Clustering and its key features’ formation in construction

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Abstract. The purpose of this study is to substantiate the terminology "Clustering in construction" used in the regulation of construction organizations in a single system of interaction, taking into account the organizational and technological model of the new and existing buildings’ formation reliability. When implementing such projects, a set of joint tasks of the organizational and technological configuration is outlined and a number of indicators (comfortable housing with deliberately used free space; a combination of residential development with other objects of social, educational and entertainment infrastructure) are taken for consideration, as well as the basic principles of organizational and technological clustering criteria in construction. The most important scientific theory is that with the use of cluster modeling methods, competitiveness indicators can be increased, the range of material and technical base of construction production can be increased, and the investment durability of the construction organization can be formed. As a result of the study, the characteristic properties of the construction cluster were established for use in an integrated model.

Materials and methods
The term "cluster" means "set, bundle, totality, concentration”. In a general interpretation, this is a set of components, which, in turn, have specific functions for solving the established issues.

A cluster is a form of economic ties’ association. It was primarily used to increase competitiveness. However, in the approved direction of improving the economy, organization with modern economy features, the cluster started to be used when developing an increasingly wide range of tasks, in particular:

- in the study of the state, region, industry competitiveness;
- as the basis of a nationwide production course;
- when preparing regional formation programs;
- as a basis for promoting innovative activity;
- as a base for cooperation between small and medium businesses, etc.

However, the term "cluster” can be considered from a different point of view - it can be applied to management. In management process, various techniques and means, which should be closely interconnected and act as a whole unit are used, the form of this whole unit should be characterized by the cluster method. In this case, the "Cluster System” [1] of the organization can be analyzed not only locally, but also more extensively. In this meaning, "cluster” is understood as an amalgamation of coordinated applications, consolidated by one business process (technological process), which covers
various mutually influencing fragments, they guarantee detailed information about the work and allow to make appropriate administrative decisions based on the acquired information.

The hierarchical form of the methods system seems to be a distinctive feature of the cluster (as opposed to the systematic approach, in which the organization methods are analyzed as an interconnected set). With the cluster method in the administration organization, each category of tools performs a specific functional meaning in conjunction with other tools [2].

Currently, the modern construction association is fragmented, consists of many separate economic elements that have specific characteristics. In terms of economic content, the construction association has a diversity, manifests itself as a system of organizations and enterprises that guarantee the formation of new and modernization of the existing basic assets for production and non-production purposes. The activity of the construction complex is divided into interrelated operations that are performed by various structures.

In construction industry, there are a lot of cooperation ties with organizations and companies, both in the current industry and in other production branches. This is due to the difficulty, consumption of materials and the variety of construction products. In construction, unlike in industry, not a single construction and installation organization is able to carry out the entire range of work on the formation of existing construction products with the available capacities. Therefore, for the implementation of individual work, all kinds of specialized organizations (subcontractors) are involved. All cooperation ties in the organization of finished construction products can be divided into resource and production.

In those areas where construction clusters are organized, the volume of house construction is much higher. The presence in the cluster of a service part in the form of banks, the legal state administration, the cluster system stability make it possible to increase the existing indicator by supplying the population with affordable mortgage loans with guaranteed terms for the housing commissioning.

The role of communities of entrepreneurs and social organizations in the issue of the construction branch independent regulation is most noticeably increasing in Russia today [3]. This is due to the fact that the basic part of its subjects is in private ownership, and the investments are off-budget. Therefore, based on the logic of the presence and formation of the market, the state task is to determine the systematization of regulations, norms, that is, institutions for private initiative, the emergence of investment markets, contract work, production and supply of material and technical resources, etc. Social associations are designed to control connections within all the markets between the market and the state.

**Cluster types**

Clusters function as semi-independent parts of the project under the overall coordination of the contractor or project manager, replicating the logic of single-point responsibility throughout the supply chain. The relationship between clusters and the overall project can change as the authority delegation level increases: clusters can be endowed with functional powers [4]. They can grant wider discretionary powers over technical and commercial agreements within a dedicated cost target, or they can fully delegate responsibility for a work portion, including direct management of all contractual and commercial relationships with the suppliers involved in activities in different typologies of development.

**Types of buildings**

The choice of building types is most often the result of such economic considerations as the land plot cost, its availability and the infrastructure cost. However, each type of building and combination of different types interacts with local environmental conditions in different ways, which affects both the microclimate around the building and the microclimate inside it.

The types of buildings are presented in Table 1.

| Table 1. Types of buildings |
|----------------------------|
| **Type** | **Description** |

Free standing / Semi-detached
Detached and adjoining houses have a high open shell-to-floor ratio, this increases heat transfer between the building and the environment and provides more options for passive heating, cooling and better use of adjacent open spaces.

Courtyard / Patio
Backyard and patio homes are quite common in hot or maritime climates. In both cases, the building completely or partially covers an open space - a closed or attached, semi-closed open space. Such spaces are commonly referred to as climate modifiers. They are believed to have better climatic conditions than surrounding open areas, and is expected to have a positive effect on the building surrounding volume microclimate. This has a beneficial effect under certain conditions, providing solar access to all parts of the building and providing better ventilation of the interior. However, the specific design of the complex (building and adjacent open space) should always be considered taking into account the specific climatic conditions of the area, hours of operation and design details, as well as the cultural, conservation and religious aspects of the societies within which this typology is developed.

| Access types |
|-------------|
| Row buildings (townhouses) and high-rise buildings can be subdivided according to the form of access into corridor and staircase / elevator types (Table 2). A single congested corridor can provide solar exposure and can provide good cross ventilation if properly designed. Two-story corridor buildings will almost always suffer from poor solar access and cross-ventilation, at least in some of the blocks. Buildings with a staircase / lift core serving two blocks per floor may have full solar access and cross ventilation. [5,6]. When more than two units are served by one core of this type, the use of sun and wind in air conditioning the space becomes difficult, although the ratio of open shell area to floor area per unit becomes less. |

| Type                  | Description                                                                                                                                                                                                 |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Row (Townhouse) Buildings | Row buildings, three to four stories high, can serve as windbreakers to protect adjacent low-rise areas. The use of common walls between the blocks minimizes the open envelope of the building and thus contributes to energy savings. However, this can also have some disadvantages in certain climatic conditions, and this requires appropriate design of the unit layout to ensure cross ventilation. |
| High building         | High-rise buildings are very common in urban centers, where they allow more intensive land plot exploitation. Their internal and adjacent spatial microclimate is ambivalent. Good ventilation can be provided for most units by positioning the openings on both the upwind and leeward sides. While intermediate blocks have a smaller open shell, edge blocks (especially on upper floors) can be exposed to adverse wind conditions. High-rise buildings cast long shadows, thus creating unpleasant adjacent open spaces in winter and causing solar access difficulties when designing nearby buildings. In addition, their volume and height create localized air movements that are difficult to control. Such tasks can be solved at the ground level by integrating the protruding shelves located close to the ground level into high-rise buildings. They can be used to distract and control air movement. Wind speed at the ground level near tall buildings can be 300% higher than in the nearby areas with lower buildings. Such phenomena may be undesirable in specific cases, but can also have positive microclimatic effects in dense urban centers suffering from poor ventilation, as well as in the areas with high air pollution recommendation that different types of buildings should be included in the cluster design to allow access to the sun, as well as wind protection. Row buildings can be used as wind deflectors, while high-rise... |
buildings can aid ventilation in dense open spaces. Low-rise buildings should be designed and positioned in such a way that they take full advantage of their connection to open spaces, but should be treated to avoid excessive heat exchange with the environment.

**Results and discussions**

The implementation of the cluster approach, the creation on the state scale of the requirements for the construction clusters existence will provide the prospect of increasing the industry level, and the social influence from clustering will affect the increase in the degree of accessibility of the housing stock for the state residents [7]. From this it follows that consolidation into a cluster of construction organizations with a successful outcome will eliminate a large number of issues.

The formation of a construction cluster will make it possible to implement such cluster initiatives, the **tasks** of which are:

1. Improving the interactions approaches between the construction organizations of the state regions, which cooperate within the framework of sectoral and cross-sectoral value chains;
2. Promotion of the construction industry production area;
3. Creation of working tools for outsourcing construction companies in the regions;
4. Formation of joint plans within the boundaries of a certain region to improve the spatial and industrial infrastructure;
5. Formation of collegial projects within the framework of the personnel course creation and functioning within the framework of innovations;
6. Formation of joint management companies to regulate and control the projects being implemented [8].

The variability of a construction cluster in the form of a clustering object is caused by the following conditions:

1. The formation of a large volume of large investment projects aspires to the construction of new enterprises and industrial territories.
2. Providing residents with a home fund within the boundaries of various government initiatives reduces the public component of investment risks and supports the development of user and production capabilities.
3. The existing unresolved issues of the construction branch negatively affect the socio-economic formation of the country's regions and, in total, on the investment environment.
4. The production association is characterized by a large increase in investment and helps the formation of other branches of various industries [9].

It is necessary to pay attention to some significant approaches characterized by the implementation of the cluster method in construction.

The strategic approach is manifested in the fact that the cluster is a working model of cooperation between the government and entrepreneurship, an apparatus for bringing the diversity of the regional economy and contributes to the formation of an effective tool for increasing the production competitive ability.

**Economic approach:**

- the cluster model of the construction formation and the creation of building materials has a significant opportunity to improve the consolidated production characteristics, for example, as an increase in gross domestic product, the creation of new job positions, an increase in work efficiency, etc.;
- along with an increase in the construction branch productivity, there is a stimulation of the economy adjacent branches’ formation: the mechanical branch, the production of apparatus and technical equipment, logistics, etc.;
- the cluster approach will increase the rate of formation of small and medium-sized businesses in the construction branch [10,11].
Technological approach:
- the cluster approach contributes to the construction industry improvement through the formation of stable transmission lines of key skills and the exchange of skills within the boundaries of the common technical and information zone;
- the emergence of an extensive distribution and management of new effective quality standards by increasing competitiveness, stimulating the process development by introducing new techniques to the market.

Public approach:
- manifests itself in the form of an increase in the citizens’ working capacity degree, an increase in the living standards quality due to an increase in the productivity of the activities of individual organizations within the cluster.

As a result, the complex impact of the work of organizations in the cluster is contained in the consolidation of the manufacturing companies’ competitive advantages. Manufacturers of building materials in a highly competitive environment within the framework of the cluster method increase the choice, the quality characteristics of the finished product increase, there is a desire to reduce the production costs, increase the efficiency of activities using effective resource-saving and energy-saving techniques in construction. The shipping cost of production materials also decreases, production costs decrease, which leads to a decrease in the price of the housing stock, making it higher quality and understandable for society.

Thus, the creation and growth of the cluster method in construction guarantees:
1. Implementation of a profitable and effective construction scheme, understandable for the citizens on the principle of modern technologies, which provide an opportunity to implement the first-class materials at low cost;
2. Durability of building units and rational use of resources;
3. Increase in the products and services’ export due to the entry of organizations into strategic cooperation networks and deliberate advertising of goods on the world market;
4. Increasing the investment attractiveness of the regions due to the specific identification of the sphere economic type and, thereby, the supply of the involved local and foreign investments in the economy [12];
5. Innovative activity increase of the companies in the cluster structure, due to increased competence on new techniques;
6. Productivity increase of the order of training professionals due to the specific establishment of prescriptions and responsibilities for the speciality of employees, which the cluster member organizations are looking for and the availability of educational approaches for builders and specific academic platforms that improve the quality of construction and installation activities;
7. Management positions in construction science, design and conduct of surveys and formations in the construction branch;
8. Formation of small and medium-sized businesses in a position of public competitive competition, by increasing the need for the latest research and attracting investment in the economy [13,14];
9. Revenues increase to the budgets of various sizes, an increase in the number of jobs and salaries due to an increase in exports and a number of products and services by the organizations participating in the cluster, continuously increasing competitiveness in the development of innovations and the implementation of working formation policies.

Summary
Thus, the formation of the cluster aspect combines the sources in the production of building materials and will contribute to the introduction of innovative resource-saving techniques and progressive approaches in construction, as well as allow the formation of favorable requirements for solving the housing problems.
The carried-out analysis of the construction industry suggests that it is necessary to increase the indicators for improving the development of this industry, however, there are a sufficient number of reasons that rightly hold back the formation of construction organizations. To achieve a favorable existing environment, the task of which is to stimulate the industry development and the constant participation of the government in this matter, it is rational to assert that an effective partnership between the construction organizations is possible only on the basis of the cluster method implementation.

Having analyzed the essence of the cluster method, we can conclude that the current event reduces costs leads to the growth of the domestic market and access to the international level, increases the wages level, increases the quality of the goods and its level of competition. Steady and solid production, which has achieved high results and is considered the basis of the cluster, "pull up" small and medium-sized organizations, obliging them to improve the quality of the equipment supplied to them. The formation of clustered webs in construction can facilitate the immediate release of a new set of goods and services. In addition, cluster cooperation of firms is promising in investment development, since for an investor, be it government or an individual investor, it is not private objects that are more attractive, but the systemic regulations, in the implementation of which the companies’ complex coordination is required.

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