RESEARCH ON THE ROLE OF THE CLUSTER APPROACH IN RISK MANAGEMENT AT INDUSTRIAL ENTERPRISES

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Abstract

The article studies the features of managing various types of risks. The main elements of risk management relevant for managing economic clusters are identified. The article studies the features of managing various types of risks. The main elements of risk management relevant for controlling of economic clusters are identified. Clusters are systems consisting of economic entities demonstrating development in a similar sector, formed by the location of related, complementary spheres of development in a certain geographical region, having a common infrastructure, technology, a single market, labour, opportunities for mutual establishment of trade relations, communication, mutual dialogue through the sharing of services. At the same time, it is assumed that competition and cooperation between small and medium-sized business entities in the clusters will be simultaneously ensured. Their demonstration of development within such a system gives a competitive advantage to small and medium-sized entrepreneurs. Consequently, with the introduction of the system, the costs of economic entities are reduced, marketing opportunities are expanded, productivity indicators are increased, their exports are increased, research and development opportunities are strengthened. At the same time, the promotion of new products, the creation of new industries, employment growth, leads to the development of regions, the improvement of infrastructure services. Clusters contribute to improving the material well-being of the population in the region by exporting goods and services in the form of groups of interrelated industries that serve to increase this location. Clusters cover the entire ring of the supply chain, support the provision of services, as well as dedicated infrastructure, which distinguishes it from traditional manufacturing industries.
Clusters have certain similarities, connections, and other trade among themselves, as companies and organizations with production ties demonstrate development in the same geographical area, they are formed.

Keywords: management of various types of risks, basic elements risk, innovation cluster, industrial cluster, competitiveness, economic efficiency

I. Introduction

With the cluster approach, it is important to take into account the self-development and self-organization of cluster structures. Clusters are not formed by chance; they are subjected to the requirements of the system. Clusters are subject to self-organization to a greater extent than other elements of economic entities. Synergy is a consequence of the joint use of specialized production facilities, scientific equipment, buildings, and engineering structures among groups of companies. It should be taken into account that in addition to the positive synergistic effect, a negative synergistic effect, which leads to an increase in risks for cluster participants may appear. Due to the synergistic effect, the authors of the article identified the risk of synergy (positive and negative synergy). To manage risks, an enterprise that is part of a cluster can be restructured to adapt to

changes in the external and internal environment of the enterprise.

Restructuring of an enterprise, which does not affect the rights and obligations of a legal entity, is the creation of a new structural unit, the liquidation of a division, the merger of structural units, the creation of a subsidiary or affiliated company [2]. Reorganization of an enterprise that is part of a cluster, in the form of creating a cluster of an auxiliary legal entity together with other enterprises, in order to manage the risks of cluster operation.

Among the main goals of clustering, one can highlight: increasing the risk resistance of cluster participants through the introduction of new technologies. The formation and support of a cluster economic model is a promising way to increase the risk resistance of enterprises. In the process of interaction of enterprises with each other within the same cluster, it is necessary to reduce the production time of products in compliance with the necessary requirements for it from a technological point of view. The effectiveness of cooperation between enterprises can also be manifested in the distribution of risk and responsibility in the event of adopting an effective (losing) version of the development strategy. The lower the probability of new potential competitors entering the industry, the higher the synergistic effect from the interaction of enterprises with each other. The closer enterprises are dispersed within one cluster to the leading raw materials center, the lower the costs of transportation and storage of products, and the higher the possibility of finding additional reserves and attracting resources for the development of activities. The cluster approach assumes that the competitiveness and risk resistance of each individual enterprise is largely related to the competitiveness and risk resistance of other enterprises that are part of the same value chain or provide the external environment of the value creation process itself.

In a market economy, producers and consumers are always faced with possible dangers, risks and fear of losses. Risk in business is not only a possible threat, but also an absolute reality. Risks reduce tactical and strategic expectations regarding the future development of the enterprise and organization. At the same time, it creates a feeling of uncertainty and hopelessness in achieving set up goals.

In a market economy, most risk management must be carried out by entrepreneurs themselves. An entrepreneur must logically and thoughtfully accept the risk and evaluate its impact on business development. An entrepreneur always faces certain risks in the process of entrepreneurial activity. Those who want to earn a lot of money, of course, often have to take risks. This is the basic rule of business.

There are objective reasons for the occurrence of risks when doing business. Because it is impossible to calculate the influence of all factors on the activity of an enterprise in the first place. Therefore, some important points in the implementation of planned activities may change unexpectedly. That is why an entrepreneur can always face a loss during the operation of the company.

World economic science considers cluster associations as an effective tool for improving the performance and sustainability of individual enterprises. Formation clusters with the purpose of distribution of risks between participants in a cluster association seem to be an effective risk management tool. At the same time, the effectiveness of combining enterprises into a cluster is also associated with high uncertainty and risks. Incomplete grades, as how consequence, ineffective risk- management lead to the failure of cluster projects and large financial loss of participants. Thus, the development of theoretical approaches and methodological tools for effective risk management of enterprises in the context of cluster association is an urgent scientific task.[9]

One of the effective methods of risk prevention is diversification. The purpose of diversification is usually to improve the performance of enterprises and gain their positions in the market (Table 1).

Table 1: *Basic advantages use diversification onenterprise [9]*

Advantages	Characteristic benefits
1. Effective control of the risks	Losses in one area of activity are compensated by obtaining greater profits from the sale of other products, while at the same time losses in one area of diversification activity - the enterprise will no longer significantly influence its financial and economic condition. So how will its share in income spirit cease to be dominant?
2. More complete usage resources	Allows you to mitigate the seasonality of production, increase worker employment, receive additional income from the timely and thoughtful maneuverability of the industry, and increase volumes faster. The production of those types of products for which there is demand and form entails the required price.
3. Receipt enterprises synergistic effect	Defined as a type of cooperation, interconnected and cooperatively deployed actions that can manifest themselves in the form of strategic partnerships, mutually beneficial cooperation, mergers and cooperative interactions and those very same, in one and other conditions, that increase the efficiency of activities.

It seems that to identify and conduct a detailed study of the essence of risks affecting the functioning of cluster structures, it is advisable to distribute them into general risks of enterprises and specific cluster risks. Of course, the formation and functioning of clusters are associated with many common enterprise risks that are characteristic of any organizational and legal form of the companies. Analysis of the conditions of formation and the functioning of industrial clusters allows us to identify two traditional areas of risk occurrence: the external and internal environments of the cluster, which determine the stability and efficiency of the cluster formation. [9].

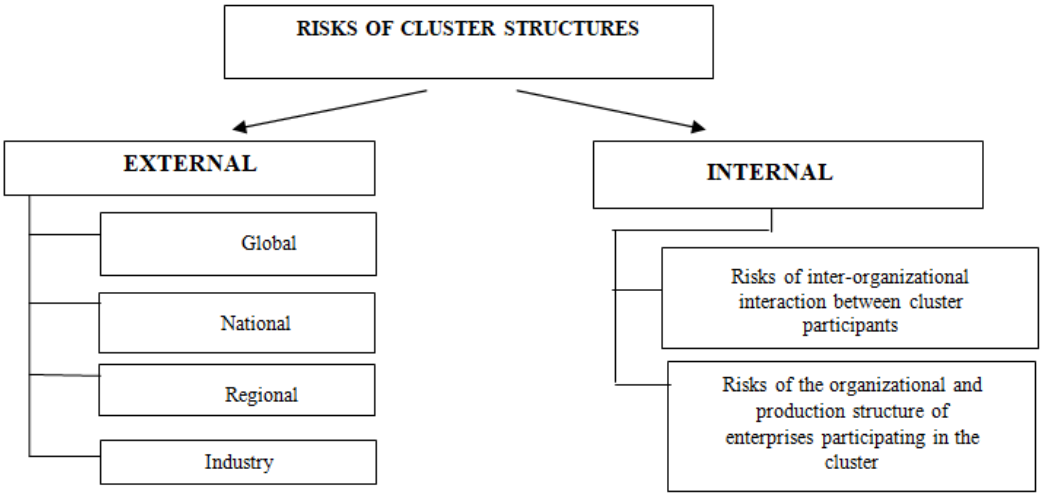

Figure 1: *General classification risks cluster structures.*

In modern economic science, innovative clusters are viewed as locomotives of economic progress due to their ability to enhance the competitiveness and innovation of businesses, and address issues related to employment, industry, and regional imbalances.

As regional entities, innovation clusters have an impact on the economy of the entire nation, given the intrinsic relationship between regional and national economic development. Innovation clusters that promote regional growth are integral to advancing the country's overall development. Furthermore, paradoxically, in the context of globalization, the significance of innovation clusters and their growth intensifies, as they have the potential to generate international and even global repercussions.

Globalization enables companies to allocate their resources and operations to the most suitable locations. Therefore, the wider the reach of globalization in markets, the greater the

likelihood of resource flows being directed towards regions that offer the most favourable business environments, thereby enhancing the significance of clusters and regional specialization. Further specialization within clusters promotes relationships with other clusters that deal with complementary values, fostering economic cooperation among neighbouring states instead of territorial disputes, resulting in mutual benefits for each state's economic development and stability in regional and domestic politics.

The interpretation of the "cluster" concept is shaped by the scientific approaches adopted by researchers studying the economic clustering process from various academic disciplines. It is worth noting the distinctive theoretical perspectives of different scientific schools. For example, scholars of the "America" ("California") school emphasized the significance of geographic proximity and shared specialization among enterprises, highlighting the interplay between competitive and collaborative mechanisms.

Representatives of the "Scandinavia" school highlights the central role of knowledge and innovation-driven interactions among enterprises in the development of regional and industrial clusters.

Muro M., Katz B. (Harvard Business School) noted the Four "Critical" characteristics of the cluster: proximity of enterprises and organizations included in it; connectivity factor of clusters; active forms of interaction between firms; The existence of a critical mass of participants in the cluster can affect the activities of the companies. [6]

It should be noted that the differences in the approach to defining the concept of "cluster" and the mechanisms of its formation led to the differentiation of the concepts of "industry" and "innovation" cluster.

An "innovation cluster" refers to a network of interdependent enterprises and affiliated organizations that complement each other and contribute to the advancement of innovation potential among each element of the cluster and the region as a whole. Some scholars perceive regional clustering as a gradual shift from innovative industrialization. Universities, engineering centres, and technological or innovation hubs serve as the nuclei of innovation clusters established through competence management, which entails acquiring new knowledge and sustaining innovation growth. The geographical scope of the technological chain underpinning the cluster may span across borders. Government support is an essential prerequisite for nurturing such clusters.

The main formation process for "industrial clusters" is technological chain (production process management) optimization and process management. State bodies may act as part of the cluster, but are not a mandatory component of it. The core of such clusters are companies that determine their technological and production integrity. The systematization of all of the above based on the analysis and generalization of leading scientific schools allowed the authors to distinguish 6 leading signs of territorial clusters:

1. Geographical proximity;
2. Critical mass of cluster participants;
3. General specialization of enterprises;
4. Competition;
5. Collaboration through knowledge-based relationships;
6. Innovativeness of production.

The term refers to the physical proximity, shared specialization of economic entities, dynamic competition and collaboration among all stakeholders, promotion of knowledge-based relationships, and active integration of all types of innovation into economic endeavours. [2]

Economic entities and participants of clusters encompass a wide spectrum, ranging from large corporations to small and medium-sized enterprises, scientific research organizations, and municipal and state authorities advocating for the advancement of regions and territories.

The disparity in defining clusters in foreign and local literature is contingent on the specific regional traits that shape their development. Most of the clusters are the result of the natural development process of the world economy and the territorial structure of its regions.

1. The research conducted unmistakably indicates that the concept of "cluster" has fortified its standing in contemporary economic science, and the tendency of fostering related legislation is discernible. Nonetheless, since there is no definitive scientific and legal clarification of the essence and features of clusters, there is a lack of consensus regarding their normative regulation.

2. The allocation of considerable financial resources of different levels of budgets for the creation and development of clusters gives special urgency to this problem. Therefore, the need for greater clarity in the understanding of the recognized category is not only derived from theoretical interests, but also aims to prevent inefficient spending of budget funds;

3. The notion of "cluster" was scrutinized, and a categorization of clusters in the economy was provided.

4. The research indicates that the economic clustering facilitates the formation of a comprehensive outlook on regional development policy, enhances the productivity, efficacy, and competitiveness of enterprises, widens the scope of innovation development, and optimizes interaction among diverse economic actors in the region, including the state, large and small enterprises, academic and research associations, and the public. Additionally, it leads to an improvement in the population's quality of life.

5. Cluster initiatives of regional economic development were explained. In addition, classification of the cluster development of economically developed countries and regions and analysis of the cluster structure of their economies and the obtained results are provided.

6. Institutions and tools for supporting and developing cluster initiatives in developed countries are reviewed.

II. Methods

Future research directions include analysing and proposing strategies for forming organizational structures for cluster management and determining their legal forms to ensure clusters' effective functioning. This includes considering internal factors as well as external challenges posed by globalization.

Research indicates that the term "cluster" was coined only three decades ago, during the final years of the 20th century. Nevertheless, governments of developed nations view the creation of innovative clusters at a regional level as a key driver for economic growth and recovery, despite its relatively recent emergence as a concept.

As the concept of cluster has various interpretations, it is more significant to examine it as a factor of economic growth and competitiveness from a political-economic standpoint. Therefore, in this context, a cluster can be described as:

1. Clusters are defined by some authors (implicitly or explicitly) as geographically close groups of firms that mainly produce the same product or service;

2. Clusters are a group of interconnected industrial enterprises located in a close geographical area;

3. Clusters are networks of firms, especially small and medium-sized enterprises and related institutions, within geographical boundaries, and organizations that cooperate with other enterprises that use the same basic technology.

The global search for ways to enhance the competitiveness of national economies has shown that the creation and advancement of clusters are worthwhile. The acceleration of globalization necessitates effective solutions for the issue of economic clustering at both the national and regional levels.

Michael Porter, a professor at Harvard Business School, is a prominent figure in the field of competition and competitiveness research in the United States. He is the founder and advocate of the cluster theory in economics and the author of the theory of competitive advantage. Porter suggests that competitive firms in a particular industry can be found concentrated in a specific region or country. In his book "The Competitive Advantage of Nations" (1990), he proposed a theory of national, state, and local competitiveness within the global economy. This theory

highlights the significance of clusters and underscores the importance of understanding the role of geographical location in shaping the competitive advantage of clusters, rather than individual firms and industries in isolation [1].

M. Porter has developed multiple definitions of the cluster phenomenon, and each of them is characterized by its own unique features and particularities. One of the most common definitions is as follows: "a cluster is a group of companies and related organizations operating in a certain area, characterized by joint activity and complementing each other, geographically close to each other." The scientist also defined the cluster as "a system of interconnected firms and organizations whose value as a whole exceeds the simple sum of its constituent parts", thus emphasizing its synergistic effect. In Porter's definitions, attention is paid to the main features such as geographical concentration (localization) of cluster members, close ties between cluster members, and the combination of competition and cooperation in the cluster.

M. Porter suggests that clusters are more effective than individual industries in achieving a balance between competition and competitive advantage. Clusters can leverage linkages, complementary industries, technology diffusion, expertise, information, marketing, and awareness of consumer needs. He further argues that the competitive advantages in the global economy are largely connected to the location of clusters, which benefit from the concentration of specialized skills and knowledge, institutions, interconnected economic activities, and consumers in a specific geographic area [3].

Clusters can be called local interconnected groups of small, medium and large enterprises and various research institutes that produce complementary products, compete and at the same time cooperate.

In this regard, M. Porter called for the funds earned in the commodity sector to be directed to the diversification of the economy and the development of clusters.

The classical clusters proposed by M. Porter in 1990 are distinct from the innovative clusters that are currently being studied and formed. While Porter's original approach to clusters was innovative, aiming to improve professionalism, specialization, customer relationships, and complementary products and services, the goal of innovative clusters is to establish more sustainable production and service facilities, associations, and start-ups by introducing new techniques and technologies. This includes constant development, enrichment of new ideas and analytical tools, and maintaining the dynamism of developing clusters.

The clustering of the economy of individual territories determines their most efficient integration into the world economic system, allows for the collection and optimal use of resources in terms of global trends, and helps to increase the efficiency of the state's industrial policy. Clusters have become one of the main driving forces and determinants of the competitiveness of geographical regions, their effectiveness is confirmed by world experience. Clusters allow to increase the competitiveness not only of their enterprises, but also of specific areas of activity within the region, including expanding the application of innovations, reducing transaction costs, developing and strengthening relations between business, science and the state.

Cluster policy is traditionally understood as a set of measures aimed at increasing the competitiveness of the national economy by stimulating the development of clusters.

Synergistic and synergistic benefits obtained from the organization of a cluster consist not only of increasing the efficiency of its work as a whole compared to the efficiency of individual participants, but also of mutual strengthening of the competitive positions of both industrial production and the territory it covers.

As previously noted, the use of regional economic clustering is increasingly being utilized to enhance the effectiveness of the entire economic system of countries worldwide. The growing number of cluster initiatives in numerous countries, including both developed and developing nations, have demonstrated their feasibility and efficacy. Cluster policy is now integrated into the innovative and regional development strategies of various countries globally, and clusters have become crucial to their economies.

The most important factor for increasing the efficiency of industrial production in cluster enterprises is the improvement of management within the framework of the creation of an information system for the management of industrial clusters.

The possibility of evaluating the efficiency of the presence of clusters through the assessment of its organizational cost and competitiveness can be considered. In this approach, the evaluation of competitiveness of clusters is carried out from three positions. The assessment of the dynamics of market positions is carried out through the analysis of the change in the share of cluster enterprises in the industrial volume of production in the world market; increase in export volumes for the cluster; the number of new markets in which firms - cluster participants participate.

Another methodology for evaluating the efficiency of the newly created cluster consists of 5 integral characteristics. Each of them consists of several assessment criteria that have different weights during the analysis:

1) Availability of competitive enterprises;
2) Implementation of innovative projects;
3) Increasing the economic indicators of the field;
4) Existence of mutual relations between cluster participants;
5) Geographic proximity of cluster participants, correct choice of cluster participants and their number.

The analysis examines various indicators to evaluate the success of cluster enterprises. These include the growth of economic indicators in the industry, the increase in the share of work and services provided by cluster enterprises, the percentage of employees working in cluster enterprises compared to the total number of employees in the industry, and the updating of main assets through increased investments in the region. The effectiveness of relationships between cluster participants is evaluated based on their ability to cooperate, create necessary infrastructure, and the managerial skills of the heads of the cluster enterprises. The selection of cluster participants, including their number and geographical proximity, is assessed by considering the territorial location of participants and the selection of the minimum number of enterprises with the maximum share of their participation in the internal market [7]

When evaluating the economic efficiency of industrial enterprises in the conditions of clustering, the following must be taken into account:

1. Cluster life cycle,
2. The interests of each economic entity included in the cluster,
3. Evaluation of efficiency at three levels: enterprise, region, territory.

III. Results

Six key characteristics can be identified for cluster derivatives of industrial enterprises formed in different regions of the world. Some of these characteristics describe the participants of the cluster, such as the leading enterprise that connects all the other participants in the value chain and smaller enterprises with a higher level of innovation in their production processes. Others determine the direction of development for the enterprises, such as a focus on internationalization through direct foreign investments and export of the final product. The formation of clusters cannot occur without direct or indirect support from the state. State cluster policies stimulate the development and improvement of relationships and competition in both domestic and foreign markets. In a free market environment, competition between companies plays a decisive role in the cluster. The more producers there are of the same product, the more efficiently the cluster market mechanism works, leading to lower production costs for the final product. [4]

Innovative cluster enterprises also have the following positive effects:

1. Effects of production scale (provides a multiplicative effect of cluster operation due to the interaction of companies);

2. Covering effect (occurs when the production factor is used in the production process of not one, but several types of products);

3. Synergy effect (an effect resulting from the movement of coordinated mechanisms in time and space, which is essentially different, but causes fundamental qualitative changes in the entire system under consideration);

The presence of these effects enables cluster enterprises that experience losses in the short term to overcome difficulties and achieve significant competitive advantages in the long term. The nature of innovation clusters gives them the ability to provide substantial benefits to their participants by combining cooperation and competition within the cluster, resulting in a synergistic effect that enhances the competitiveness of the entire system. In comparison to industrial clusters, innovative clusters are comprised of organizations that generate new knowledge, such as research centers or universities. This allows for the coordination of efforts and funding to create new products and technologies, as well as the formation of a complete technological chain, beginning with the conception of an idea and ending with the introduction of new products to the market.

The economic effect created by innovative clusters is the object of analysis of many scientific articles and studies, the results of which have been published in the last decade. In modern economic science, innovative clusters are considered locomotives of economic development.

Based on all this, in general, assistance (support) to the formation and development of innovative clusters by regional authorities should be implemented in the following directions:

- Creation of conditions for constructive dialogue between business and government, alignment of interests of cluster members and strengthening of cooperation between them;
- Stimulation of demand, formation of consumer preferences in the region, development of related and supporting areas of the economy, state orders;
- Development of the vocational education system in order to form the necessary competencies in the region;
- Development of foreign relations, elimination of trade barriers, protection of intellectual property rights, implementation of joint infrastructure and investment projects;
- Creation of favorable economic, institutional and other conditions in the region;

Innovation clusters, which operate at a regional level, have a significant impact on the national economy due to the direct link between regional and national development. Nevertheless, their importance extends beyond the national level as they can have international and even global impacts, especially in the context of globalization.

In addition to the above, in the organization and management of clusters, not only in the public sector, but also in the private sector, the attitude towards this field should be strengthened and a sufficiently efficient environment for entrepreneurs should be created.

One of the advantages of cluster management of an industrial enterprise is the ability to concentrate management influences on the most promising areas of activity and their support. The cluster is a sustainable territorial-industry partnership of enterprises and entities united by an innovative program for the introduction of advanced technologies to increase the sustainability of cluster participants in the market of manufactured goods, works, and services. The cluster includes independent enterprises, the cooperation of which is beneficial to each of the participants and generally increases their sustainability and profit.

IV. Discussion

The cluster development stages are as follows: at the formation stage, cluster members collaborate around the main activity and explore common opportunities, making it impossible to assess effectiveness. Thus, only economic activity indicators such as the dynamics of Foreign Direct Investments, production volumes, state support, and the number of jobs created can reflect the actual situation. Since performance indicators are not considered at this stage, the efficiency weight index value will be 0, while the performance will be 1.

During the "development" stage of the cluster, the area of interaction between the cluster members expands, new participants are involved in the work, and new formal and informal

institutions are formed. At this stage, it is possible to evaluate the activity of enterprises in terms of both efficiency and productivity on all the proposed indicators.

The stage of "maturity" is determined by the degree of reaching a certain critical mass of participants, which allows forming and permanently maintaining constantly updated relations between cluster members. At this stage, it is possible to use all the recommended indicators (except for the number of jobs created).

In the "decline" stage, some indicators can no longer show positive dynamics (for example, the growth rate of the production volume, the company's market share, the number of highly productive workplaces, the volume of shipped innovative products and scientific-research works).

To put it differently, the approach suggested for evaluating economic efficiency allows for a range of values between 0 and 1 for the economic efficiency index.

$$0 < I_{EE} < 1$$

The lower the value of the index, the lower the economic efficiency of the enterprises in the cluster.

Our opinion is that contemporary approaches to assessing the effectiveness of clusters should consider the various stages and factors involved in their development, along with the concerns and objectives of all involved parties. It's important to note that the methodology we propose is only applicable for evaluating clusters that are of the same type and can be compared.

In clusters, higher labor productivity is achieved, as well as higher employment opportunities. At the same time, the role of regional authorities is as follows: using information opportunities to attract new participants to clusters; tax policy stimulating the development of clusters; simplification of establishment procedures; facilitating access to start-up and venture capital.

Constant improvement of worker qualifications is a crucial requirement for successful economic clustering in the rapidly evolving technological landscape. However, US companies are currently falling behind their counterparts in Europe and Asia in terms of investing in their employees' training, both in production and otherwise. Compared to regions like Europe, Japan, and Southeast and Southwest Asia, US employers allocate fewer resources per employee towards training.

The evaluation of the economic efficiency of the clusters consists of 6 main stages:

Stage I: The assessment of cluster formation involves examining various factors such as proximity of the businesses, common areas of specialization, number of participants, collaboration on scientific research and innovation, competition and cooperation. It's important to note that the absence of any of these factors would make it inappropriate to evaluate the performance of the cluster.

Stage II: The selection criteria can be evaluated by determining the nature of the clustering action factor, such as forming pairs of factors like foreign direct investment, executive directions, the primary consumer, and market competition and innovation for small and medium businesses.

In order to develop the cluster on the basis of "direct foreign investment-export directions", it is absolutely necessary to analyse the indicators of the volume of foreign direct investment and export.

If the cluster is formed and develops on the basis of the main consumer - market/competition, then the price indicator is the organization of the number of workplaces, the volume of production, tax and profit of the enterprise in the market. If the enterprise cluster works on the basis of "innovation - small and medium-sized business", then the issues of evaluating the volume of scientific research and construction works, the volume of innovative products and the organization of workplaces must be analysed.

Stage III: Efficiency and result indicators are employed to assess the performance of industrial companies within the cluster, and these are referred to as selection indicators.

The level of achieving the planned result characterizes the final result. For example: the organization of the number of jobs, innovation products, exports, taxes, etc.

Taxes allocated to the population, growth rate of production volume, export level; the rate of growth of the enterprise in the market and the volume of state aid characterize the efficiency indicators.

For an objective assessment of the result, the cumulative index of efficiency can be used. Which is calculated as the sum of the achieved indicators of the planned results:

$$I_{ef} = \sum_{n=1}^{k} \alpha_n R_{fh}/R_{ph}$$

Here, I_{ef} - integrated productivity index;
R_{fh} – the actual indicator of productivity;
R_{ph} - planned indicator of productivity;
K is the sum of indicators, $0 < \alpha_n > 1$, if the indicators are equal, then $a_n = 1/K$
We propose to calculate efficiency as a cumulative index. This is calculated as the sum of quality indicators of the achievement of results:

$$I_{ec} = \sum_{n=1}^{k} b_n E_{fn}/E_{pn}$$

Here I_{ec} is the integrated efficiency index,
E_{fn} – the actual indicator of efficiency
E_{pn} – planned indicator of efficiency,
K' is the sum of indicators, $0 < \beta_n > 1$, if the indicators are equal, then $\beta_n = 1/K'$
Thus, the economic efficiency can be calculated as the subtotal of the total efficiency index and the efficiency index:

$$I_{EE} = {}^{1}/_{2}\, I_{ec} + {}^{1}/_{2}\, I_{ef}$$

Here:
I_{EE} – economic efficiency,
I_{ec} – efficiency index,
I_{ef} – general index of results (integral index).

Stage IV: Selection of signs characterizing the efficiency of the work of different types of economic subjects. It is proposed to distinguish:

1. Large business enterprises (main manufacturers),
2. Enterprises belonging to medium and small businesses,
3. Research and educational institutions.

At this stage, it is necessary to evaluate the activity of each enterprise in terms of its characteristics and possible participation in the cluster work.

Finally, the calculation of efficiency or effectiveness indices is carried out on the basis of specific indicators. For example: the efficiency index for large business enterprises is calculated by the following formula (number of indicators K=3).

$$I_{efbb} = 1/3\Delta V_{prf}/\Delta V_{prp} + 1/3\Delta V_{exf}/\Delta V_{exp} + 1/3\Delta WP_f/\Delta WP_p$$

Here:
I_{bb} – efficiency index of large business enterprises,
ΔV_{prf} – dynamics of actual production volumes,
ΔV_{prp} – dynamics of planned production volumes,
ΔV_{exf} – dynamics of actual export volumes,
ΔV_{exp} – dynamics of planned export volumes,
ΔWP_f – the dynamics of the number of actual workplaces,
ΔWP_p – the dynamics of the number of planned workplaces.

Stage V: Determining the efficiency of cluster work and its criteria, taking into account the development interests of enterprises, the region as a whole or a separate field.

To assess the development of individual businesses, it is crucial to analyze changes in production volumes, adoption of innovative products, market share, and employment rates. Indicators of sustainable growth in both domestic and foreign markets can be determined by evaluating export volumes and the share of industry enterprises in the market. The indicators of

socio-economic progress in the regions include the number of new jobs (including high-productivity roles) and the trend of taxes per capita. The selection of indicators at this stage is based on a similar approach to the previous stage.

Stage VI: Consideration of the possibility of realistic evaluation of activity indicators at different stages of the development of cluster enterprises. For the correct assessment of economic efficiency, it is necessary to take into account the weight of each of the indices:

$$I_{EE} = j_{ec} I_{ec} + j_{ef} I_{ef}$$

Here:
I_{EE} – Economic efficiency,
I_{ec} – Efficiency index,
I_{ef} – Consequentiality index,
j_{ec} – Efficiency weighting factor,
j_{ef} – is the activity measurement factor.

The significance of the weighting coefficients varies in all four stages of production and is directly proportional to the number of indicators considered in calculating the integral productivity indices.

The weighting coefficients are assigned greater importance as more indicators are included in calculating the integral productivity indices, and this varies across the four production stages. The efficiency weighting factor is determined by dividing the efficiency or effectiveness indicators considered during the analysis by the total number of such indicators evaluated for that particular stage of cluster development.

$$j_{ec} = N_{ec}/(N_{ec} + N_{ef}); \quad j_{ef} = N_{ef}/(N_{ec} + N_{ef})$$

Here,
j_{ec} – the efficiency weighting factor,
j_{ef} – activity measurement factor,
N_{ec} – the number of analyzed indicators of economic activity and
N_{ef} – the number of analyzed indicators of economic activity.

References

[1] Porter, M.E. The Competitive Advantage of Nations, Free Press, New York, 1990.

[2] Michael E. Porter. Clusters and the New Economics of Competition, Harvard Business Review. November-December 1998. Retrieved 3 August 2018

[3] Porter Michael E. Location, competition, and economic development: local clusters in a global economy // Economic Development Quarterly, Vol. 14. - № 1, February 2000, 15-34 s

[4] Rosenfeld S.A. Industrial-strength strategies: regional business clusters and public policy. Washington, The Aspen Institute Community Strategies Group. – 1995, 150 s.

[5] Enright, M. J. Survey on the Characterization of Regional Clusters: Initial Results. Working Paper, Institute of Economic Policy and Business Strategy: Competitiveness Program, University of Hong Kong, Sun Hung Kai, 2000, 21 s

[6] Muro M., Katz B. «The New Cluster Moment: How Regional Innovation Clusters Can Foster the Next Economy» // Brookings Institution Metropolitan Policy Program, September 2010. (in Russian)

[7] United Nations Industrial Development Organization. Available at: http://www.unido.org 165. Van der Linde C. The Demography of Clusters, Findings from the Clusters Meta-Study // Innovations Clusters and Interregional Competition. Berlin, 2003. pp.130-149.;

[8] World Economic Forum «The Global Competitiveness Report 2009-2010». Available at: http://www.weforum.org/en/index.htm

[9] Izmalkova, I.V. Risks of the formation and functioning of a cluster model of development of organizations. articles of the 8th All-Russian scientific and practical conference with international participation / Southwestern State University. 2018. (in Russian)