | Kostroma region |
| 9 | 1 | Lipetsk region |
| 10 | 2 | Moscow region |
| 11 | 1 | Oryol region |
| 12 | 1 | Ryazan region |
| 13 | 1 | Smolensk region |
| 14 | 1 | Tambov region |
| 15 | 2 | Tver region |
| 16 | 2 | Tula region |
| 17 | 2 | Yaroslavl region |

According to the cluster analysis, the regions of the Central Federal district form three groups with clearly distinguishable deviations of centroid values of a subset of variables expressing production indicators (Table 7, 8).

**Table 7.** Cluster analysis of production indicators of the Central Federal district

| Centroid values of indicators (variables) in the cluster | Cluster | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| | Number of elements cluster (regions) | | |
| | 10 | 1 | 6 |
| **X11** | 25819,7 | 87334,5 | 23834,1 |
| **X28** | 25749,7 | 93655 | 23898,3 |
| **X5** | 8324 | 10848 | 7882,9 |
| **X8** | 7658,7 | 9922 | 7458,6 |
| **X12** | 87708 | 134681 | 73008 |
| **X13** | 116,1 | 113,2 | 113,4 |
| **X14** | 25819 | 87334 | 23834 |
| **X15** | 25749 | 93655 | 23898 |
| **X16** | 8324 | 10848 | 7882,9 |
| **X17** | 7658,7 | 9922 | 7458,6 |

**Table 8.** Distribution of regions of the Central Federal district by clusters (based on the values of production indicators)

| Region number | The cluster number | Region |
|---|---|---|
| 1 | 1 | Kursk region |
| 2 | 1 | Belgorod region |
| 3 | 3 | Bryansk region |
| 4 | 3 | Vladimir region |
| 5 | 1 | Voronezh region |
| 6 | 1 | Ivanovo region |
| 7 | 3 | Kaluga region |
| 8 | 1 | Kostroma region |
| 9 | 1 | Lipetsk region |
| 10 | 2 | Moscow region |
| 11 | 3 | Oryol region |
| 12 | 1 | Ryazan region |
| 13 | 3 | Smolensk region |
| 14 | 3 | Tambov region |
| 15 | 1 | Tver region |
| 16 | 1 | Tula region |
| 17 | 1 | Yaroslavl region |

According to the results of a comprehensive three-stage cluster analysis of seventeen subjects of the Central Federal district on selected subsets of financial, economic, socio-demographic and production indicators, Oryol region belongs to the group of medium-level competitiveness of regional regions that form the territorial and economic center of the Russian Federation.

## 4. CONCLUSION

In General, the strategic directions of innovative development of Russian regions are shown in figure 1.

To ensure effective feedback and adaptability of innovation policy implementation processes, it is necessary to develop, approve and implement a methodology for monitoring the results of innovative development of enterprises in the context of individual sectors of the economy, industries, sub-sectors and scales of activity.

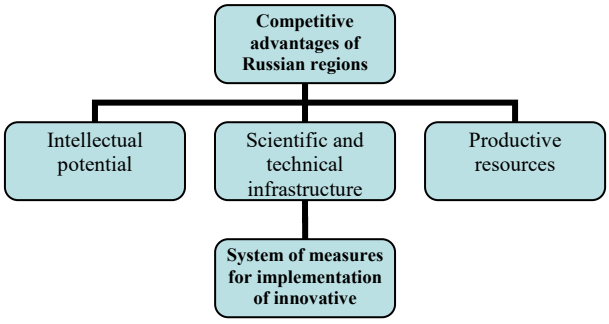


**Figure 1.** Strategy of innovative development of Russian regions

In this study, the role of regional authorities in the formation of conditions for reactive clustering is justified. As the foreign experience of economic development shows, it is not enough to recognize the fact of the formation of the cluster structuring of the economy. If the state has the capacity to stimulate the formation of clusters with the potential for economic development, which can act as points of growth, it is advisable to use the appropriate economic mechanisms of public administration. Clusters objectively have all the advantages that economic integration gives on the basis of cooperative ties.

To achieve the goals and objectives of the innovation and industrial policy of the Central Federal district, it is necessary to form a cluster of regional type, with elements of vertical and horizontal integration on the principles of scientific, technical, industrial and financial cooperation [17].

The implementation of a comprehensive program of structural diversification of industry in the regions and cities of the Central Federal district will improve the efficiency of production and competitiveness of products through the identification and involvement in the economic turnover of the resource and innovative potential of municipalities.

The implementation of the proposed measures will ensure the achievement of the following important socio-economic goals:

- replenish the revenues of the budgets of subjects of the Central Federal district;
- to avoid mass unemployment and maintain political stability in the regions and municipalities;
- to ensure the transition to the path of intensive economic recovery;
- to prevent the decline in the standard of living of a large part of the population;
- to ensure the growing interest of both domestic and foreign investors in the domestic industry;
- to form optimistic expectations of a significant part of the population of the regions and cities of the Central Federal district regarding the future of our district and Russia as a whole.

Thus, the creation of regional cluster structures on the basis of the technological chain provides that the main actor in planning and managing the supply of material resources should be their customers. It is they who, taking into account their needs and capabilities, form the nomenclature and volumes of ordered resources, as well as dictate the modes and conditions of their deliveries to other members of this cluster. In regional cluster structures, deliveries must have a high degree of

reliability and, at the same time, allow flexible changes to be made depending on the situation in the sales markets.

The article reveals the basic principle of creating regional cluster structures, defines the necessary and sufficient conditions for their successful functioning. The advantages of the cluster approach are proved. The considered problem and theoretical approaches to its solution can be useful for specialists in the field of management and logistics in the framework of managing relationships with contractors.

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