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SCIENTIFIC AND INNOVATIVE ENVIRONMENT OF SPATIALLY LOCALIZED ECONOMIC SYSTEMS

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Abstract

The modern economic systems of most of the world's economies create bottlenecks for the knowledge and innovation economy. At the same time, such bottlenecks act as filters, they limit the ways of innovation spreading and do not allow for development spatially localized economic system more effective. It is already evident that the scientific and innovative knowledge obtained at universities does not reach the end users and, ultimately, does not create new value for the economic system as a whole. The purpose of this work is to show how universities contribute to the regional ecosystem and to the scientific and innovative environment in general. The authors tried to find an answer to the identified limitations associated with the process of self-organization and the network infrastructure of spatially localized economic systems. The results obtained during the study confirm the hypothesis that scientific and technical discoveries that occur in university laboratories often do not lead to innovative and technological changes because the key factors of this complex reactions chain have significant limitations in the form of bottlenecks. In addition, they can completely break off before reaching the desired agent, because the ecosystem itself did not have a mechanism for self-organization. Using a hybrid approach, the authors of the article tried to develop a new concept that will enrich this scientific direction with new knowledge, as well as give impetus to the scientific and innovative environment in spatially localized economic systems.

Keywords: Scientific and innovative environment, innovation, region, economic system.

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1. Introduction

In the conditions of global turbulence of the world economy and its guaranteed deceleration, it is increasingly noticeable that the main inexhaustible resource today is not only natural resources but new knowledge. World leaders have long noticed the trend that the knowledge economy is the inexhaustible "Grail" that will ensure sustainable development and global socio-economic leadership in the fourth industrial revolution.

It is already evident that the modern economy is not only the economy of material production, but also fundamental and applied scientific research, the communication system and the patent system (Mowery, Nelson, Sampat, & Ziedonis, 2001), as well as the system of higher education.

The key question is how effective the scientific and innovative environment functions in a spatially localized economic system are and where are the factors that allow for a significant increase in the efficiency of such systems. The development of effective models of organizational and economic mechanisms of interaction between the scientific and innovative environment and the spatially localized economic system is determined primarily by: competitiveness in the system itself; availability of sufficient financial resources; high level of innovation activity; a wide network of cooperative relations with production, business and government; unlimited access to new technologies, etc.

In addition, this mechanism should use all the accumulated potential of the system and actively involve all elements of the innovation infrastructure, such as research institutes, technology parks, business incubators, accelerators, infrastructure development funds, etc.

Growing expectations of the role that universities can play in the research and innovation environment have led to a number of changes, which in turn have been aimed at strengthening the links between academia and industry. The commercialization of academic knowledge through patenting, licensing, and company allocation is a cornerstone of science and innovation policy in modern countries (Mowery et al., 2001).

Therefore, this article is intended to empirically assess the processes aimed at improving the quality of the mechanism of knowledge exchange between universities and industry and offer more effective ways to develop the scientific and innovative environment of spatially localized economic systems.

2. Problem Statement

Research shows that in 1820, less than 20% of the world's population was literate, and this group was mostly concentrated in Western Europe. Today, the literacy rate is almost universally close to 100%, except Africa-64%. After the spread of basic education, secondary and higher education became the norm for all economies of the world. However, over the past 50 years, this process has become a global phenomenon, it has led to a significant increase in the average years of education of the world's population, from about 1 year in 1870, to 3 years after the Second world war and more than 7 years in the new Millennium (OECD, 2014).

At the turn of 1850, with the beginning of the first industrial revolution, there is a transformation of views and a rethinking of the role of education in the economy, there are evolutionary processes that become the basis for the development of fundamental, applied and experimental science. In the future, with the improvement of the institutional framework, there is a significant breakthrough in development in all areas of natural science, more modern approaches have strengthened progressive ideas in society, they in turn

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gave an acceleration in science and gave a significant impetus to all scientific and technological progress in the world.

With the emergence of people's need for new knowledge, there is an increasing shift from faith-based religious schools to universities based on the desire for knowledge and reason (Polyakov & Gordeeva, 2019). Today through retro perspective of generations of schools and "universities" empirically you can see the whole picture of the world that prevailed in different historical periods of time within which apparent trigger points - the first drivers of growth the research and innovation environment in the world and the basis of all "industrial revolutions".

Between 1820 and 1875, against the background of the spread of transport technologies, there was a significant increase in the mobility of people and their concentration in the first urban clusters (Polyakov, & Gordeeva, 2019). The development of the urban economy required an influx of talented young people and specialists, and the key factor here was the technological system of division of labor, about which Hirst (1904) wrote 250 years ago. New views, talents, and creativity were accumulated in the first points of attraction-urban clusters.

Since about 1750, a series of fundamental changes in technology and society have defined the nature of long-term fluctuations in economic growth. These fluctuations were called "Kondratyev waves" after its influential statistical analysis of Nikolai Kondratyev (1928). In subsequent studies, which drew their inspiration from the ideas of Joseph Schumpeter (Schumpeter, 1942), in particular the works of Sergei Glazev (1990), Freeman and Soete (1997), Dosi and Nelson (2016) and Carlota Perez (2010), explanations of long-term growth patterns occur through industrial innovation, the authors of this article also tend to this point of view.

There are five areas of regional growth theory: 1) neoclassical theories based on the production function; 2) cumulative growth theories, which are a synthesis of neocainesian, institutional, and economic-geographical models; 3) new regional growth theories based on increasing returns to scale and imperfect competition; 4) new forms of territorial organization of production, based on industrial and regional clusters, value chain, learning economy, national and regional innovation systems, as well as self-organizing effects; 5) other theories that explain particular or individual issues of regional growth.

In modern conditions, it is clear that the globalization of economic space dramatically activates the innovation process in all countries of the world community in order to achieve competitive advantages in socio-economic and political development.

The author's concept is based on the fact that the basis of all socio-economic transformations of spatially localized economic systems is a network of interconnected heterogeneous clusters, which is based on a self-organizing core in the form of scientific and innovative environment that allows the entire system, under the influence of the external environment, to more effectively reinvest its own capital in the renewal of technics and technologies, as well as actively develop the entire range of innovations.

The authors support the opinion of Joseph Schumpeter that as soon as innovations (product, work or service) become successful and profitable, other entrepreneurs rush after them, competing for it and thus creating a kind of "congestion – cluster", which in turn develops as a self-organizing system. As can be seen, the research and innovation environment stimulates innovation in one industry and, thanks to the network effect, can stimulate other innovations in related fields.

Thus, modern clusters (Suire & Vicente, 2014) have a significant impact on the expansion of integration links between science, education and production, not only in the reproductive, but also in the

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territorial aspect. Stable integration ties become the basis of innovative economic development, and their interaction goes beyond one administrative entity, and can spread to other territories, including other countries. In this regard, the development of the theory, methodology and recommendations for the practice of spatial integration of science, education and production in spatially localized economic systems on the basis of their scientific and innovative potential is an urgent problem that has not yet received due attention in modern economic research.

3. Research Questions

Given the significant gaps in the field of building a scientific and innovative environment in the existing literature, the questions for this study will be as follows:

- How do universities contribute to the regional ecosystem and to the research and innovation environment?
- Is there a connection between the process of self-organization and the development of the network infrastructure of a spatially localized economic system?

4. Purpose of the Study

The objectives of this study are:

- To study the factors and drivers of growth of scientific and innovative activity;
- To develop a concept that allows for more effective development of the ecosystem of the scientific and innovative environment.

5. Research Methods

Over the past fifty years, there has been a significant shift in the perception of universities in the world, recognizing their role as Central players in the knowledge-based economy, they have become more responsible in their activities in the system itself. Growing economic expectations have led to a number of significant changes aimed at strengthening the links between academia and industry (Bianchini, Llerena, & Patsali, 2019). As custodians of knowledge and stewards of human capital, universities have come to play a major role in training a skilled workforce. However, with the increasing speed of scientific and technological progress, many universities began to lose sight of the main trends and cross-cutting technologies that are the link of the future digital economy, which have already become significant and came out on top, giving a significant impetus to the development of many industries. At the same time, the economic systems of many countries have become unable to keep up with the global estates and their systems have begun to fail, as a result, this leads to significant socio-economic problems and causes a growing backlog in the rapidly developing sixth technological order and in the fourth industrial revolution in general.

5.1. Growth restriction

Despite the emerging problems in the science and innovation environment of spatially localized economies, many countries still have a "chance for the future", but this will require much more investment than the 3% of total spending (Holoniq, 2019) currently allocated to technology in the education sector.

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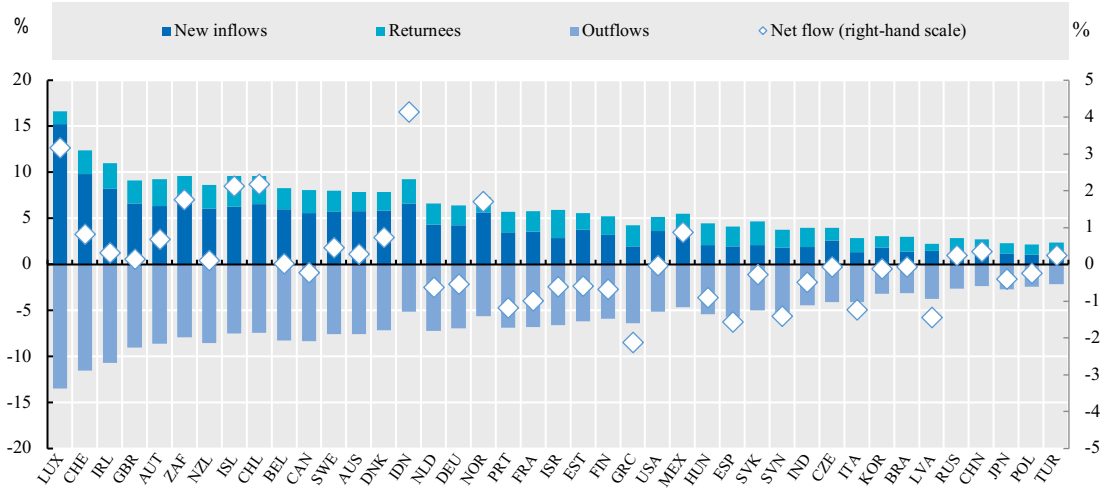
Like any business industry, universities will need digital solutions to overcome the big challenges in higher education, science, and innovation.

In comparison with European countries, the lowest public spending on education from GDP in Russia (OECD, 2019). This factor may indeed leave it out of scientific and technological progress and cause irreversible consequences that will have a significant impact on the entire economic model of its development. Pointing to this fact of limitation, it is possible to think over the most optimal solutions for effective growth, including separately taken spatially localized economic systems.

The modern scientific and innovative environment is a complex system. When it comes to understanding market dynamics and what technologies, business models and sectors can grow or shrink, it is worth paying attention to such a tool as the Global Learning Landscape taxonomy, consisting of 50 innovative clusters, which significantly help in understanding and rebuilding the entire network infrastructure of a spatially localized economic system and its future points of effective growth.

According to the 2019 Global Learning Landscape (Holoniq, 2019), the greatest interest in the near future will be focused on such areas as knowledge and its content, education management, in traditional and new models of content delivery and education itself, on learning experiences, on integration into international education, on learning support, assessment and verification of knowledge, on the training of labor and talent, as well as around the development of skills and talents. As we can see, it will also follow the student from early childhood to learning and then play a significant role throughout his life.

The market of scientific and educational technologies also provokes international mobility of scientists, which facilitates the dissemination of scientific knowledge. Using this soft tool, the leading countries are able to gather the most authoritative scientists from all over the world like a vacuum cleaner, providing them with opportunities in the form of grant support, infrastructure and other privileges. This approach shows that the exchange of knowledge ("brains") is much more important than the strengthening / leakage of "brains" from the country. One way to track the mobility of scientists is to track changes in institutional affiliation through their list of publications in scientific journals (Figure 01) (OECD, 2017).



Source: authors based on (OECD, 2017).

Figure 01. International mobility of scientific authors, 2016. As a percentage of authors, by last main recorded affiliation in 2016

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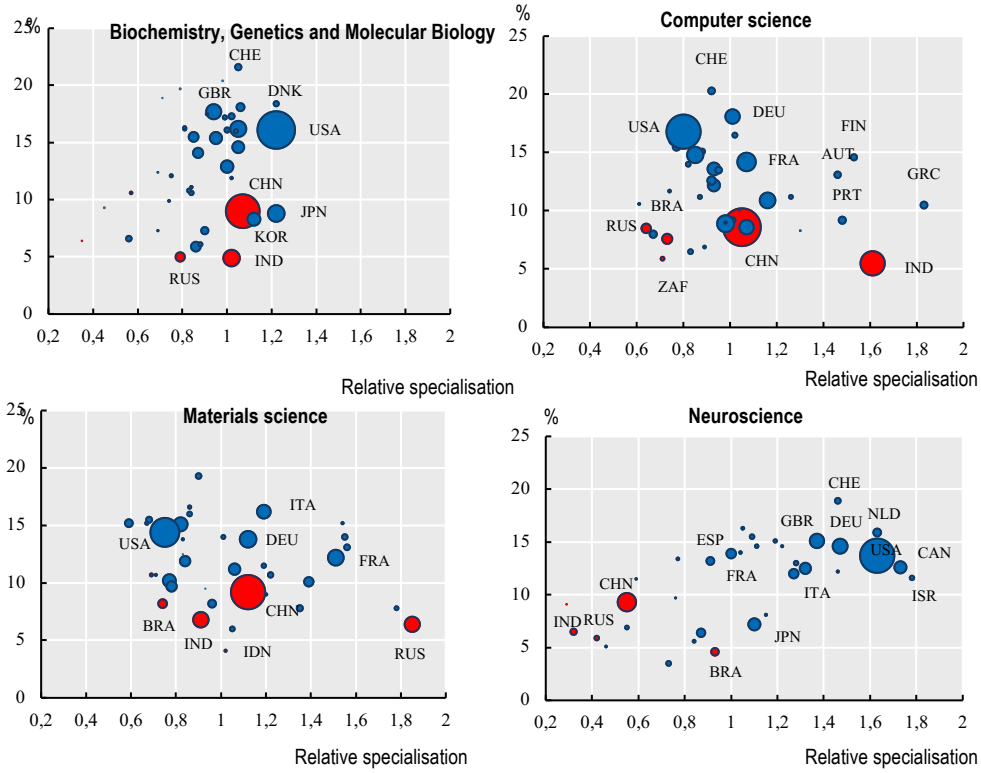
Citing scientific authors on the mobility profile in 2016 (OECD, 2017) shows that Russia is in the penultimate place on this indicator and this is alarming. This index indicates significant problems with the quality of research.

Meanwhile, in 2015, the United States topped the ranking for scientific publication output, China ranked second in the number of cited documents, almost as much as Germany and the United Kingdom combined. Switzerland has the largest share of domestic scientific documents with a high citation impact, followed by the Netherlands.



Source: authors based on (OECD, 2017).

Figure 02. Specialisation and citation impact in science, selected fields, 2015

As can be seen from the figure (Figure 02) there is currently a country specialization in scientific fields. The specialization index indicates that there is already a relatively high share of specialization in scientific products in the world compared to the global distribution of scientific products by area. The relationship between specialization and citation impact is analyzed in four selected areas: biochemistry, computer science, materials science, and neuroscience (OECD, 2017).

Using the latest technology, universities can go beyond campus and empower students of all ages, academic or social categories on a global scale. However, this requires focusing on the development of a self-organizing research and innovation environment, where the basis can be an ecosystem thinking that can link all available resources together, significantly expand the reach of the audience and establish partnerships with other universities, industries and IT companies that are in the digital vanguard of the modern economy. Thus, existing research centers will be able to effectively transform and more painlessly adapt to future global changes.

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5.2. Decisions and actions

In the conditions of severe and sometimes unprecedented external pressure, structural transformation and search for the trajectory of economic growth are taking place for almost all scientific and innovative environments of spatially localized economic systems. The processes of interregional differentiation observed in the sphere of socio-economic development of the world's countries lead to an uneven distribution of investment flows on a global scale. In this regard, an urgent task is to find new mechanisms for scientific and innovative development of spatially localized economic systems that provide a multiplicative effect of growth in related industries, as well as mechanisms for the formation of "growth points" especially in peripheral regions with a complex socio-economic situation.

At the same time, the effective development of spatially localized economic systems is hindered by such problems as low efficiency of development institutions, subsidized budgets of regions with a complex socio-economic situation, disproportions in the level of demand and supply in the regional labor market, limited experience in the development of private-public partnership, low level of infrastructure development and, as a result, low level of scientific and innovative environment and, consequently, their investment attractiveness.

The creation and development of effective spatially localized economic systems is also a key objective of the UN sustainable development and is designated as Goal 9 "Creating sustainable infrastructure, promoting inclusive and sustainable industrialization and innovation". According to the data, the top 5 R & d performers in relative terms (R & d spending as a percentage of GDP for 2017): Israel and the Republic of Korea (4.6%) are the world leaders, followed by Switzerland (3.4%), Sweden (3.3%) and Japan (3.2%). Expenditures on research and development as a percentage of the gross domestic product of the Russian Federation for 2015-2017 amounted to 1.1%. The ranking changes: in absolute terms (in billions of dollars based on purchasing power parity) we have the following five largest countries that made significant investments in R & d in 2017: the United States (543), China (496), Japan (176), Germany (127) and the Republic of Korea (90) (NESCO Institute of Statistics, 2019).

Tax incentives in addition to direct support measures (such as grants) to promote R & d in firms have become an effective tool for stimulating innovation and economic growth for most governments around the world.

So, in 2018, 30 OECD countries have established a preferential tax regime for R & d spending in business, compared with 19 OECD countries in 2000 (OECD, 2018). Between 2006 and 2016, total government support for R & d spending as a percentage of GDP increased in 27 of the 45 countries, with the Russian Federation, France and Belgium providing the largest support as a percentage of GDP in 2016. Some countries that appear to provide little support solely through direct funding actually provide significant assistance through the tax system. This applies to countries such as Australia, Japan, and the Netherlands, where tax incentives account for more than 80% of total government support (Appelt, Galindo-Rueda, & Cabral, 2019).

As previously mentioned, the greatest potential in these incentives is used by Russia (OECD, 2018), applying tax incentives for R&D and property tax incentives for national Research centers and organizations that implement state-approved research projects. However, pursuing such a policy in isolation from the real economy, many of the most implemented innovative projects are obviously not in demand on

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the market. Today, domestic expenditures on research and development for socio-economic goals of the Russian Federation in 2018 amounted to 1028,2 billion rubles, which is 9 billion rubles more than in 2017.

In 2018 the main source of funding of domestic spending on research and development in priority directions of development of science and technology was the budget of the Russian Federation, and it accounts for more than 60% or 420,1 billion. The main goals of the application of public funds were directions in the field of economic development, social goals, General development of science, research and use of the Earth and the atmosphere, the use of space for peaceful purposes, as well as other goals.

The current agenda of Russia's innovative development is closely linked to cluster policy. In early 2012, the Ministry of economic development of the Russian Federation initiated a competitive selection of projects for the development of pilot innovative territorial clusters in the regions of the country. 25 clusters, of the hundreds of applications submitted by regional administrations initiatives, received state support. The recipients of funds were mainly projects in the field of innovative infrastructure (Kutsenko, 2015), which, unlike complex cluster development programs, did not involve the implementation of research and development (R & d), innovation, (re)training and other large-scale activities.

In our opinion, the most promising solution is the development of a network of interconnected heterogeneous clusters, which is based on a self-organizing core in the form of scientific and innovative environment that allows the entire system. This self-organizing cluster will contribute to the synergy and integration of knowledge between science and creative chaos and will increase the diffusion of innovation, which in turn will lead to the emergence of original ideas. In this regard, let us consider the structure of the new organizational structure.

6. Findings

Today, the synthesis of the cluster, network and synergetic approach allows us to implement new more stable schemes of network interaction in spatially localized economic systems, where the internal scheme of the scientific and innovative environment allows us to develop a self-organizing environment of the cluster itself. In this scheme, it is possible to implement ultra-fast processes in the mode with the aggravation of the reactions of all the agents of the cluster, which significantly increases the efficiency and competitiveness of the cluster in the entire designed system.

From the figure (Figure 03) it can be seen that the cluster is a network - a self-organizing system based on the scientific and innovative environment, on the basis of which there are positive (+) connections between the cluster participants or clusters, including those from other branches of the spatially localized economic system. Contacts with the external environment or its direct influence on the spatially localized economic system can have both positive and negative (-) consequences. As you can see, ultra-fast processes in the mode with aggravation affect the additional reactions of all agents of the cluster, which has a positive effect on the environment in terms of its internal competition, the synergistic mechanisms of such a system have a positive effect on the efficiency of the entire industry.

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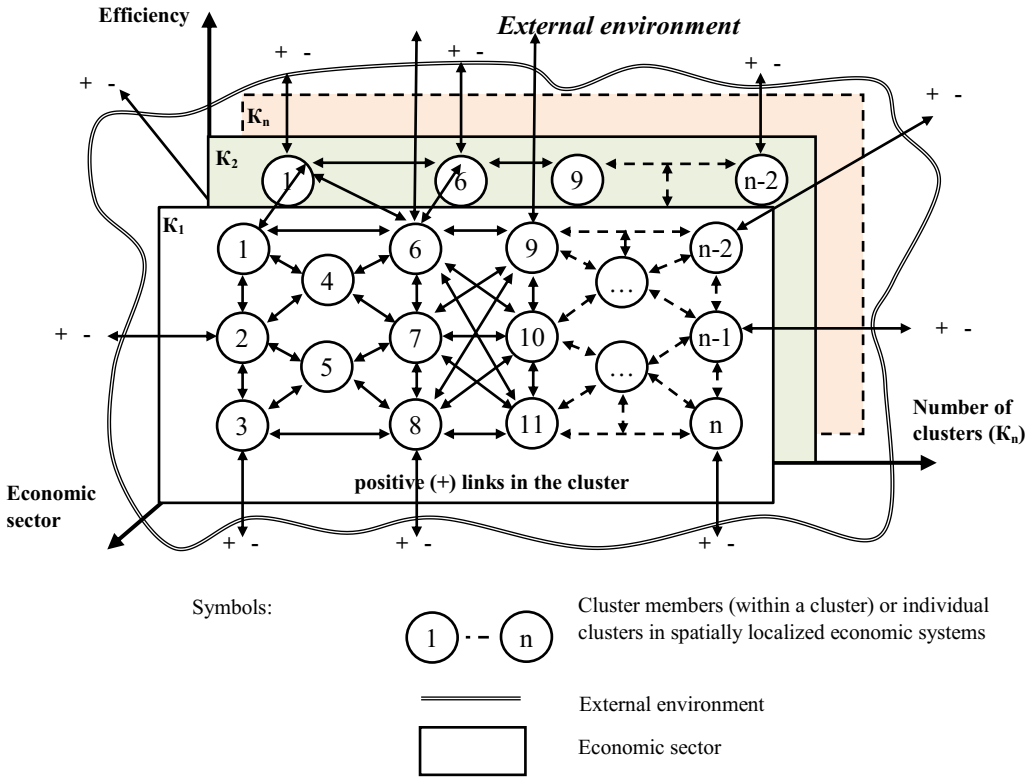

Source: authors.

Figure 03. Network cluster model based on a synergistic approach

Thus, developing a conceptual approach based on the cluster approach can significantly improve the efficiency of scientific and innovative environment any spatially localized economic systems, and using hybrid approach based on synthesis of cluster, network and a synergetic approach, the authors have tried to develop a new concept that will enrich the new knowledge this research area, as well as to give impetus to existing research methodology, inspires confidence in the possibility of developing a holistic theory of economic clusters and ultra-rapid development of any economy, even one that is in the mode of aggravation.

7. Conclusion

Considering that the latest technologies will be the driver of growth of all changes, as well as the fact that the world of technology in the XIX century has become global, the authors support the view that the implementation of international cooperation can be considered as one of the processes of global growth (Polyakov & Gordeeva, 2019).

A characteristic feature of the new world will be the following technologies: bio - and nanotechnology, genetic engineering, membrane and quantum technologies, Photonics, micromechanics, thermonuclear energy.

Considering the explosive nature of modern innovation, the ubiquitous penetration of digital platforms and highly integrated intellectual environments in all spheres of human activity, humanity has

faced one global question, what place will man occupy in the digital environment, where the world will be ruled by highly massive parallel computing.

The authors of the article conclude that the integration connections of science, education and production, the formation of spatially localized innovative subsystems of the region become objectively necessary. Development of the theory, methodology and practice of management of innovative development of regions, integration connectivity of science, education and production is an urgent problem. Modernization of the economy must begin with education, increasing the interest of territorial entities in scientific activities, innovation activity and receptivity.

Implementation of the model of innovative development of the region is more effective in the conditions of formation of territorial innovation clusters. The multi-level method of forming a cluster of science, education and production includes analysis and diagnostics of the prerequisites for creating a cluster, development of its structure, organizational and economic mechanism of functioning and development.

In our opinion, the following main directions can set a new growth trajectory:

- Development of cluster networks;
- Creating a self-organizing core in the form of a scientific and innovative environment;
- Building a system of early identification and development of talents, creating an environment that allows these talents to realize their potential;
- Acceleration of scientific, technological and innovative changes in accordance with the expansion of globalization of world economic relations.
- Interregional scientific, technological and innovative cooperation.

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