

# Methodological Approach to Creating a Cluster in the System of Innovation-Oriented Management of the Construction Complex Development



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**Abstract** The methodological approaches to the creation of a cluster in the system of innovation-oriented management of the construction complex development are determined. An advanced model that determines the principles, conditions of activity and the expected economic effect from the introduction of the cluster is proposed. The model is aimed at ensuring the innovative development of the construction complex and reducing the cost of construction. The directions of innovation-oriented management of the construction complex development are proposed; their implementation makes it possible to obtain combinatorial advantages from the joint activities of its participants.

**Keywords** Construction complex · Innovation-oriented management · Cluster model

## 1 Construction Cluster as a Tool for Innovation-Oriented Management in Construction

Constant changes in the economy, low level of macroeconomic indicators and the life of the population necessitate strengthening the competitiveness of industries and the economic complexes, important for the state. In the context of the above, it is important to determine the sectors of the economy with highest priority that have significant impact on the socio-economic development of Ukraine and primarily need constructive changes. These undoubtedly include construction, which is involved in the creation of fixed assets in other sectors of the economy, providing the population with one of the primary public goods—housing. Today, the intensive path of development of the country and its regions is possible only if the achievements of science and technology are utilized, in particular, the strategy for implementing the principles of

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innovative development. That is why the introduction of innovations in construction should become a priority task for the further development of the complex.

The innovative development of construction complex makes it possible to implement the investment policy of state, to determine national economic proportions, scale and rate of development of particular industries, scientific and technological progress and efficiency of investments in all sectors of economy [1].

The choice of goals and directions of economic policy, formation of the concept of development of Ukrainian society provides for the renewal of organizational structures in accordance with modern global integration trends, especially with those that combine innovation and investment processes. The analysis of the problems of formation and development of innovative organizational and economic structures indicates the intensification of the implementation of clusters, an organizational model that is widespread in the world [2–4].

Foreign experience shows that it is clustering that is the form of internal integration, capable of ensuring socio-economic development. Thus, in the USA there are about 380 clusters; their sphere of activity covers the processing industries and the service sector, producing about 61% of industrial products. The West Pannonia cluster in Hungary accounts for 9% of GDP. Finland, having only 0.5% of the world's forest resources, due to the high productivity of clusters ensured by innovative structures, provides 10% of the world's wood products exports. Austria has cross-border clusters with Hungary, Italy, Switzerland and Germany.

M. Porter used the term “cluster” in economics at the end of the last century [5, 6]. According to him, a cluster is a combination of enterprises and institutions for which the territorial commonality of its components is an additional factor in economic efficiency increasing due to the constancy of interrelations, reduction of transport costs, rational use of all types of local resources, creation of conditions for combination with territorial planning and management.

In Ukraine, the first theoretical and practical scientific developments are found in 2000 in the works of M. Voynarenko [7]. While studying the peculiarities of the implementation of cluster technologies in the Ukrainian economy, he conducted a study of the conditions for the creation and functioning of clusters, the role of state authorities in stimulating small and medium-sized businesses to incorporation. In his opinion, the cluster is a territorial and sectoral voluntary integration of enterprises that work closely with scientific institutions and local authorities in order to increase the competitiveness of their own products and economic growth. The other scientists [8–10] continued the research.

The construction cluster is a special form of the cluster model, as construction is an industry that is focused primarily on the domestic market. Its main products are services: reconstruction, modernization and new construction. The construction cluster brings together not only constructors or manufacturers of constructional materials. It includes research institutions, planners, designers, lawyers, trade associations and private entrepreneurs, auditors and consulting firms.

Effective innovation-oriented management in construction is hindered by the underdevelopment of the systemic functioning of the scientific and innovation

spheres. In modern conditions, with the growth of people mobility, finance, production capacity, especially within the EU, not only advanced technologies and production are needed, but, first of all, regions that are ready to accept and ensure their activities. It is the regions that are the “engine” of economic development based on research, technology and innovation. The regions with strong innovation and investment potential do not have a particular specialization and are prone to innovations and industry flexibility, they are called the basis of sustainable development and competitiveness of the country.

Foreign experience shows that clusters are an effective mechanism for regional development. They are a kind of platform for a constructive dialogue between representatives of business, science and government bodies; they enable the increase in the involvement of the private sector, the state, research and educational institutions in the innovation process [11–13]. Slovenia is an example of efficient formation of cluster-type networks in the construction sector. Construction Cluster of Slovenia (CCS) was created in February 2004 by 14 companies. Since then, it has developed as an innovation cluster, with a significant focus on internationalization and international cooperation. Austria has significant experience in clustering the construction industry. In 2003, the Green Construction Cluster of Lower Austria (Lebensmittel Cluster Niederösterreich) was formed there. At present, its turnover is more than € 3,534,000,000, and its main activities are the reconstruction of old houses, the construction of new multi-storey passive houses, improvement of the comfort of living quarters. In Ukraine, the first construction cluster was created in Khmelnytsky on the initiative of the “Podillia Pershyi” Association; it unites more than 50 small and medium-sized enterprises specializing in the production of construction materials, design, construction, and provides a full cycle of construction. In 2007, a construction cluster was created within “Slobozhanshchina” Euroregion that covers Kharkov and Belgorod regions.

## **2 Models of Construction Clusters Formation in the Regions of Ukraine**

The study of domestic and foreign experience of construction clusters [14–17] made it possible to develop a conceptual model of their formation in the regions of Ukraine, based on the four-aspect vision of regional development (Fig. 1).

The presented model gives only a systematic idea of the interrelation of regional development, it does not separate the aspect of education and science as the main aspect, a subsystem for the formation of other aspects of regional development. But, in the authors’ vision, the interaction of science, education and industrial production is a key factor in the civilized process, further economic and social development. In Ukraine, the relevance of such interaction is enhanced by the fact that the joint participation of scientific institutions and higher educational institutions, innovative

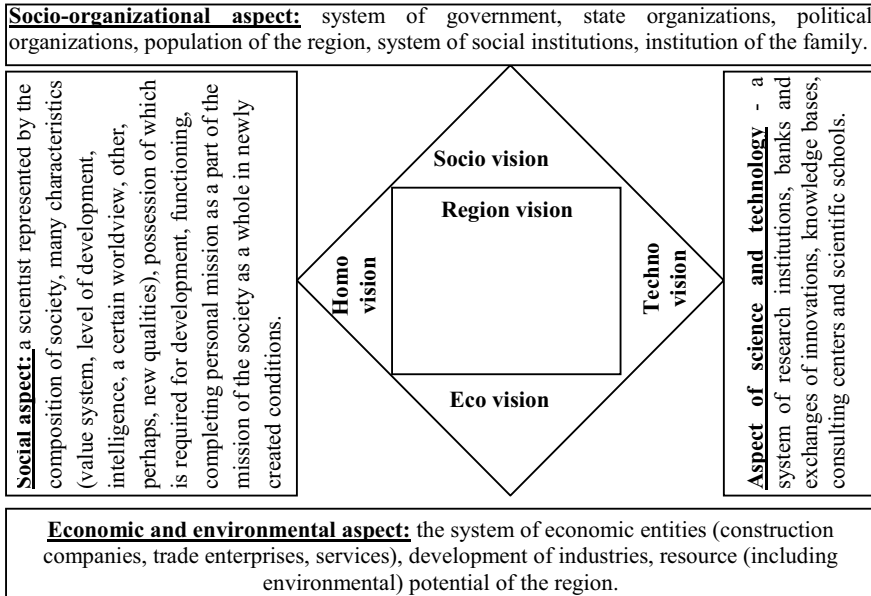


Fig. 1 The model of four-aspect vision of regional development

structures and enterprises in the training of highly qualified personnel, the implementation of priority research, the development and implementation of the latest technologies is an important condition for the implementation of an effective system of innovation-oriented management.

With this in mind, the authors proposed a cluster model that has a focal system of creation, that is, any higher educational institution in the region of Ukraine with a centuries-old history in construction is chosen as the “core” of such a cluster. The model of the four—aspect vision of regional development of Ukrainian regions, based on the determinative role of the higher educational institution, which acts as the “core” and the condition for creation and functioning of the research and production construction cluster, is shown in Fig. 2.

As a rule, an innovation cluster has a core structure, forming around a large enterprise, research center or university. Accordingly, if there are several such enterprises (centers), we are talking about a multi-core cluster. A cluster that develops effectively must include medium-sized specialized enterprises, one large industrial enterprise, a research center and an educational institution. To coordinate actions and increase the efficiency of interaction, a kind of platform is needed, that represents, on the one hand, the individual interests of each of the participants, and on the other hand, the general direction of movement in the interests of the entire cluster.

The experience of other countries shows that the most effective is the creation of innovative infrastructures based on higher educational institutions. Thus, four main

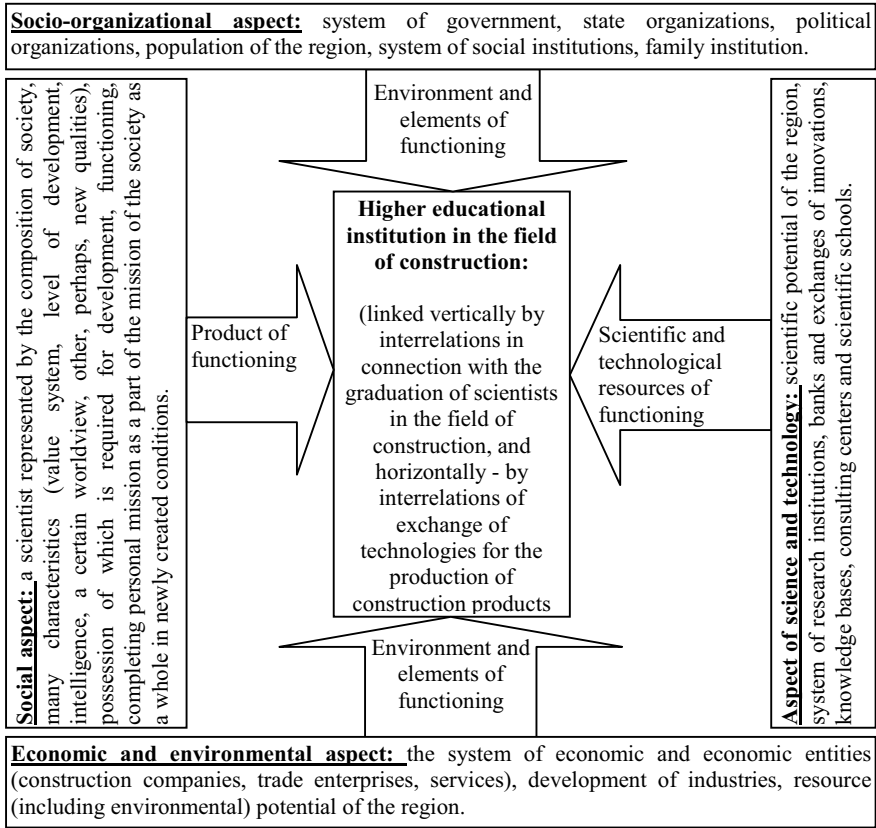


Fig. 2 The “core” of the cluster in the structure of the region’s economy (compiled by the authors)

groups of university innovation structures can be identified: business incubators, technology parks, technopolises and science parks.

Business incubators are multifunctional complexes that provide various services to new innovative firms that are at the stage of emergence and formation.

Technology parks, in comparison with incubators, provide for the creation of a more diverse innovative environment. The services of technology parks are used by small and medium-sized innovative enterprises that are at various stages of commercial development of scientific knowledge, know-how and science-intensive technologies.

A technopolis, unlike previous forms, is a large modern scientific and industrial complex, that includes a university or other higher educational institution, research institutes, as well as residential areas with cultural and recreational infrastructure.

The purpose of science parks establishing, in contrast to technology parks, is the development of scientific, technical and innovative activities in a higher educational institution or a scientific institution, the effective and rational use of the available

scientific potential, material and technical resources for the commercialization of scientific research results and their implementation in the domestic and overseas markets.

Of all the presented university innovation structures, a technology park is most consistent with the goal of creating an innovation cluster; that is why it is included in the core of the proposed construction cluster.

The main purpose of the technology park is to form the competitive advantages of the cluster in the region as a whole and its subjects (participants), in particular, through integration in a single information space of education, science and business, interaction between them and creating synergies to develop priority areas profits due to the coordination of activities and organization of joint structures of different legal forms (specialized educational institutions, research organizations and commercial enterprises). Thus, close cooperation between innovation-active enterprises, science, education and the local community (including public authorities, the media) in the presence of a certain coordinating element forms the so-called triple spiral—business, university and society.

In the author's vision, the final "core" of the cluster is represented, on the one hand, by the technology park, and on the other hand - by the key partner of the technology park—the profile university in the construction industry. In the context of the proposed model, the system-forming element is the technology park, which is created on the basis of the university buildings, which provides a number of key functions for the cluster as a whole.

High efficiency, sustainability and viability of the cluster are determined by the presence of participants-partners of the "core" of the cluster (technology park and university), including research centers, large construction companies in the region, service firms needed to provide quality services to innovative firms and companies specializing in profile activities of the technology park, regional authorities responsible for the implementation of innovation policy in the region.

Under this approach, within the proposed cluster there is a possibility of forming a "closed" innovation and educational chain, in which each of the elements plays a key role within its competences, and the technology park provides coordination and coherent policies aimed at achieving efficiency and competitiveness of innovative construction cluster. in general.

The technology park core is designed to serve as a link between the needs of business, the capabilities of the research center, the university, government officials on a wide range of issues, namely:

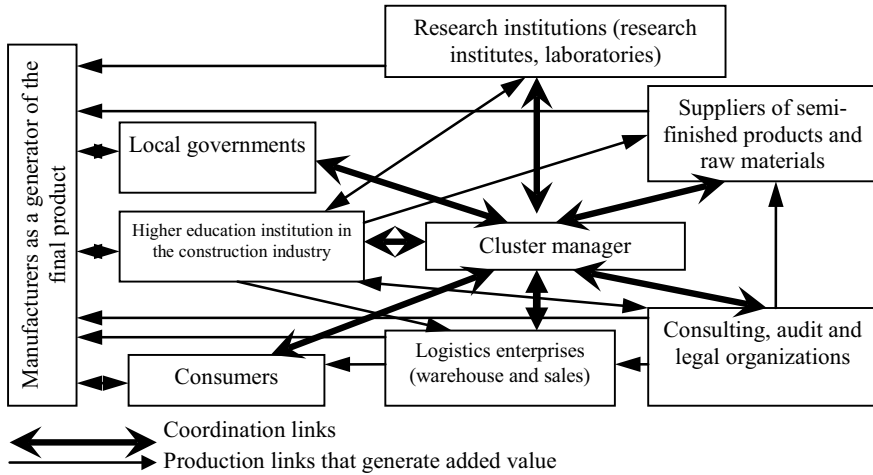
- support of development processes on the basis of the university and its separate research laboratories and approbation in the regional market of science-intensive technologies and high-tech products in the field of construction, ensuring interaction between science, education and business;
- systematic monitoring of construction projects carried out at the university and specialized research organizations, in order to identify intellectual property and technologies that have sufficient potential for commercialization;

- creation and maintenance of a database on research, personnel and other capabilities of the Faculty of Civil Engineering and adjacent departments, research units, laboratories to work with industrial construction models, primarily—with construction companies in the region—members of the technology park;
- formation of a “community” within the construction cluster; balancing individual activities in the interests of its participants, coordination and development of resources, evaluation and protection of results.

In this way, the technology park creates and develops the necessary connections between all members of the innovative construction cluster: innovative companies, research organizations, the university, large construction companies, financial institutions, authorities and the media.

In addition to the formation of a common synergetic effect for the cluster and increase its competitiveness, we can talk about a number of additional benefits that participants will receive from the proposed innovative construction cluster from the implementation of the proposed strategy:

1. For construction companies:
  - increasing competitiveness in domestic and foreign markets through the use of advanced technologies and results of scientific and technical achievements of research centers and universities that are the part of the cluster;
  - solving the personnel problem by using the educational potential of the university and other educational organizations—members of the cluster;
  - significant cost savings due to preferential terms of placement and provision of a wide range of construction services on the basis of the technology park;
  - facilitating access to the capital market, forming an attractive investment image; access to unique high-tech equipment and the ability to interact with public authorities and the media.
2. For research organizations: commercialization of the results of scientific and technical activities, increasing demand for research and scientific and technical products from enterprises that are part of the cluster.
3. For a higher education institution in the field of construction:
  - intensification of scientific and technical activities in the field of construction, commercialization of the results of scientific and technical activities and intensification of innovative activity of students, graduate students, faculty;
  - improving the quality of educational processes of the university due to the use of the innovative potential of the technology park and cluster.
4. For the construction industry as a whole: creation of an innovative construction high-tech cluster and a powerful technology park, new jobs for highly qualified specialists in the construction industry; increase of tax revenues to the budgets of different levels; development of international cooperation in the field of construction, realization of intellectual and innovative potential of the construction complex of the region.



**Fig. 3** The structure of relations within the research and production construction cluster (author’s development) while long ones are justified

The links of the innovation cluster are provided by peculiar mechanisms that can operate within it (Fig. 3).

The levels of development of each element in a cluster cannot differ greatly. The existence of competition between the horizontal elements of the cluster has a positive effect on the efficiency of the cluster. In addition to its main production function, it provides coordination and production links within the cluster, each cluster element is able to produce “additional utility” for other elements.

For example, a higher education institution may be interested in the success of a cluster not only because its research is in demand, but also because the most successful graduates are guaranteed employment in the cluster’s enterprises. Small suppliers can count on the support of larger participants in the form of short-term cheap loans (or other types of financial support). Research organizations can include in their research plan not only the large developments required for the production of the main product of the cluster, but also small case studies commissioned by other partners in the cluster.

Additional utility can not always be measured in monetary terms, but any social, organizational, even moral support increases the efficiency of the entity, and this over time leads to direct economic benefits that can be measured in monetary terms.

Due to the creation of clusters, as the most important method of innovation-oriented management of the development of the construction industry, construction companies will become potentially attractive to domestic and foreign investors. Clustering will help develop specialization, improve production quality, attract reserves, reduce production costs and maximize the overall economic effect.

In addition, the creation and effective development of innovative construction cluster in any region of Ukraine will create additional jobs, increase employment,



increase wages and budget contributions, relieve social tension in society, improve the quality of life, promote innovative development of the construction industry.

### 3 Assessment of the Economic Efficiency of the Functioning of an Innovative Construction Cluster

The effective functioning of a research and production innovative construction cluster based on a technology park depends on many factors, the main of which are: the level of construction complex development; availability of demand for construction goods and services; cooperation of construction companies heads with government agencies; the presence of leading enterprises that could become the “core” of the cluster; human resources of operating enterprises of the construction complex; availability of educational institutions of the appropriate profile; investment attractiveness of the region; the level of development of industry, social sphere, etc.

The question of determining the economic efficiency of the technology park and the cluster association as a whole remains open. Since it is extremely difficult to assess in advance all the benefits of such cooperation, especially in the context of the lack of a regulatory aspect of this problem.

The efficiency of the construction cluster is a relative indicator that shows the ratio of results and costs associated with the use of means of production, labor, entrepreneurial skills in the provision of construction services of a certain quality in a limited resource and unlimited needs.

At the same time, the efficiency of the cluster itself is assessed, which reflects the efficiency of the process of forming new organizational entities and, accordingly, the structural elements of the cluster and the efficiency of using resources for their work according to the formula:

$$Ew.cl. = \frac{\sum_{i=1}^n Ecl.i}{\sum_{i=1}^n Bcl.i} \quad (1)$$

where  $Ecl.i$ —the effect of the  $i$ -th participant from working in a cluster;

$Bcl.i$ —costs incurred during the cluster period;

$i = 1, \dots, n$ ;

$n$ —number of enterprises.

Assessment of economic efficiency of the proposed innovative construction cluster based on the technology park, which is based on the use of fixed and working capital, labor and financial resources, leads to an increase in the level of soundness of management decisions, cost optimization [18], which allows full use of resource potential and opportunities in the construction services market. The overall effect of the implementation of the cluster on the basis of the technology park, the model of which was

proposed, is to optimize the costs of the construction industry in the region by effectively managing them and increasing the profitability of innovation in the regions of Ukraine.

## 4 Conclusion

The successful implementation of the cost optimization mechanism in the system of innovation-oriented management of the development of the construction complex is possible only if the complex interaction of all its elements at all levels of the complex management. Managers must clearly understand the structure of the cost mechanism at all levels of management, since the price of construction projects depends on its functioning and the interaction of all its constituent elements. In the construction industry of Ukraine, the formation of product prices is influenced by many different factors, but the regional authorities due to the introduction of an innovative construction cluster have the opportunity to find reserves to reduce the total cost of construction, which is the result of cost formation. After all, the main reason for the high cost of construction projects is the imperfection of cost management, which is manifested in the inefficient organization of resource and cost management in the construction industry of the regions, which leads to high and uncompetitive prices for construction sites.

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