Formation of a scientific and educational complex as a factor for the sustainable development of the region

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Abstract. In modern conditions of ensuring sustainable socio-economic development of the region, the choice and justification of the optimal organizational variant of interaction between the main institutions of the innovation economy (science, education, business, and government institutions) becomes relevant. The authors develop the format of the scientific and educational complex (SEC) based on network interactions. The proposed option allows one to solve the problem of finding new ways of sustainable development and sources of competitiveness. And the integration in the form of SEC on the basis of common goals, communication, labor cooperation, and resource dependence allows each subject to get a synergistic effect. The system of indicators to assess the effectiveness of the SEC functioning is proposed in the context of the main groups of participants.

Keywords: sustainable development, innovation, scientific and educational complex, innovative economy

1. Introduction

A positive attitude towards innovation is steadily increasing, while the focus is not so much on their initial implementation, but on the wide distribution and use of innovative products and services [16]. Activation of innovative activities aimed at transferring the economy to the path of innovative development and its integration into the global socio-economic space contributes to sustainable growth and competitiveness, both in the regions and in the country as a whole. Special attention is paid to the problems of innovative development of the regional economy [22, 25].

A study of the trends of integration processes between the main institutions of the modern economy and innovative international experience confirms the following. The ultimate value of sustainable economic growth based on innovation can be achieved at the point of intersection of interests in the fields of science and education, business, and government. The competitiveness of the country and its regions in an innovative economy largely depends on the effectiveness of their interaction.

The interest shown in the situation in the scientific and educational sphere of our state develops in a very contradictory way [5]. And this is despite the fact that during the Soviet times one of the largest and most effective in the world history of the SEC was formed in the country. And today, in his experience of creation, various integrated structures are being introduced abroad, Russia is still losing its competitive advantages in terms of scientific achievements and quality education [4, p. 72].

The purpose of this study is to substantiate the form of integration in the form of SEC that meet the goals of commercialization of scientific knowledge in the framework of a holistic and continuous process of the innovation cycle, with an assessment of the effectiveness of its functioning in the context of the main subjects of interaction.

2. Materials and Methods

Research in the field of integration processes of the scientific and educational sphere, business and government, as well as the commercialization of scientific knowledge are reflected in the writings of American (Baker D, Gumport P., Scott P., Wynne B.), English (M. Ash, J. L. Davies), Japanese (K. Kitamura, K. Okamoto), Dutch (S. Craciunoiu, M. Henkel) scientists [12, 17]. In the works of L. P. Kleeva, D. Yu. Lapygin, S. S. Malina, the problems of choosing the optimal form of interaction between the participants of the innovation economy at the regional level are considered [6, 8, 9].

When justifying effective organizational forms of interaction, attention is paid to the cluster construction formats. Two fundamental characteristics of clusters are distinguished [2, p. 386]. The first of these reflects the presence of certain links (horizontal and vertical), with the help which participants must be connected. The second provides for their geographical proximity, since co-location favorably affects the formation and increase of the benefits resulting from their network interaction. Consequently, a synergistic effect is observed. At the same time, in Russian conditions, a clear predominance of continental politics and the Asian model is observed [13, p. 164] in the field of building and developing clusters. The main role in the cluster organization of the economy is assigned to the state.

The scholarly papers of J. Ruegg-Sturum, L. Achtenhagen [14], R. Huggins [19], Yu. S. Bogachev, A. M. Oktyabrsky, D. A. Rubwalter [1] show that in the innovation economy, the network method considers the socio-economic space as a set of interrelated systems. At the same time, network communications are the main condition for interaction. It includes both connections between similar subjects of integration and between subjects having different affiliation with hierarchical systems. [10, p. 74]. Networking allows one to achieve multiple increases in the potential for business communications. As a result, one of the main problems of the globalization processes and the development of the information society is solved, which is the use of the resources of the subjects of interaction to achieve personal goals.

3. Results

Foreign experience of interaction between science and education confirms that their integration plays an important role in sustainable development and increasing the competitiveness of states in terms of building an economic growth model based on innovations.

According to the authors, the separation from the hierarchical system with government directives to the network interaction model with full integration, developed communication channels, and coordination of activities from the state of each interested participant is the most optimal. The network principle provides a dynamic equilibrium, when the union of subjects in the form of SEC, on the one hand, has a fairly clear structure, and on the other, flexibility and openness are characteristic of this association. At the expense of what, the interacting organizations can jointly generate innovations.

The authors proposed and substantiated the principles of the SEC formation based on the network interaction of the subjects, which included:

1. *Common goals*. This is a target principle, which determines the degree of consistency of interests of the subjects, the coordination of their activities, the distribution and exchange of resources. Despite the fact that scientists generate new ideas, in most cases, they do not have the management experience and managerial skills necessary to bring R&D to commercial success [7, p. 316]. And in accordance with the business theory of Isaac Kirtsner, entrepreneurs are constantly in search and evaluation of new business opportunities. The state should be guided by this particular process, called the entrepreneurial discovery. The state should focus not on sectors, but on activities that can be the basis of a “smart specialization” strategy. [18].

Therefore, an extensive system of scientific, educational, and business relations is needed, and the network nature of the relationship between science, education, and business is optimal [21, 22].

2. *Spatial localization* is justified by research in the field of national and regional innovation systems [20], as well as research in the field of clusters [23]. It is one of the basic principles of integrative complexes, enshrined in the names of the structures of integrative interaction.
3. *Infrastructure support* is characterized by the presence in the specific territory of the formed infrastructure, focused on achieving the important objectives of the SEC. It is intended to create conditions for the deepening of network interactions and the development of interactions between network actors.
4. *Network communication* of the SEC is presented as a complex of interconnected network nodes, between which connections are formed based on the ability to communicate. Entry into the complex, on the one hand, is based on the ability of the subject to effective network communication. On the other hand, entry into the complex guarantees information support to all subjects of interaction. It is on the basis of network communication in the SEC that information and knowledge as the main resources for creating innovation are generated.
5. *Network intercompany* cooperation promotes joint competitive advantage. That is, the network can act as a source of income that cannot be obtained within the functioning of a single subject (the effect of emergence).
6. *Resource dependency* determines the legitimacy of borrowed resources and introduces an element of trust, turning the resources external for each subject of interaction into internal ones. According to the theory of resource dependence, the SEC as a resource network allows its constituent entities to gain access to resources on more attractive conditions for them [11, p. 314].

In the formation and functioning of the SEC, like any subsystem of regional development, the question of the effectiveness of the activity and its assessment arises. According to the results of a study on the Russian and international statistical databases reflecting the indicators of scientific, educational and innovation activities, the authors propose a system of indicators in the context of the main groups of participants (Table 1).

Table 1. Indicators of socio-economic efficiency of the functioning of the SEC.

SEC performance indicators	SEC subject			
	S*	E*	B*	St*
I Economic				
International publication activities, units	+	+		
Inventive activity coefficient, units	+	+		
Technology exports per researcher, rubles/person	+			+
Number of international patents, units	+			+
Research and development organizations, units	+			+
Research and development costs, rubles	+			
Number of advanced production technologies created, units	+			
The share of financial resources of business partners in the university, %		+		
Increasing revenues from the implementation of educational projects, rubles		+		
Amount of funds raised, rubles		+		
Volume of innovative goods and services, rubles			+	+
An export of high-tech products, rubles			+	+
The costs of private business on R&D, rubles			+	
Business costs for technological innovations, rubles			+	
An innovative activity of business on domestic innovations, units			+	+
Capital participation of companies in the development of SIC infrastructure, %			+	+
The share of innovative products in the total volume of products shipped, %			+	+
The number of used advanced production technologies, units				+
Growth rate of average industry profitability, %			+	+

Labor productivity growth, %			+	+
The volume of attracted investments, rubles			+	
Financing the leading research institutes, rubles				+
Growth of tax deductions to the budget, %				+
II Social				
An income level per employee, rubles	+	+		
Creating direct and indirect infrastructure facilities, units	+	+	+	+
The volume of scientific emigration, people	+			+
Number of personnel employed in R&D, people	+			
Establishing faculties for training in universities, units		+	+	
Targets for direct contracts, people			+	
Creating new jobs, units			+	+
Growth rate of average wages, %			+	+
An employment dynamic in enterprises, %				+
The amount of social payments from the integrated structure, rubles				+
The influx of young professionals in the scientific and educational sphere, %	+			+

** Legend: S – science, E – education, B – business, St – state.*

4. Discussion

According to the authors, the formation of an integrated structure in the form of the SEC based on network interactions is an effective way of creating an innovative economy. The SEC is a productive tool that takes into account the interests of the scientific and educational sphere, business, and government. And the network structure allows creating conditions for their interaction as equal partners, recursively coordinating their goals.

The peculiarity of the SEC is realized in its function of participation in ensuring the components of regional development. And the ability to assess the effectiveness of the SEC functioning of allows one to make an informed decision about the need for its formation within the region. According to the authors, the participation of the SEC in the sustainable development of the regions of Russia can be assessed by the following components [15, p. 256]:

1. As a promising sector of the economy, with a large employment of the population of the region in enterprises producing products with a high level of added value;
2. As a producer of innovations, providing increased competitiveness of enterprises in the region;
3. As a growth factor contributing to the emergence on its base of innovative enterprises with high growth potential;
4. As a competitive factor that provides the region's economy with highly skilled labor resources.

5. Conclusion

Thus, the sustainable development of the regions can be formed under the condition of a balanced SEC that is able to solve the most important socio-economic problems facing the state, can expand access to technology and innovation, improve the quality of trained personnel, increase commercialization of scientific research, i.e. form an innovative economy on the territory of the region.

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