REVISTA ESPACIOS

Formation and development of industrial clusters in the socio-economic regional system

Formación y desarrollo de clusters industriales en el sistema socioeconómico regional

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ABSTRACT:

Within the industrial cluster, an active exchange of information between interrelated economic entities takes place, and the conditions for their economic activity are coordinated. The cluster mechanism allows to reduce the element of uncertainty and provides a high degree of foresight of the market situation for the cluster participants. The initiative to form and develop industrial clusters should come from the executive and local government bodies that should promote the institutional development of clusters, including organizational support for cluster creation.
Keywords: industrial cluster, regional economy, management system, construction algorithm.

RESUMEN:

Dentro del clúster industrial, tiene lugar un intercambio activo de información entre entidades económicas interrelacionadas. El mecanismo de clúster permite reducir el elemento de incertidumbre y proporciona un alto grado de previsión de la situación del mercado para los participantes del clúster. La iniciativa para formar y desarrollar clusters industriales debe provenir de los gobiernos ejecutivo y local, que promueven el desarrollo institucional de los clusters, incluido el apoyo organizativo para la creación de clusters.
Palabras clave: clúster industrial, economía regional, sistema de gestión, algoritmo de construcción.

1. Introduction

As an economic agglomeration of interconnected enterprises, the cluster is a point of growth or an important factor in the sustainable social and economic development of the region. The cluster policy, firstly, creates the conditions that help activate innovation activity in the real sector of the economy and its modernization for the formation of technological leaders. Secondly, in the conditions of insufficient resources and inconsistent policy of the state, this

policy allows to solve the acute social problems of the region. According to modern global economic trends and the priorities of the development of society, social development becomes a strategic goal that provides stability and competitiveness of the territory (Lundvall, 1993; Maillat, 1998).

Accordingly, the role of socially-oriented clusters in the region is growing. Such clusters, as a rule, have a global character; they are aimed at improving the quality of life of the population providing food, improving health and reducing mortality, raising the level of education and culture, and environmental safety of life.

In the field of forming a socially-oriented cluster policy, there are numerous works of foreign and domestic scientists. However, they do not represent systematic studies on the problems of identifying such clusters, diagnosing their development, developing mechanisms for their state support, creating the necessary infrastructure and development institutes, elaborating rules for interaction between cluster participants, the state authorities, and management bodies, their business structures, scientific and educational institutions, public organizations and so on (Martin & Sunley, 2002).

In addition, practical experience in the implementation of cluster policy in the regions of Russia indicates the emergence of new types of socially-oriented clusters, whose activities are aimed at creating products that contribute to a sharp increase in health and life expectancy and reduce mortality, which, ultimately, will allow:

- to reduce consumer prices for vital and socially important drugs; cut government spending related to the creation and implementation of modern technologies for diagnosis and treatment of diseases; change the structure of budget health expenditures;
- to bring the level of development of domestic healthcare and the pharmaceutical and medical industry to the world level;
- ensure import substitution and increase the competitiveness of domestic medical and pharmaceutical products;
- to change sanitary and epidemiological, and building norms and standards; put medical and economic standards in accordance with international requirements;
- to take education in this sphere to a qualitatively new level and to change the structure of labor remuneration.

Such structures differ from the existing socially-oriented clusters by their goals and objectives, functionality, architectonics, peculiarities of their interaction with the state (Belyakova, 2005).

2. Literature review

In the economic literature, there is a significant number of definitions of cluster, which is the basis of the cluster theory of economic development. Thus, M. Porter defines cluster as geographically neighboring interconnected companies (suppliers, producers) and related organizations (educational institutions, government bodies, infrastructure companies) operating in a certain sphere and complementing each other (Porter, 2005).

The cluster approach was also used by E. Dahmen to identify and study the interrelationships of large Swedish multinational corporations. According to E. Dahmen, clusters are formed in "development blocks", the basis for the development of competitive success is the connection between the ability of one sector to develop, and the ability to ensure progress in another. Development should be carried out in stages, or on the "vertical of actions" within the same industry as other industries, which will provide an opportunity to gain competitive advantages.

The French scientists J. Tolenado and D. Soulie used the concept of "dies" to describe groups of technological sectors. The formation of dies was explained by the dependence of one sector on another on the technological level. Thus, "dies" are very close in meaning to the term "cluster", since the basis for their development is the need to create technological links between sectors of the economy in order to realize their potential advantages. E. Leamer considered clusters with a high level of correlated exports in his analysis of trade at the national level.

According to A.A. Migranyan, cluster is "concentration of the most efficient and interconnected types of economic activity, that is, the set of interconnected groups of successfully competing firms that form the "golden section" (in the Western interpretation the "diamond") of the entire economic system of the state and provide competitive positions on the sectoral, national and world markets."

T.V. Tsihan identifies three broad definitions of clusters, each of which emphasizes the main feature of its functioning:

- regionally limited forms of economic activity within related sectors, usually tied to one or another scientific institution (research institute, university);
- vertical production chains; rather narrowly defined sectors in which the adjacent stages of the production process form the core of the cluster (for example, the chain "supplier ® producer ® marketer ® client"); the same category contains the networks formed around the head firms;
- industries identified at a high level of aggregation (for example, a "chemical cluster") or a set of sectors at an even higher aggregation level (for example, an "agro-industrial cluster") (Tsihan, 2003).

M. Afanasyev and L. Myasnikova believe that the main thing in the structure of a cluster is the spread of innovations to the whole value chain and to the single logistic window for interaction with the external environment.

There is no single, strict definition of the cluster, which is due to the incompleteness of Porter's concept. Over the years, various authors have given different definitions to the concept of cluster.

Clustering implies diversity, not single firms. In the absence of such diversity, each observed agglomeration probably consists of an expanded enterprise, where other companies or units can serve only as subcontractors or customers in relation to the main organization.

Likewise, group companies incorporated as affiliates, controlled through formal joint ownership, are not independent and are usually subject to their own costs and benefits.

Generalizing the concepts of a cluster above, we can single out the following essential features:

- the presence of leading companies having a significant share in the domestic and foreign markets, supplemented by specialized service organizations;
- concentration of cluster participants in a limited area that presents unique advantages;
- interaction of the cluster participants for the purpose of producing competitive products in the domestic and foreign markets;
- competition between the cluster members;
- accelerated distribution of innovations due to the developed information transfer (Gorsheneva, 2006).

3. Materials and methods

In our work, the following methods and techniques of economic research were used: integrative, system-functional, computational-constructive, logical-structural, economic-statistical methods (observation, generalization, comparison, grouping, graphic method).

The scientific novelty of the study is the development of directions for modernization and improving the efficiency of the regional economy based on cluster approach.

Among the elements of increment in scientific knowledge are:

- justification of the need to apply the cluster approach as the most effective form of organizing the economic space of the region, which made it possible to define cluster policy as a set of organizational and economic relations formed in the process of creating and increasing the competitiveness of the region on the basis of formation and development of clusters between regional authorities and business entities;
- clarification of the essence of the industrial cluster as a set of geographically separate interconnected enterprises (research and development institutes, educational institutions,

population, organizations) whose activity is aimed at the formation of an effective infrastructure and innovation component, the competitive advantages of the cluster and region and the manifestation of the multiplicative effect, which made it possible to determine requirements for stimulating the processes of modernization (Egorov, 2006; Fedorova, 2005; Larionova, 2007; Menshenina, 2008).

4. Discussion

4.1. The cluster approach in industry

Industrial clusters, which include the machinery and equipment production, are a group of geographically localized interrelated companies, integrated into the production chain, within which the final product and added value are created.

Let us consider the general structure of the cluster (Fig. 1):

- as a rule, the "face" of the cluster is one branch, whose products the cluster exports; this is the "core" – the objects performing the main activity around which clustering occurs;
- "complementary" objects, whose activities directly provide the functioning of the "core" objects;
- "service" objects, the presence of which is mandatory, but whose activities are not directly related to the functioning of the "core" objects;
- "auxiliary" objects; their presence is desirable, but not necessary for the functioning of other cluster objects.

Figure 1
General cluster structure
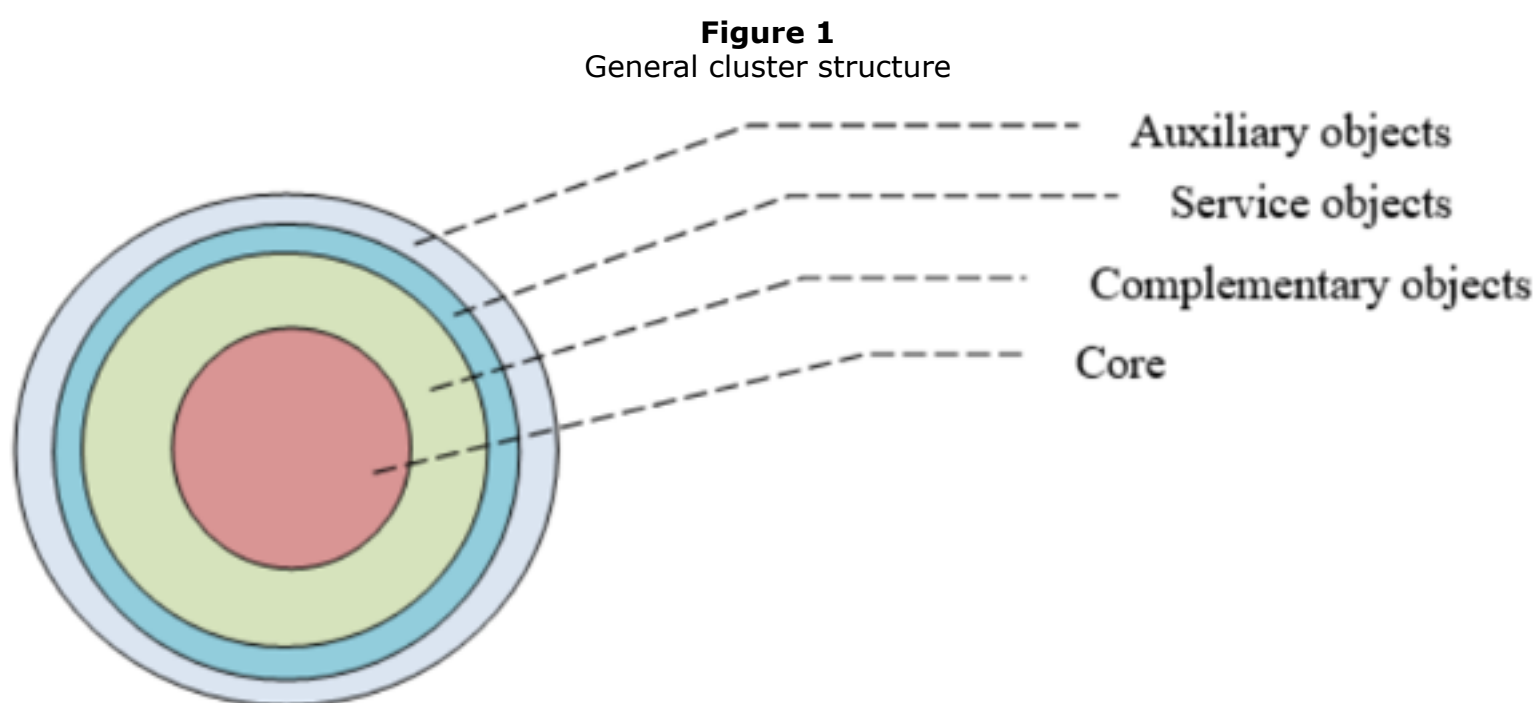
Source: Prepared by the authors

A cluster model of innovation development, where an active role is played by enterprises of the machine-building complex, can be based on:

- the integration interaction of enterprises located in a certain territory (for example, in the region),
- the integration interaction of enterprises of different industries, connected by a single industrial and technological chain.

The possible structure of an industrial cluster is shown in Figure 2.

Figure 2
The structure of an industrial cluster
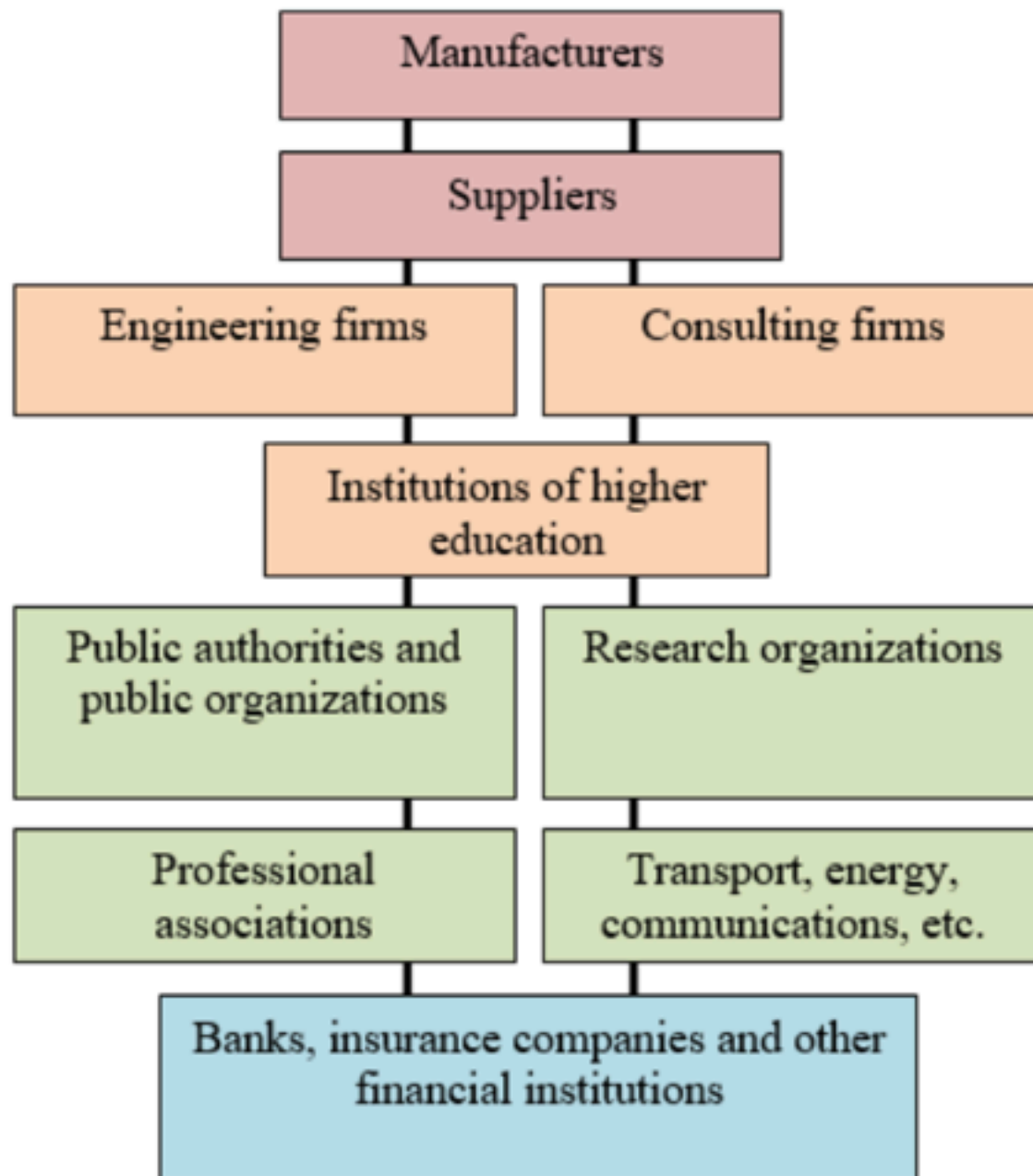
Source: Prepared by the authors

To organize interaction, it is necessary to take into account the interests of the stakeholders: society, nature, production.

Clusters include producers and suppliers, engineering and consulting firms, research organizations and universities, credit organizations and banks, infrastructure, regional administrations, professional and public organizations. One of the key success factors for the development of clusters is the availability of working links and coordination of efforts among the cluster participants (Menshenina, 2008).

Direction of interaction:

- Vertical links (descending, ascending) – cooperation between firms occupying different levels in the production chain.
- Horizontal links – cooperation between firms occupying the same level in the production chain.

The direction of interaction and the role of the interacting firms are shown in Table 1.

Table 1
Directions of interaction and the role of interacting firms.

№	The role of interacting firms	Horizontal links	Vertical links
1	Buyer-seller	Sale of information, technologies, sale of equipment. Supplies of raw materials. Provision of specialized services	
2	Competitor-partner	Joint marketing. Technological exchange. Joint quality control	

3	Consumers of shared resources	Joint purchase of raw materials. Joint training of employees. Joint information acquisition. Joint acquisition of technology. Co-financing

Source: Prepared by the authors

The roles of interacting firms:

- Buyer-seller
- Competitor-partner: being competitors, the firms in the cluster realize that together they can more effectively solve common problems. As a result, there are many forms of cooperation, and the competitiveness of the entire cluster as a whole increases.

Consumers of shared resources: interaction arises from the cooperation of firms in the use of common resources.

4.2. Industrial cluster as an example of interpenetration of clusters

The industrial cluster is a good example of the interpenetration of clusters. Its main specialization is the production of equipment for the forest industry, energy, metallurgy and construction, as well as transport, i.e. for the industries, which by definition are included in the composition of the corresponding clusters.
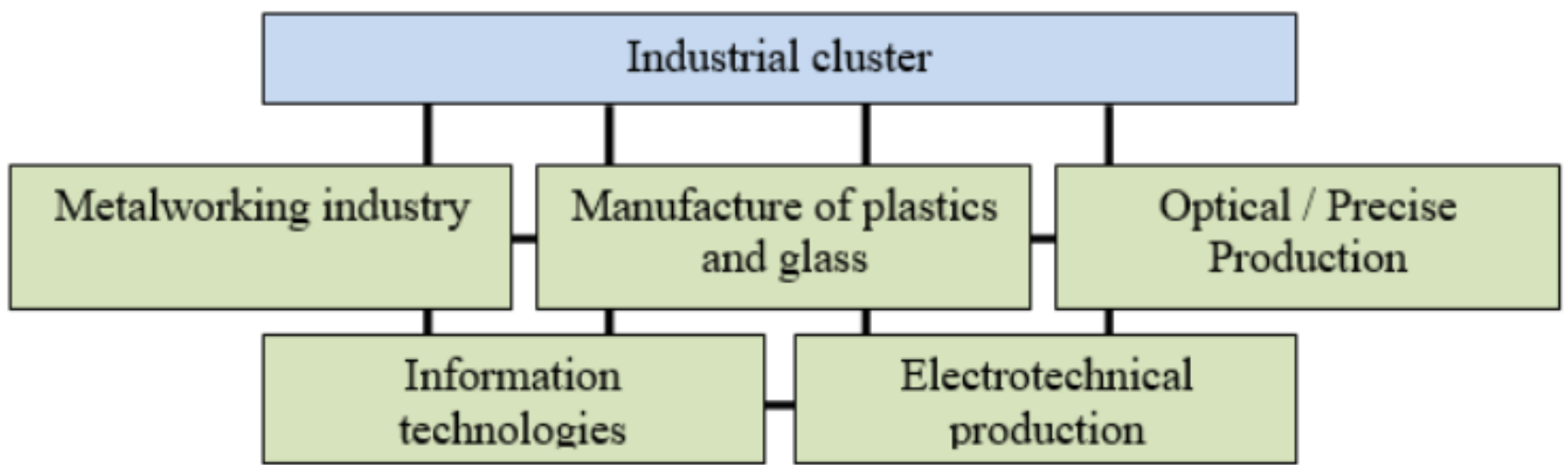
However, the intensive development of specialized machine building led to the formation of an independent cluster with a number of specialized suppliers, service and engineering companies, research and innovation centers (Bogoviz Alexei, Vukovic Galina & Stroiteleva Tamara, 2013). And although domestic demand remains an important factor of competitiveness and the driving force behind the development of equipment manufacturers, machine-building companies have long been important actors on the international market.

The complex technological structure of the machine-building complex requires a good connection of various functional areas of the production system and should be based on close integration between enterprises of different sub-sectors and sectors of national or regional economy. The result of this integration in the system of innovative development can be the formation of appropriate clusters. Integration of various enterprises can be carried out in various forms using a variety of mechanisms, the choice of which depends on the specifics of production, the market situation, the conjuncture, and so on (Fedorova, 2004; Rudneva, 2007).

The formation of a cluster in the machine building complex is based on the creation of the corresponding associated groups of enterprises (one or several industries) concentrated in a certain territory. Such a cluster model allows integration of machine building into the system of world economic relations, through the establishment of horizontal and vertical links of interterritorial cooperation.

Possible links of the industrial cluster are shown in Fig. 3.

Figure 3
Clustering industries

Thus, one of the indications of the industrial cluster in the general model of production-cooperative and other interactions of economic entities is the principle of territorial localization. Unlike conventional forms of cooperative and economic interactions of small, medium and large businesses, cluster systems are characterized by the following features:

- presence of a large enterprise-leader, which determines the long-term economic, innovative and other strategy of the whole system;
- the presence of a large leading enterprise, which determines the long-term economic, innovative and other strategy of the whole system;
- territorial localization of the bulk of economic entities – participants of the cluster;
- the stability of economic relations of economic entities participating in the cluster, the dominant significance of these links for the majority of its participants;

long-term coordination of interaction of participants in the system in its production programs, innovation processes; basic management systems, quality control, etc.

4.3. The key characteristic of the cluster is the increase of competitiveness of its companies

It is generally believed that one of the sources of this increase is the efficiency of the use of factors of production.

In the postindustrial economy, however, the emphasis shifts from the factors of production and distribution to intangible, institutional factors. Moreover, the exchange of the key competences of its participants is of particular importance in the cluster.

There are several models of cluster formation. Let us consider three of them:

- technological cluster model;
- business model of the cluster;
- model of the relationship between the cluster and the determinants of the competitive advantage.

Based on these models, it is possible to implement the methodology for forming an industrial cluster.

The following technology of forming a cluster is proposed:

- development of a cluster technology model using the basis factors – determination of growth points, opportunities and weaknesses of the cluster; identification of the ways of technological development and cluster boundaries;
- building a business model based on the cluster core (defining the core of the cluster, the links between enterprises within the cluster, and potential business opportunities);
- the formation of a model of relations between the cluster and the determinants of the competitive advantage (based on the adaptation model for the formation of a competitive cluster in the conditions of Russia).

The technological model of the cluster. Consider the factors on which the cluster technology

model will be based:

- the model takes into account the products of enterprises related to each other, both production links, and the shared raw materials, technologies, the interchangeability of personnel, etc.

A number of enterprises are represented in the model, taking into account both existing competitive manufactures and potential cluster members;

- the model implies the use of different types of connections between the cluster enterprises, including supplier-buyer relations, competitor-competitor, supplier-potential buyer;
- taking into account the uneven distribution of competitiveness of the enterprises under consideration, cluster leaders are identified – highly competitive enterprises, as well as mid-level enterprises with a potential to increase competitiveness, and non-competitive companies;
- the model can be expanded by reviving enterprises that are currently experiencing problems.
- the model is created on the basis of the conducted research; the concept of potential competitiveness is the essential point, since with the low estimations of some enterprises, the majority of them still has a high potential for competitiveness, because the output can indeed be claimed by the market. Enterprises-participants of the cluster may have different competitiveness assessment, which should be taken into account when building models. The possible solution may be the use of graphic and color interfaces.

Geographical proximity promotes the exchange of these implicit knowledge, and allows to create a market of skilled labor that enables, instead of organizing the transfer of knowledge, to employ its carrier in the company. It is these circumstances that explain that certain types of occupations or approaches to occupation are usually developed and practiced in a strictly limited territory.

Similarly, the importance of informal communication of company representatives with consumers located in its area is important.

Thus, geographical proximity is important not for the dissemination of formalized scientific knowledge, but for the dissemination of less formal implicit knowledge.

The decrease in transportation and communication costs that has been in place for a long time has an ambiguous effect on geographical concentration.

On the one hand, the importance of geographical proximity for the successful interaction of firms is reduced in part. On the other hand, the transfer of implicit knowledge continues to be based, first of all, on personal contact, while low transport and information costs contribute to further division of labor and the specialization of regions. The advantages of the approach of allocating clusters, including major clusters, are that it allows a complex, systemic view of the situation in a group of interrelated enterprises belonging to different sectors. In addition, the cluster approach allows to use initiatives put forward and implemented by business leaders as initiatives of the cluster development strategy, which, therefore, will be successfully implemented.

4.4. The experience of foreign countries in the formation and development of industrial clusters

Six models of forming industrial clusters have been identified.

The Italian model: there is a large number of small firms, united in various associations to improve competitiveness. The model is applicable for products of low technological level with a high degree of differentiation and fluctuations in demand.

The Japanese model is formed around the leading company with a large-scale production, integrating a lot of suppliers at different stages of the chain; it is applicable for the production of technologically complex products. Product development requires high fixed costs, which can pay off only with a large volume of sales.

The Finnish model is characterized by a high level of innovation, supported by a powerful sector of research and development, and developed education system. Internationalization of business is intrinsic. It is most applicable for small compact countries that have relatively scarce natural resources and are export-oriented.

The North American model emphasizes competition between enterprises; it is applicable if the production process does not involve the establishment of close relationships. Due to the competition between suppliers in the cluster, and mass production, the head company achieves a low cost of the final product.

The Indo-Chinese model: the key role is played by the state. The main emphasis is on foreign investments, which bring modern technologies and provide access to world markets.

Summarizing the results of cluster strategies abroad, we can say that they have been a significant impetus to the development of the regions of those countries that applied them. The experience reviewed confirms that modern production of high technologies can be based only on integration processes: horizontal, regional, and vertical. The practice of Western countries shows that industrial clusters are very effective and capable of producing competitive products with high value added. This experience is especially relevant for the regions of the Russian Federation, for which their transformation into technological centers is seen as both an objective and an urgent necessity.

5. Conclusions

The cluster, as a special form of territorial and industrial policy of the state, was developed in the European community in the 1990s. Clusters consist of enterprises specialized in a particular sector of the economy and localized geographically. In the economic system, the cluster association performs the following task: big and strong enterprises help small and weak ones.

Three characteristics are important for distinguishing a cluster: the geographic localization, the common products (resources, technologies), close interrelations between firms within the cluster.

The most important feature of an industrial cluster is the combination of competition and cooperation between participating firms. Close cooperation ties between firms in the cluster lead to positive synergies, so the success of one firm in the cluster can not be separated from the overall success of the cluster.

The key to the success of the cluster is civilized competition, equalization of leaders, getting support from leaders, and from the administrative resource of the region. In the period of post-industrial economy, clusters are groups of enterprises, including medium and small, located on the same territory. Clusters are the basis for effective economic development of the territory of the regions and contribute to the effectiveness of the development of the state as a whole.

Clusters are needed for enterprises to work in the market not separately, but together – against other competitors. And at the same time, it is necessary for them to compete among themselves within the region, because without competition, there will be no technical progress.

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