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MODELING OF THE ORGANIZATION OF INTERACTION OF PARTICIPANTS OF THE MANAGEMENT PROCESS OF CLUSTER COOPERATION DEVELOPMENT

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Introduction. Globalization has led to a change in the role of cluster cooperation in economic development. The impact of globalization on regional development of cluster cooperation primarily manifests itself in the fact that it gives regional clusters a new status of subjects of the world economic system and world competitive processes. In the context of globalization, there is a deepening gap in the levels of economic development of regional clusters and an increase in the social vulnerability of the population.

Research hypothesis: the concept of regional cluster cooperation covers both a variety of qualitative factors and conditions (informal knowledge networks, trust, image), and a quantitative assessment of attributes and processes (for example, interfirm trade, patenting rates, labor supply, cost of resources used). Regional cluster cooperation consists of the interaction of individual subjects of the region, the social, economic, institutional and social attributes of the region itself. This creates the effect of a combination of factors, increases the competitiveness of the region, creates and (or) uses innovations.

The purpose of the study is to substantiate a system of criteria for classifying the forms of spatially localized systems of cluster cooperation, to identify the comparative characteristics of cluster policy models.

The research methodology is based on the fundamental principles of a number of scientific fields – the theory of national and regional competitiveness, cluster economic theory, the concept of regional archetypes, theories of spatial proximity, the general theory of systems.

Results. The features of the clustering of the Ukrainian economy are identified, the main ones are identified: the formation of bottom-up clusters, discrepancies in the interpretation of the concept of cluster policy, the lack of interest of the cluster members in the interaction.

Findings. Analysis of cluster policy in the regions of the EU and Ukraine allowed us to distinguish several types of cluster policy depending on various classification criteria. Depending on the stage of cluster development, the features of cluster policy are highlighted and an effective system of cluster cooperation for the Dnipropetrovsk region is proposed.

Keywords: cluster policy; spatially localized cluster collaboration systems; regional cluster, cluster regional competition.

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МОДЕЛЮВАННЯ ОРГАНІЗАЦІЇ ВЗАЄМОДІЇ УЧАСНИКІВ ПРОЦЕСУ УПРАВЛІННЯ РОЗВИТКОМ КЛАСТЕРНОГО СПІВРОБІТНИЦТВА

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Вступ. Глобалізація призвела до зміни ролі кластерного співробітництва в економічному розвитку. Вплив глобалізації на регіональний розвиток кластерного співробітництва насамперед виявляє себе в тому, що вона надає регіональним кластерам новий статус суб'єктів світогосподарської системи і світових конкурентних процесів. В умовах глобалізації відбувається поглиблення розриву в рівнях економічного розвитку регіональних кластерів та зростання соціальної вразливості населення.

Гіпотеза дослідження: поняття регіонального кластерного співробітництва охоплює як безліч якісних факторів і умов (мережі неформального знання, довіру, імідж), так і кількісну оцінку атрибутів і процесів (наприклад, торгівлі між фірмами, ставки патентування, пропозиції праці, вартості використовуваних ресурсів). Регіональне кластерне співробітництво складається як з взаємодії окремих суб'єктів регіону, соціальних, економічних, інституційних і громадських атрибутів самого регіону. При цьому створюється ефект впливу сукупності факторів, підвищується конкурентоспроможність регіону, створюються і (або) використовуються інновації.

Мета дослідження – обґрунтувати систему критеріїв для класифікації форм просторово-локалізованих систем кластерного співробітництва, виявити порівняльні характеристики моделей кластерної політики.

Методологія дослідження базується на фундаментальних положеннях ряду наукових напрямків – теорії національної та регіональної конкурентоспроможності, кластерної економічної теорії, концепції регіональних архетипів, теорій просторової близькості, загальної теорії систем.

Результати. Виявлено особливості кластеризації української економіки, основними з яких визначені: формування кластерів «знизу–вгору», різночитання в тлумаченні поняття «кластерна політика», відсутність зацікавленості членів кластера у взаємодії.

Висновки. Аналіз кластерної політики в регіонах ЄС та України дозволив виділити кілька типів кластерної політики в залежності від різних класифікаційних ознак. Залежно від етапу розвитку кластера, виділені особливості кластерної політики і запропоновано ефективну систему кластерного співробітництва для Дніпропетровського регіону.

Ключові слова: кластерна політика; просторово-локалізовані системи кластерного співробітництва; регіональний кластер, кластерна регіональна конкуренція.

Formulation of the problem. One of the areas of search for new ways to improve the efficiency of economic complexes of individual regions, overcome the negative trends in the functioning of the national economy and increase the country's competitiveness is the transformation of the traditional economic space and the transition to the agglomerative (cluster) type.

State initiatives for the development of cluster-type territorial structures can be not only a stimulating factor for the business climate, but also an effective way to increase the competitiveness of regions. However, the existing capabilities for managing competitiveness are limited, since there is no comprehensive assessment of the impact of clusters on competitiveness and comparability of management decision-making factors, which necessitates the addition and development of theoretical studies and methodological developments in this subject area. Of particular importance are the issues of operationalization of cluster theories, the creation of an effective arsenal of methodological and regulatory documents for solving the tasks of improving the competitiveness of domestic industrial production, as well as the creative use of the experience of other countries (USA, EU countries, China, Singapore, India, etc.) since the 90s of the twentieth century, they successfully use the tool of clusterization of the economy in the context of increasing globalization and increase competitiveness.

Analysis of the current state of research in the field of theories of territorial organization of production, concepts of competitiveness, patterns of formation of cluster structures, the development of new methodological tools for identifying clusters, cluster effects, determining criteria and performance indicators make it possible to update the areas of cluster policy, to offer strategies to improve the competitiveness of regions and the quality of life of the population.

Analysis of recent publications and the unresolved part of the problem. The study is based on the conceptual – categorical apparatus and theoretical concepts of cluster entrepreneurship, spatial economics, cluster theory, as described in domestic and foreign publications. To solve research problems related to the development of theoretical ideas about the competitiveness of the national and regional economy, the authors used the classical theories of W. Petty and D. Ricardo, the concept of learning regions M. Enright [1], the theory of the "quality index" of economic activity K. Blois [2], the eclectic paradigm of T. Eggertsson [3], the cluster theory of M. Porter [4], the theory of "region-economy", W. Powell, L. Smith-Doerr [5]. The use of the theory of economic clusters, described in the works of A. Marshal [6], H. Itami [7], T. Roehl [7], made it possible to study the spatial aspect of economic activity and to highlight such a phenomenon as "accumulation of economic units". Works of the French school of spatial economics Ö. Sölvell, G. Lindqvist,

Ch. Ketels [8], devoted to the study of the polarization of economic development of regions, served as the starting point for establishing the patterns of interrelated functioning of the aggregate of regional clusters within the national economy. The contribution to the development of cluster theory at the present stage, a comprehensive understanding of the economic nature and essence of clusters, the formation of the theoretical foundations of the functioning of cluster structures have been studied using the works of Ukrainian scientists I. Gryshchenko [9], V. Fedorenko [9], L. Ganushchak-Efimenko [10], V. Shcherbak [11], S. Sokolenko [12].

Despite the large number of publications in this field of research, many theoretical, methodological and practical aspects are far from being resolved and require updating as applied to the current situation. This also applies to the problems of assessing the contribution of clusters to improving the competitiveness of regions, and questions of the Ukrainian specifics of cluster formation, and filling regional cluster policy. All this actualizes the need to model the organization of interaction of participants in the management of the development of cluster cooperation, taking into account new forms and methods of conducting economic activity on the basis of cluster policy.

The purpose of the study is to improve the methodological support of ways to assess the cluster interaction of business entities, the development of scientific and practical recommendations for improving cluster policy in the context of globalization.

The results of the study. The most important backbone property of a region in the context of globalization is becoming competitiveness, which is formed as a result of competitive interaction between regions of different levels. In a global economy, the value of unique local characteristics of the region grows, which provide their competitive advantages that are not found in other regions: the image of the region, human capital, unique knowledge, economic and geographical position, allowing to preserve the identity of the region.

An important feature of the modern development of the regions was the deepening gap in the levels of their economic development, the growth of social vulnerability of the population in certain regions, manifested in in-country and inter-country disparities, people's exposure to certain types of risk. Vulnerability types evolve, they are related to gender or ethnicity, region of residence, stage of the individual’s life cycle. Disproportions in income and inequality in education are growing. One of the characteristic processes of our time is to increase the role of regions in the economic development of national economies and the development of inter-regional competition. The basis of inter-regional competition is increasing the independence of the regions, as well as the development of competitive processes in the context of globalization.

A new form of competition – network – appears in the context of the globalization of the world economy and the "new regionalization". The area of regional competition goes beyond national boundaries, and networks of authorities (supranational authorities, for example, within the EU), networks of business structures (clusters), networks of partnerships (public-private partnerships) [12] become subjects of network competition. Within the framework of networks, the formation and movement of financial, informational, commodity flows takes place. In the context of globalization and innovation economy, the competitiveness of regions is determined by their ability to link and direct flows, including virtual, financial, emerging in the global financial market.

One of the factors of competitiveness is "soft factors of spatial organization" and local spatial systems are network structures of economic agents. Social networks are becoming the main feature of local (regional) spatial systems.

We believe that local (regional) regional spaces should be regarded as economic regions, the main feature of which is the presence of social networks. It is precisely the concepts of agglomeration and M. Porter's cluster theory that allow the system analysis to be carried out within the framework of the ER-regions (economic regions), to identify systemic effects and achieve social equilibrium.

There is no single theoretical concept that would cover the whole complexity of the concept "regional competitiveness"; there are three concepts that differ significantly from each other – regions as centers of knowledge; regions as centers of export specialization (production sites); regions as a source of increased profits (efficiency centers).

On the basis of the three selected concepts of regional competitiveness and their unification in the author's approach, we suggest examining the competitiveness of the region through the prism of three aspects: the need to achieve a high standard of living for the population (competitiveness provided by the population); the efficiency of the functioning of the economic mechanism of the region (competitiveness provided by production); the need for effective interaction between the subjects within the network structures (competitiveness provided by clusters).

A cluster is a set of independent, innovation-active, related by territorial proximity and functional dependence of organizations. We believe that the main cluster characteristics are: proximity (localization); interaction; innovation. Based on these features, we propose a three-dimensional matrix with the separation of 8 forms of spatially localized systems and the location of clusters in it (Figure 1).

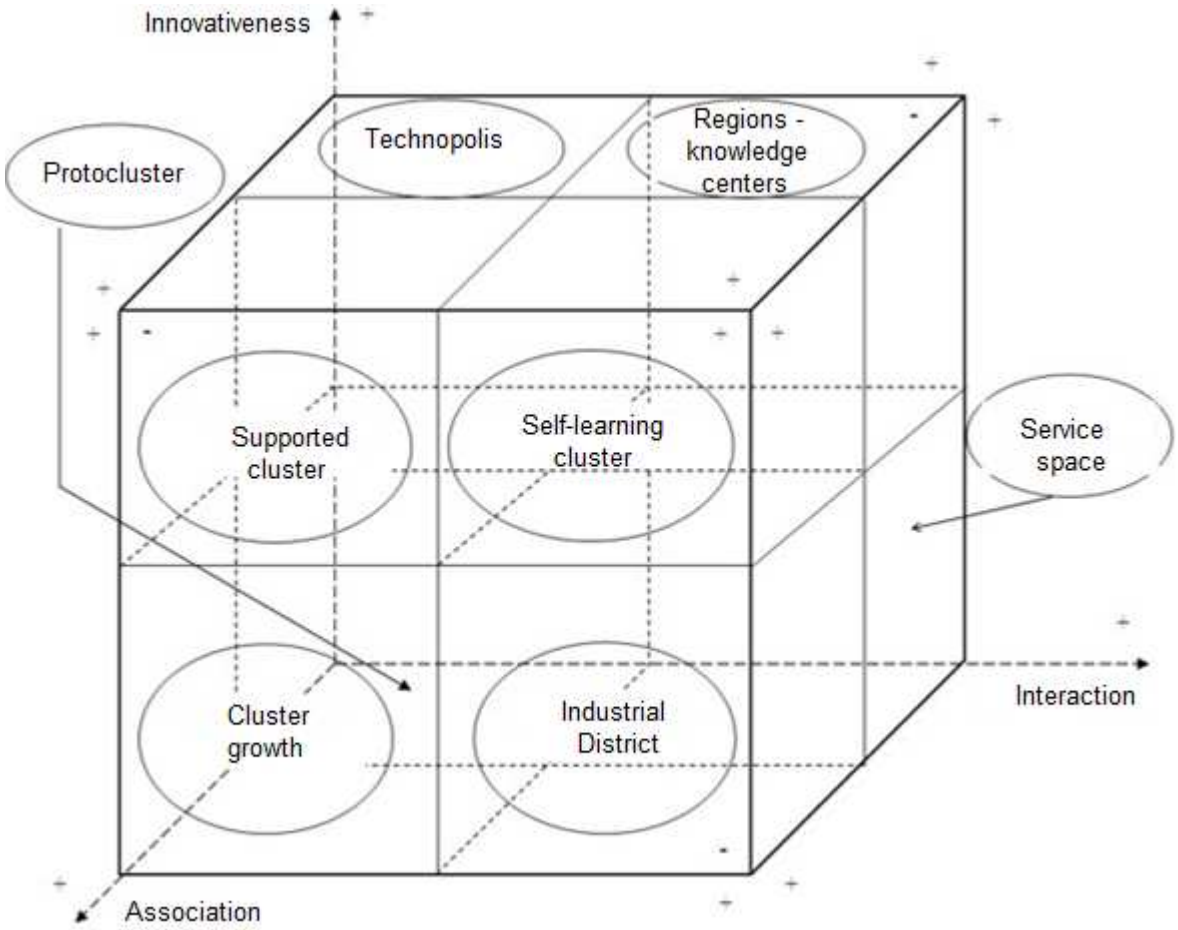


Figure 1. **Three-dimensional matrix of spatially localized systems and the place of clusters in it**

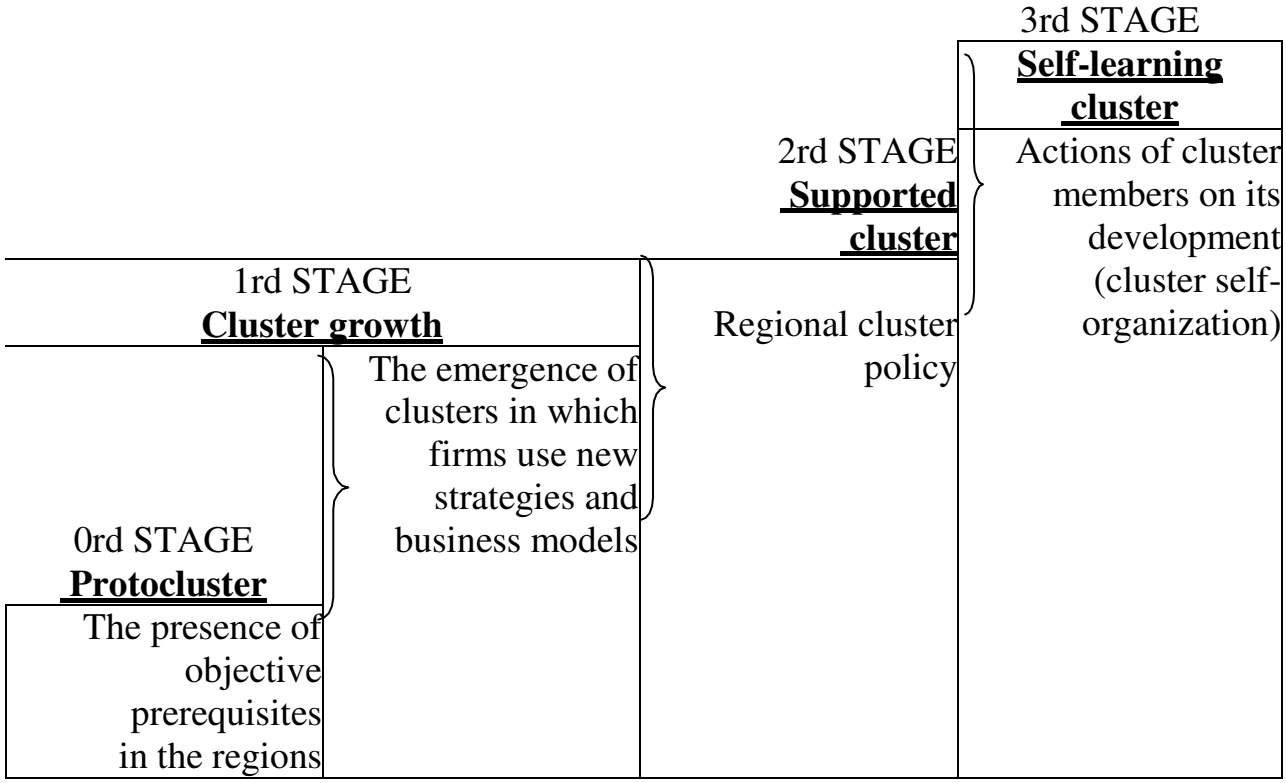
Cluster types do not occur simultaneously; they evolve. The evolution of the development of clusters can be represented as follows (Figure 2).

Stage 0 – prerequisites for the formation of clusters: evolutionary forces (traditions, culture, geographic location, natural resources, macroeconomic environment) are in place, prerequisites for the formation of a region's specialization, the protocluster, appear.

Stage 1 – the emergence of clusters, in which firms use new strategies and business models, their actions are not yet coordinated, are part of the normal market mechanism – cluster growth.

Stage 2 – the efforts of the region to create a regional microenvironment: the region's policy in the field of science, education, small and medium-sized businesses, the creation of an innovation infrastructure is a supported cluster.

Stage 3 – cluster initiatives: actions of cluster members on its development (training human capital, creating associations, developing the business environment, innovations and technologies) – a self-learning cluster.



Proposed by the authors.

Figure 2. **Cluster evolution**

Cluster policy instruments should correspond to the stage of cluster development. Cluster policy is a set of measures for: 1) creating conditions (including business environment, developing competition, creating infrastructure) for the development of a cluster; 2) support cluster initiatives. The disadvantages of modern cluster policies both at the level of the European Union and Ukraine are: lack of attention to non-technological innovations (for example, in the service sector); weak consideration of international relations in the development of clusters – national development programs dominate; lack of coordination between different areas of cluster policies; past experience is not taken into account; a huge number of initiatives and support programs for clusters with poor coordination between them. The study revealed the following features of the clustering of the Ukrainian economy (Table 1).

A higher level of cluster development of the regions leads to a decrease in the level of social vulnerability of the inhabitants of the region, which can be measured as the proportion of the population at risk of poverty and social exclusion. Among the regions with strong clusters, experts from the European Cluster Observatory included the so-called three-star clusters located in the EU regions with the highest level of innovation activity. It was revealed that the share of socially vulnerable population in regions where there are strong

innovation clusters is lower than in the EU as a whole and lower than in other regions of the EU (Figure 3).

Table 1

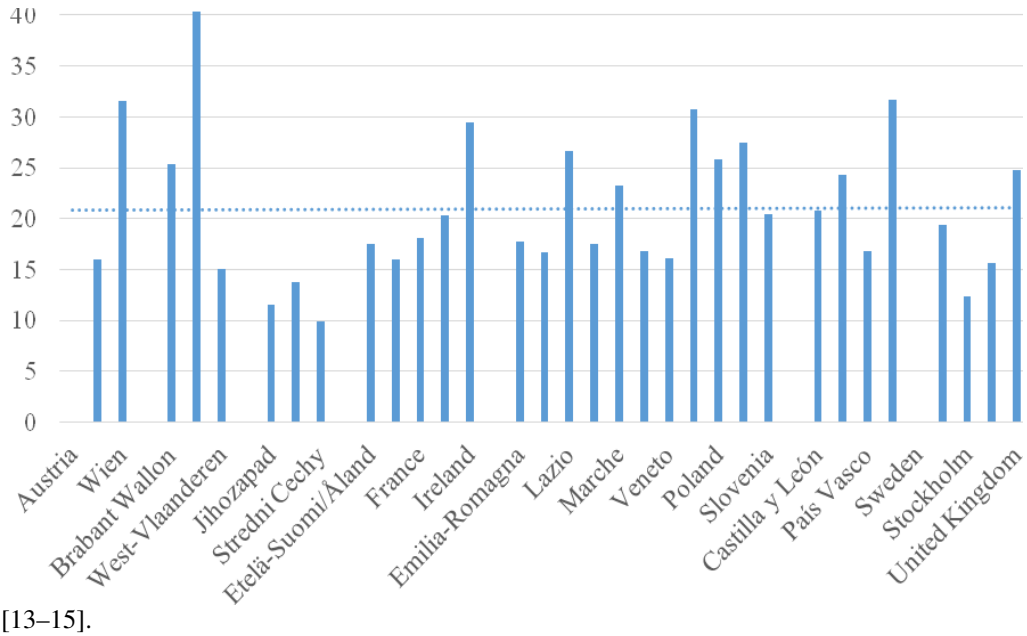
Features of Ukrainian clustering

Features	Manifestations at the cluster policy level
Cluster selection mechanism, mainly "top-down"	The use of administrative resources in the formation of cluster policy
Different interpretations of the concept "Cluster policy"	The presence of such terms as: "innovation cluster", "territorial cluster", "cluster"
Lack of interest of cluster members in cooperation and collaboration	One of the main tools of cluster policy should be a mechanism for encouraging participants to cooperate
Lack of cluster infrastructure in general	Lack of coordination between different cluster policy directions
Imperfect business climate and lack of cluster interaction culture	The use of mainly catalytic cluster policy
Cluster – as a tribute to fashion	Methodological support of regional cluster policy
Lack of serious motivation to develop innovations	The focus of cluster policy on the promotion of research and development and the creation of innovative infrastructure
Ukrainian clusters are mainly at the stage of their formation (protoclusters)	Cluster policy should be aimed at stimulating competition between cluster members improving the investment climate
Specialization in narrow industries	No clusters related industries
Mostly large companies are present in clusters	Difficult to match corporate development goals with regional development goals

Proposed by the authors

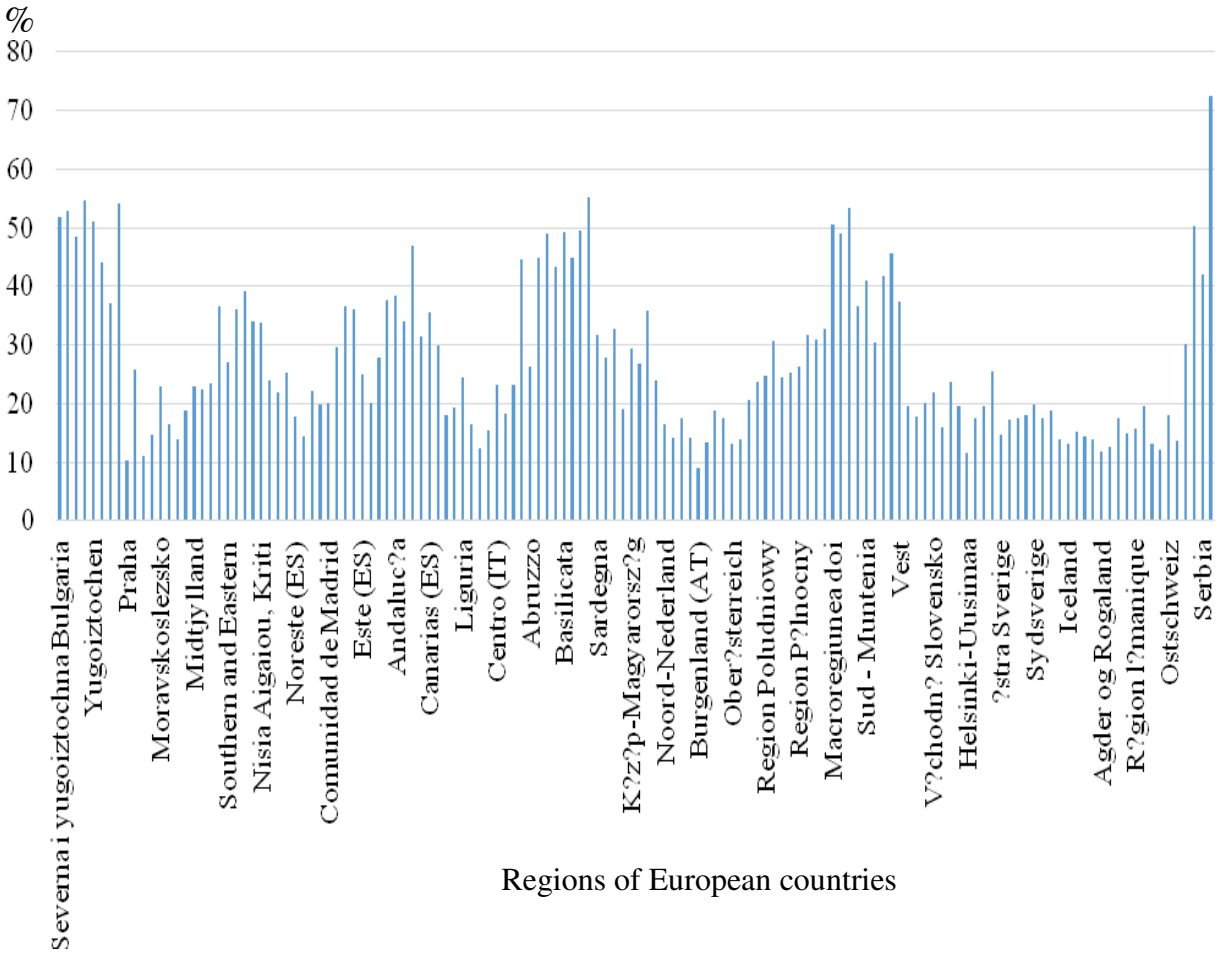
The average share of the population at risk of poverty and social exclusion in the EU regions with strong innovation clusters is 20.94%. Moreover, if we do not take into account in the calculations the capital regions, which, due to their peculiarities, are always characterized by a higher level of income inequality, then the average value is 19.94%. The calculation of the same indicator as a whole in the EU regions and in the rest of the EU regions shows that the value of the level of social vulnerability is higher than in the cluster regions (Figure 4).

In the EU as a whole, the share of socially vulnerable population is 25.79%. In the EU regions, in whose territories there are no strong clusters, the proportion of such a population is even higher – 27.23%. Moreover, it should be noted that the standard deviation of the indicator in strong cluster territories is significantly lower (6.95) than in regions that do not have strong clusters (12.85). All of the above leads to the conclusion that the use of cluster policies aimed at creating strong clusters reduces the level of social vulnerability of the population of the EU regions and their susceptibility to various types of risks.



Source: [13–15].

Figure 3. **Proportion of population at risk of poverty and social exclusion in EU regions with strong innovation clusters**



Source: [13–15].

Figure 4. **Proportion of population at risk of poverty and social exclusion in EU regions without strong clusters**

The model allows us to identify the basic conditions of competitiveness, to which we assign the location, natural resources, historical features, cultural values. This is followed by the determinants (drivers) of competitiveness: a reasonable specialization of the region, clusters, innovation infrastructure. We consider the next determinant to be the regional authorities in stimulating innovative demand (for example, tax incentives for enterprises introducing innovations; subsidizing measures to protect property rights; encouraging the import of technology, government support for small innovative enterprises). Innovative performance of a region is an intermediate indicator of a region's competitiveness, such variables as "Share of innovative goods, works, services in the total volume of goods shipped, completed works, services", "Created advanced technologies" and "Technology exports" can be observed variables for its assessment". The economic well-being of the region's population is the resultant, final indicator of the region's competitiveness and three variables can be used to measure it: GRP per capita, unemployment rate, proportion of long-term unemployed.

In the course of the study, a methodological approach was developed to assess the competitiveness of the regional economy, which involves dividing the assessment process into several stages: assessment of the final result of the state of the region, which is characterized by the standard of living; assessment of the effectiveness of innovation activities in the region, which characterizes the capabilities of the region in the conditions of intensifying competitive struggle; assessment of the determinants of competitiveness, of which the main one is the level of development of clusters in the region. The proposed method has a number of advantages in comparison with the existing assessments of regional competitiveness, since: it contains a scientifically-based selection of indicators included in the composition of the integral index of competitiveness, previously interpreted; characterized by the absence of a correlation relationship between the indicators in the system of indicators selected to calculate the competitiveness of regions (sub-indices); involves the procedure of smoothing the extreme values of the indicators on the final result of the calculations; differs in availability and objectivity of initial data; is simple in its execution, as it is based on a small number of indicators (16).

The algorithm of the author's methodology for assessing the competitiveness of the regions of Ukraine was presented by the sequential execution of the following stages:

1. Collected data of official statistics for each indicator for the last year.

2. The degree of symmetry of the distribution of data for each indicator was evaluated. A data smoothing procedure was applied to the indicator when the asymmetry coefficient exceeded 0.5, based on the extraction of a root of degree N from regional data.

3. The smoothed data was normalized by the linear scaling method to bring their values to a range from zero to one using the following formula:

$$\widetilde{X_i^j} = \frac{X_i^j - X_{min}^j}{X_{max}^j - X_{min}^j}$$

X_i^j – smoothed value of j for region i;
X_{min}^j – the minimum value of j for the year in question;
X_{max}^j – the maximum value of j for the year in question.

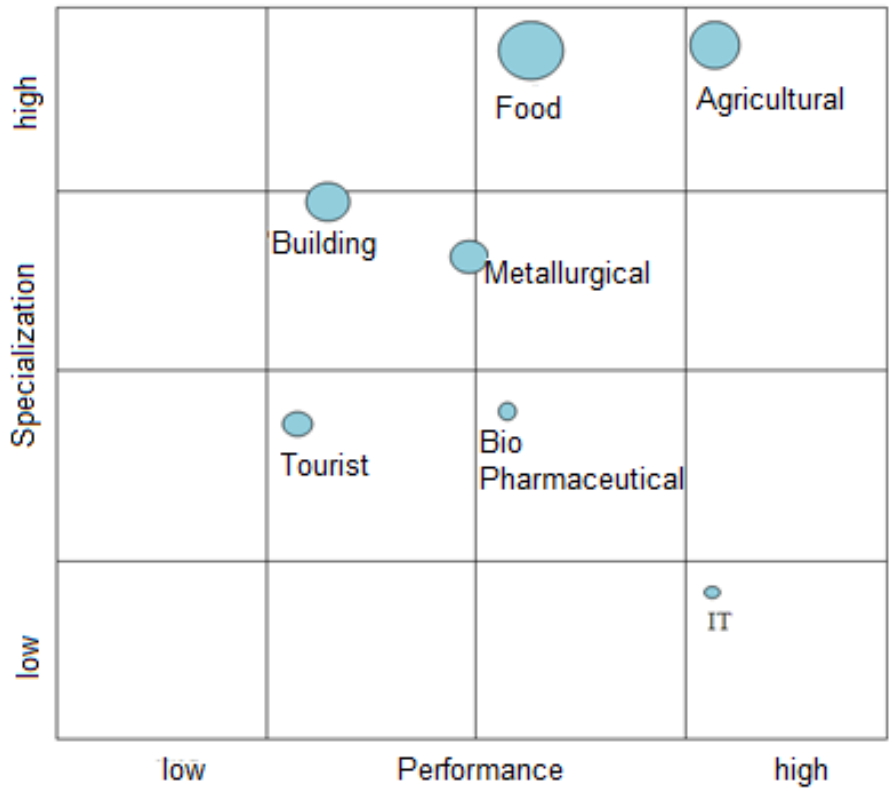
4. The normalized values of indicators collapsed into subindexes (total, innovation result, determinants of competitiveness) as a simple arithmetic average.

5. The calculation of the composite index of competitiveness of a region is carried out by folding the previously obtained subindexes into a final indicator using the arithmetic average formula.

The main directions of the formation of a competitive economy of the Dnipropetrovsk region should be: the adoption of the law “On innovation activities in the territory of the Dnipropetrovsk region; development of a cluster development strategy in the territory of the Dnipropetrovsk region based on the principle of "smart specialization"; reorienting the focus of cluster infrastructure objects towards development institutions: a cluster development center; stimulation of innovative activity of regions through the provision of preferences of various kinds to participants of innovation activity: the presence in the subject of Ukraine of a share of expenditures of a consolidated budget aimed at supporting innovation activity that exceeds the average regional level; availability of a mechanism for the provision of an investment tax credit and tax incentives for taxes credited to the budget of the region of Ukraine.

The "Cluster Portfolio of the Region" diagram (Figure 5) is a matrix with the designations of the main clusters of the region.

Clusters are positioned depending on their relative level of performance (in comparison with the average value in Ukraine) and specialization, i.e. shares employed in the cluster (also a comparison with the average Ukrainian indicators). The sizes of the circles denoting clusters reflect the number of people employed in the clusters. On the basis of the proposed methodological approach to cluster identification, systematization of clusters of the Dnipropetrovsk region by types was carried out, cluster policy tools were developed for each of the clusters, and recommendations for managing innovative clusters were proposed (Table 2).



Justified by the authors.

Figure 5. **Cluster portfolio of the Dnipropetrovsk region**

Table 2

Cluster policy tools for clusters of Dnepropetrovsk region

Cluster name	Cluster development stage	Proposed cluster policy measures
1	2	3
Tourist	Supported	- Attraction to the "Dnepropetrovsk Association of Tourist Organizations", travel agencies in the region, enterprises of accommodation facilities, museums, universities; - ensuring their effective interaction, in particular, the joint preparation of curricula and work programs for universities; - development of joint innovation projects; - organization of work on certification and licensing in the field of tourism; - creation of favorable tax and credit and financial conditions for stimulating the tourist and recreational sphere of the district; - search and attraction of extra-budgetary sources, including foreign investments.
Pharma-ceutical	Protocluster	- - analysis of the prerequisites for creating a cluster; - - encouragement of links between existing enterprises; - - investment promotion; - - establishing the functioning of all links in the value chain; - - improving the investment climate.

End of *Table 2*

1	2	3
Building	Cluster growth	- a set of measures for the organizational development of the cluster, in particular, the creation of the Dnepropetrovsk Association of the Construction Industry, in which, in addition to the producers of building materials and construction companies, scientific organizations and specialized universities should be included.
Agrarian-industrial complex (agricultural, food)	Cluster growth	- a set of measures for the organizational development of the cluster, in particular, the creation of the Dnepropetrovsk Association of Meat Producers, which, in addition to meat producers, should include scientific organizations and specialized universities; - development of its own breeding and hybrid base to improve the competitiveness of products – adoption; - decisions on the regulation of meat production by regional quotas.
IT	Protocluster	- analysis of the prerequisites for creating a cluster; - encouragement of links between existing enterprises; - investment promotion; - establishing the functioning of all links in the value chain; - improving the investment climate.

Conclusions and offers. For the Dnipropetrovsk region, it is possible to offer a set of measures for the cluster policy of the region, the features of which should be the transition to cluster portfolio management. The region should develop a cluster development strategy focused on "smart specialization" (highlighting priority development areas of innovation in the territorial planning scheme), based on benchmarking, searching for structurally similar regions of the world for transferring knowledge and successful practices and choosing a market niche, taking into account the region's uniqueness in the global technological trends. The principles for the implementation of cluster policy should be: differentiated, taking into account the stages of cluster evolution, an approach to the composition of activities; priority in the composition of the objects of the cluster infrastructure of development institutions (cluster development center, specialized organizations), focused not on supporting subjects, but on creating conditions for activities; reliance on tools to shape and stimulate demand for innovation; activation of new players – subjects of cluster initiatives (civil society, local government, experts).

It seems that the regional cluster infrastructure, regional and city organizations of infrastructure support and development of small and medium-sized businesses in the Dnipropetrovsk region, cluster development organizations, business incubators, technology parks, industrial design centers, certification bodies, consulting organizations, centers should become elements

of the cluster infrastructure of the region. collective use of equipment, prototyping centers, technology transfer centers, marketing and research centers try, educational institutions, venture capital funds.

Based on the above, we can conclude that the Dnipro region has all the necessary conditions to improve competitiveness: developed engineering, transport and market structures, extensive foreign economic relations, a tendency to increase the volume of small innovative businesses, labor and scientific and technical potential, investment attractiveness. The further development of clusters will provide the region with increased competitiveness based on synergistic effect and innovative approaches, which will result in the optimal use of the territory's available resources, as well as its economic, environmental, social and demographic sustainability.

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