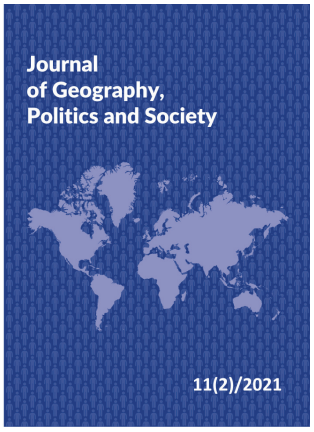

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ANALYSIS OF THE KEY ELEMENTS OF THE MECHANISM OF FORMATION OF THE SYSTEM OF INTRA-CLUSTER INTERACTION

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Abstract
The article considers the key elements that influence the mechanism of formation of the system of intra-cluster interaction. The article analyzes the competitiveness of the national economy as one of the system-forming factors, the mechanisms of self-organization of cluster formations, the properties of integration and cooperation of the participants of cluster formations, and it analyzes the structure of cluster system connections and develops the principles of state policy to promote the development of cluster formations.

Key words
clusters, system-forming links, structural components of system-forming links of clusters, principles of state regulation.

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1. Introduction

One of the urgent problems of clustering the economy is the study of the methodology of cluster formation. In the course of the development of the economic science, many theories were distinguished, which were based on certain processes of formation and development of branches of the national economy. In conditions of external instability, as the world economic crises have shown us, no enterprise is immune from bankruptcy. The crisis of recent years (2008–2009) clearly showed the strengthening of the process of interdependence of business structures, even not so much within the state as within the global economic system.

To improve the competitiveness and efficiency of the national economy, it is necessary to strengthen the processes of self-organization of enterprises, including the formation of an effective cluster model.

The competitiveness of the national economy is one of the key factors of its socio-economic development. The World Economic Forum (WEF) has published the next Global Competitiveness Index (GCI 2019) ranking of 141 countries. The first places were distributed as follows: 1st place – Singapore (GCI-84.8); 2nd place – USA (GCI-83.7); 3rd place – Hong Kong (GCI-83.1), 4th place – Netherlands (GCI-82.4), 5th place – Switzerland (GCI-82.3).

The overall global competitiveness index of 2019 for the countries of the former USSR was as follows:

Estonia – 70.9 (31st place); Lithuania – 68.4 (39th place); Latvia – 41st place (67.0); Russian Federation – 66.7 (43rd place); Kazakhstan – 62.9 (55th place); Azerbaijan – 62.7 (58th place); Armenia – 61.3 (69th place); Georgia – 60.6 (74th place); Ukraine – 57.0 (85th place); Moldova – 56.7 (86th place) (The Global Competitiveness Report, 2019).

The Republic of Belarus is not represented in this rating; however, according to the estimates of 110 indicators proposed in the AC "Strategy", it could take the 82nd place. The relatively low indicators of the post-Soviet countries are associated with the inability to build a competitive national economy.

T. Hagerstrand in his work "Spatial diffusion asa process of innovation implementation" said that the translational capacity of a region depends on the investment climate and the development of the market environment. This study is a logical extension of Francois Perroux's theory of the poles of growth, as it is dedicated to determining the factors that affect the speed at which "motor" industries will pull the rest of the economy (Mâmlin, 2013).

P. Krugman created the model of "industrial center agricultural periphery" and came to the conclusion that industrial enterprises are concentrated near markets; in turn, the markets are located where the industrial enterprises. P. Krugman (1999) is the founder of the method of economic analysis of the spatial organization of the economy based on models of imperfect competition.

M.E. Porter is considered the founder of the cluster theory. In his work, *Competition* [1998], he defined a cluster, "a geographically concentrated group of interconnected enterprises, companies specializing in the supply of a certain type of product, service organizations, companies operating in related industries, and related institutions (for example, universities, standard-setting agencies and trade associations) in specific industries, competing, but also cooperating with each other" (Porter, 2005).

M. Enright introduced the concept of "regional cluster" and emphasized the main feature of clusters – their geographical concentration, writing that the competitive advantages of countries are formed at the regional level, not at the national level. Having identified the prerequisites for the formation of the cluster: the peculiarities of the economic development of the region, the common culture, education, peculiarities of doing business and organizing production, he defined it as: an industrial cluster in which the member firms of the cluster are located in geographical proximity to each other (Dyrdonova, 2015). M. Enright mathematically proved the positive impact of the geographical concentration of production on the economy of the region.

The concept of a cluster, instead of its contribution to studies on competitiveness, met with profound critique. There are two essential aspects of this critique. First, R. Martin and P. Sunley (2003) underlined the deficits in the profundity of the concept that caused concerns related to the definition, theorization and empirics. Second, according to the French school of proximity achievements, A. Nowakowska (2011) argued that geographic proximity is not the only kind of proximity that fosters cooperation between economic entities. For example, institutional or cultural proximity can replace geographic proximity to some extent. Moreover, the primary question – geographic proximity – is also debatable. As G. Micek (2017) proved, the perception of distance differs among economic branches.

After analyzing the theoretical component of the study, some hypotheses were developed to test:

H1: there are several mechanisms of cluster formation – self-organized and formed under the influence of the state;

H2: the ability of a cluster to self-organize regulates its ability to develop in the future;

H3: the structure of intra-system connections of the cluster determines its impact on the efficiency of the cluster formation.

The research presented in this article is based on the theoretical methods of scientific research (Blaug, 1992; Bochenski, 2012; Hunter, 1998):

- the method of induction, which allows considering and analyzing the system-forming properties of clusters to analyze the process of cluster formation;
- the axiomatic method whose purpose is to test hypotheses of the mechanisms of cluster formation and the influence of intra-system connections on the efficiency of cluster functioning;
- methods of analysis and synthesis in order to generalize the study results.

2. Results and discussion

From the point of view of the regional economy in the context of a systematic approach, a cluster is a collection of enterprises of various sectors of the national economy. They are connected in a single structure and function to achieve common goals, achieve competitive advantages and develop their own potential.

Integration and cooperation of cluster members is a system-forming property. However, the degree of interactivity is determined by the presence and parameters of system-forming factors that stimulate the cluster actors to develop and implement

innovations. This is individual in each cluster, but there are general trends. When assessing the degree of the integrative property, several opposite approaches are used: the principle of "systematization", which is an approach based on reducing the degree of independence of the cluster actors to find effective system solutions for managing the cluster initiative and obtaining effective synergy. The other one is the principle of "factorization", whose essence is to ensure a high degree of independence of the cluster actors because in non-standard situations, certain solutions are required based on the independence and individuality of the resources of the cluster actors, but taking into account the functioning of the system. Both approaches have certain disadvantages: an increase in factorization leads to a decrease in the potential of the cluster actors; an increase in systematization leads to the concentration of enterprises in the cluster and an increase in competition through innovation.

However, in addition to the system-forming factors, it is necessary to assess the cluster's ability to self-organize and self-develop. Rapidly changing environmental conditions dictate new conditions for the functioning of the system, so its ability to adapt is an important property. The adaptation mechanism is formed by various elements of self-organization, including differentiation (a desire of the system to diversify the structure and functions of the elements in order to resolve emerging contradictions and the possibility of adapting the elements to the changing environmental conditions) and flexibility (an ability of the system to change depending on the situation for decision-making).

The ability of the cluster to self-organize dynamically implies the ability to develop. However, the changing factors of competitive advantages imply the intra-system mechanism of functioning of the cluster. All this happens in the conditions of development of the market environment and under the influence of the environment of direct and indirect influence. This contributes to the formation of intra-system shifts and a flexible mechanism for the functioning of the cluster in the context of the development of the system. It entails a change, an increase in the structural and functional diversity of the system, reflecting the changing external conditions for the existence of elements. Among the promising areas of increasing the diversity of cluster elements, we can highlight the involvement of insurance, financial companies, public organizations and other structures that, in addition to the main ones, will be involved in the tourism cluster, forming a new system of interrelations of structural elements and their cross-functional interaction within the cluster and, as a result, strengthening the synergistic effect in terms of increasing the diversity of activities and the formation of new structural and functional capabilities. Consideration of these processes in dynamics will allow us to trace the process of self-organization and self-development of the cluster structure, and additionally, to identify the key features of the system in development and its "weak points". The active phase of self-development continues until the system reaches a state of stability, i.e. the formation of relatively stable organizational and financial ties within the cluster and in the context of the interaction of its actors with key external stakeholders that ensure effective functioning within the cluster.

Another key feature of the cluster's self-development is the system's communication capability. As mentioned earlier, for effective functioning, the enterprises that are part of the cluster must interact with the elements of the external environment, which is represented by different organizations that are on a different hierarchy of power relative to the subjects of the cluster. This can be horizontal interaction formed as a result of contact with enterprises located at the same level (other industry clusters) or at different levels (public authorities, etc.). It can also be information or financial interaction with elements of subsystems (marketing agencies, enterprises that are not part of the cluster, etc.). Effective interaction within the framework of communication forms a related property of hierarchy, which is manifested in the fact that the pattern of integrity is manifested at each level of the hierarchy. Consequently, new properties arise at each level, which can be derived as the sum of the properties of the elements.

Like any socio-economic system, a cluster functions continuously, which means that as long as it functions, it exists. This is because all processes within the cluster are closely interrelated, since the appearance of a synergistic effect is impossible without the interconnected and purposeful work of the cluster entities.

If we analyze the system properties of industry clusters, it is necessary to identify a number of general patterns. W.R. Ashby (1956) highlighted the law of necessary diversity, which in cluster formations is manifested in an ability to self-development. This law reads as follows: in order to create a system that will be able to cope with a solution to a problem that has a large variety of solutions, a large variety of options and functional elements must be created within the system, in relation to the problem. This system must have them or be able to create them in a short time.

The cluster-forming system is influenced by factors of the external and internal environment.

External factors affect the goal setting, the level of profitability in certain sectors of the economy, key factors of competitiveness, integration trends of enterprises, etc.

According to the procedure for building a "goals tree", they have a certain hierarchy, which is based on the principle of decomposition, which means that the achievement of the main goal is possible with the effective implementation of sub-goals in the hierarchy. The quantitative and qualitative indicators of the final goal depend on the resulting indicators at each of the levels. This property reflects the cluster structure and characterizes its intra-system connections. The overall structure of the cluster's system relationships can be shown in Figure 1.

In the strategic economic policy of the state, in order to ensure the growth of regional competitiveness, solve the problems of unemployment, and increase the efficiency of a number of enterprises, it is necessary to stimulate the participants of cluster formations. This approach to the development of the regional economy is more and more common. However, the efficiency of cluster policies is debatable (Brodzicki, Kuczewska (eds.), 2012). In order to broaden the experience, the state policy should be based on a number of principles, including:

1. *The principle of state regulation*, which consists in developing a number of programs of state support for the development of cluster initiatives, creating the necessary and" comfortable" conditions for business to enter the cluster, ensuring the mechanism for the functioning of public-private partnerships, planning and monitoring its regulatory side, developing long-term strategies for the development of regional economies in the structure of the state, providing tax benefits to participants of cluster associations and projects implemented within the framework of public-private partnerships.
2. *The principle of balance*, which provides for the compliance of the developed strategies for the development of the regional economy with the interests and specifics of local cluster formations.
3. *The principle of partnership*, which provides for the cooperation of cluster structures with authorities of different levels, coordination and cooperation for the effective implementation of projects and implementation of interaction in various forms.
4. *The principle of complementarity*, which means that state support for the development of cluster formations should be provided not only from the state, but also from local budgets.

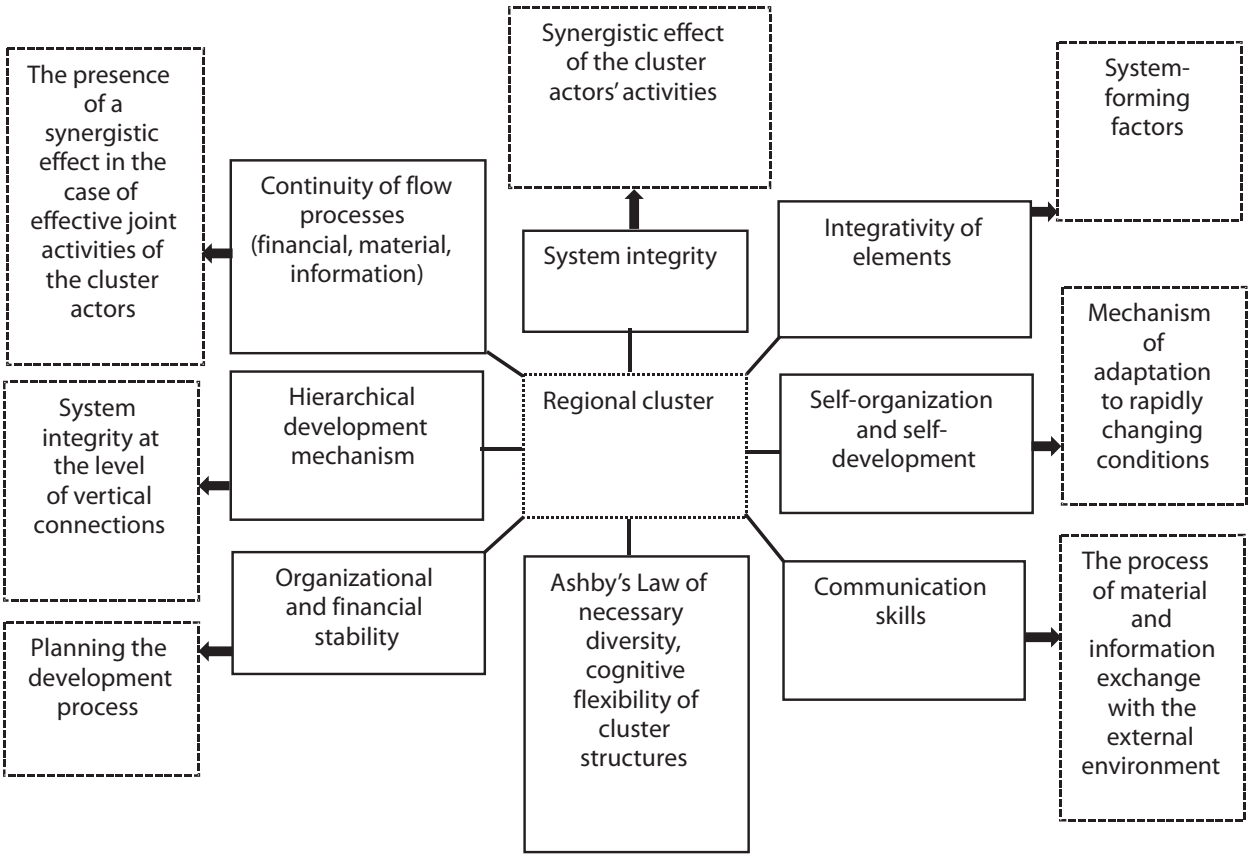

Fig. 1. Structure of cluster system links

Source: Own study.

In order to analyze the development of the regional economy of the Republic of Belarus, we present the following data. The assessment of the degree of development of regions and countries is carried out using a number of universal integral indicators, one of which is the Human Development Index developed by the UNDP. According to this index, in 2020 Belarus occupied the 50th position out of 189 countries and was included in the group of countries with a very high level of human development according to the UN classification. According to the indicators of countries , achievement of the Sustainable Development Goals, the republic was in the 23rd place (77.4 points out of 100), which is higher than the average score for the region of Eastern Europe and Central Asia. In the overall national welfare rating for 2019, Belarus was ranked 73rd (out of 167 countries). The country also ranks high in terms of education (32nd place) and living conditions (45th place) (Socio-economic status…, 2020).

These results were achieved as a result of the implementation of forecast and program documents at the state and regional levels (Ukaz..., 2016, 2019; Postanovlenie..., 2019) and others, including Presidential Decrees, Resolutions of the Council of Ministers concerning the socio-economic development of the regions of the Republic of Belarus, the National Strategy for Sustainable Development (until 2030), the State Program for the Development of Tourism "Belarus Hospitable" (2016–2020), state programs approved by industry, programs for socio-economic development developed at the level of regions, districts and cities of regional subordination and Minsk. They reflect the main complex directions of the development of the regions of the republic, as well as the key directions of the development of the regions within individual sectors of the economy. They form the target indicators of their development and reflect the methods of evaluating the effectiveness of activities and the complexity of results.

One of the features of the mechanism for stimulating the formation and functioning of innovation clusters is the expansion of the use of the potential of free economic zones (FEZ), which are located in each region and are part of the territory of the economic complex of the region.

The main purpose of the functioning of the FEZ is to stimulate the free movement of resources and the optimal use of economic factors in the interests of a particular region. The use of a special FEZ regime for business entities that are part of an innovation and industrial cluster forms a mechanism for the effective functioning of the cluster and obtaining a relatively quick effect by attracting external and internal investments to the region.

The analysis of the economic activity of the FEZ residents showed that today they do not fully use their potential, but in the future, they could become points of growth for the development of certain regions of Belarus. The world experience of using the potential of FEZs (the USA, Japan and China) allows solving the problems of innovative development of regions and creating cluster formations that would ensure the effective development of regions. Belarusian FEZs have all the prerequisites for the formation and effective functioning of innovation clusters: tax incentives, the creation of an effective infrastructure, the creation of infrastructure, incubators for small and medium-sized businesses, etc. To create favorable conditions for the functioning of the FEZ, it is necessary to modernize the existing economic relations and create effective management structures in relation to the conditions of Belarus, based on the experience of economically developed countries. Another way is to transform cluster policy into regional smart specialization strategies. The EU has chosen this path in the period of 2014–2020 financial perspective. The initial research suggests positive outcomes of these strategies (Wojnicka-Sycz, Sycz, 2018).

3. Conclusions

According to the formed system of intra-cluster relations (Figure 1), the process of cluster formation can be carried out both with the help of the state and spontaneously, i.e. based on the prevailing favorable conditions. It is proved that the cluster's ability to self-organize forms the mechanism of its functioning and development in the future. The study determines the structure of intra-system connections and its influence on the efficiency of the cluster functioning, which proves that the optimization of the cluster structure has a directly proportional relationship with the increase in the efficiency of its functioning.

However, in the context of regional development, a balanced strategic component of the analysis of national economy sectors is also needed, taking into account the regional concentration of enterprises and their specialization, as well as the cluster-formation ability, the processes of self-organization of clusters, indicators of their development, cooperation and coordination of the levels of intersectoral relations and opportunities for stimulating enterprises participating in cluster formations. Regions have different territorial and sectoral structures, different degrees of formed relations between enterprises, their integration and cooperation. In addition, the market environment forms and supports the development

of competitive relations between enterprises, which contributes to the application of innovations, the development and struggle for the best quality of their products, but it also forms the uneven development of regions. The regional economy is the most important basis for the balanced development of the country's economy because the regions have a unique potential for the development of various sectors of the national economy.

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