Formation of sustainable development of investment and construction enterprises based on increasing their mobility

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Abstract In market conditions, the effective zone of activity of the investment and construction complex enterprises dramatically changes its boundaries under the influence of the achieved level of their mobility. The object of the research is the organizational and technological processes of the construction of a capital construction facility and the activities of enterprises in conditions of mobility and uncertainty of construction production. The study considers several rational options for increasing the mobility of construction organizations when creating capital construction projects, each one defines the necessary directions for their sustainable development. The use of various mechanisms and digital technologies in the activities of enterprises for their effective management and construction of real estate objects at the stages of the life cycle will increase the stability and reliability of all types of work in conditions of mobility and uncertainties of construction production, carry out and manage all processes that take place at the stages of the life cycle of the object. This will ensure the minimization of negative consequences during the actual implementation of projects at the main stage of the construction of a capital construction facility. Keywords: investment and construction complex enterprises, mobility of construction system, cycle of project formation, code-analysis, options of work mobility.

Introduction
The development of a sustainable development strategy by enterprises is now primarily related to the need of increasing their mobility to the required level. This is due to the creation of new production complexes and the involvement of previously undeveloped or poorly established territories in their economic use. These territories are characterized by the lack of residential and production bases necessary for the sustainable development of the investment and

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construction complex enterprises. In the process of organizational and technological preparation of construction production, it is necessary to take into account the main characteristics of real estate objects at all stages of its construction life cycle, as well as space, resource, time and cost parameters of enterprises and ensuring the rationality of their sustainable functioning and development, which requires increasing their mobility levels. Currently, the mobility of construction organizations is the most important factor affecting the efficiency of their functioning and reducing various types of losses in the production processes of building real estate objects at all stages of its construction [1, 2, 3].

The activity of construction organizations is largely determined by the degree of rational use of their organizational, technological and economic and managerial potentials, reliability of development of production processes taking into account all types of losses on them, conditions of risks and uncertainties, the values of which change under the influence of space, resource, time and cost parameters of enterprises activity and organizational and technological parameters of construction production, flexibility of organizational forms of their management, as well as taking into account the conditions of mobility and uncertainty associated with the dispersal of the objects being erected. These prerequisites indicate the need and relevance of the development of modern directions for the sustainable functioning and development of the investment and construction complex enterprises, production processes and the comprehensive development of organizational and technological management mechanisms, taking into account the formation of various types of losses at all levels of development of production processes in conditions of mobility [3, 4].

**Materials and methods**

The research methods used in the work are theoretical analysis, empirical study, followed by generalization and systematization of the data obtained. In addition, the main scientific approaches are used, for example, "dialectical," "systemic," "dynamic," "variant," "balance," "modeling." The object of analysis is the organizational and technological diagram of the processes of the capital construction facility. Taking into account losses of different levels the algorithm for the implementation of control models using information models in risk conditions is considered.

The mobility of construction production is characterized by the ability of individual divisions of enterprises to respond to the influence of environmental and internal factors quickly due to their prompt movement to specified areas for subsequent concentration on them in the form of creating the necessary production capacities and labor resources in order to produce finished products, subject to the rational use of all available types of resources and accumulated potential. At the same time, it is necessary to take into account the possibility of creating various risks associated with the specifics of the development of production processes at all stages of the life cycle and losses.

The implementation of any investment and construction project in these difficult conditions of organizational and economic situations can be presented in the form of the following main stages, namely [5-6]:

**Stage 1: "Technical and economic study".** At this stage, it is necessary to hold negotiations of the first persons on mutually beneficial cooperation; determine the capacity of the wound and the specifics of the development of the housing market. In addition, it is necessary to conduct studies related to the analysis of competitors, the selection of a land plot with the determination of the cost of the project, the interests of potential customers, pre-sketched houses fit (2-3 options) with the economic justification of each option, the cost of sale, approximate cost and profitability of each individual option in percent and in rubles. The duration of the stage is approximately 2-3 months.

**Stage 2: "Engineering"** includes: obtaining a technical assignment for design; search for a
design organization; land acquisition/lease; conclusion of the contract for design and designing; obtaining technical specifications; obtaining a city plan from the administration. The duration of the stage is approximately 4-6 months.

Stage 3: "Preparation of the object project" is associated with the conduct of various types of examinations; obtaining a building permit; placement of the draft declaration in the media; start of sales and others. The duration of the stage is approximately 2-3 months.

Stage 4: "Organizational and technological preparation and construction" is associated with the performance of all types of construction and installation works. The duration of the stage depends on the selected technology and forms of organization in the production processes; the presence of mobility conditions and risk; the values of various types of losses during the work, etc., and can be approximately 1-2 years or more.

Stage 5: "completion of the project" is associated with the commissioning of the finished real estate and can take 2-3 months.

At the same time, we should consider the main stages of the implementation of the life cycle of construction projects can be significantly modified depending on the region where a particular project is being implemented, taking into account the conditions of mobility and factors of uncertainty of construction production, which affect the choice of options for its implementation, the main of which are presented in Figure 1.

Option I corresponds to the situation when the complex residential and production base $A_n$ and the investment and construction complex enterprises $B_i$ are concentrated in one place. The construction of the $C_i$ property is carried out at a distance $L_i$ of daily transport accessibility of all types of resources. In this case, a minimum level of mobility is required for the construction system to provide production processes resources.

Option II corresponds to the situation where the construction of the property $C_n$ is carried out at a greater distance than the daily transport accessibility from the main base $A_n$. Then, enterprises in increased conditions of mobility and risk $B_n$ create auxiliary residential production bases $A'$ and auxiliary unit $B'$ at a distance $L_j$ from the main base $A$ and at a distance $L$ from the object $C_1$, not exceeding the daily transport accessibility. In this case the schemes arise reflecting the relationship of the organizational structure of construction management.

![Fig. 1](https://doi.org/10.1051/e3sconf/202453501016)

*Fig. 1. Interconnection of construction system elements in the process of erection or renewal of an object*
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Domestic as well as foreign scientists adhere to the classification of environmental factors, in which they are considered as external and internal. External factors manifest themselves in such complex organizational, technological and economic situations and conditions of mobility in production processes, when they function in the external environment and exert their influence regardless of the activities of a particular business entity and other similar ones located outside it. Under these conditions, these factors are not amenable to any influence and change. Their influence is permanent within a particular situation. The influence of external mobility conditions forms the sustainability of the development of enterprises and the formation of risk-forming factors associated with the uncertainty, complexity and dynamism of the influence of the external environment. Such interference invariably leads to a negative development of events, as a result, a significant negative deviation from the set goal, the plan for the implementation of the investment project or the general plan for the development of the activities of construction enterprises [3; 4, 7, 8].

Previously carried out studies [5, 6, 9] showed that all the losses arising from the production processes of the construction of real estate objects can be conditionally divided into losses of the first and second kind. Losses of the first kind include direct losses from the influence of external and internal factors at each stage of the life cycle. Losses of the second kind include losses formed at the joints between the stages of the life cycle. This is due to the fact that the boundaries between the stages of the life cycle are tight, inflexible, because on each of them many different entities of economic activity interact, both with single-vector and opposite courses of strategic development, which does not determine the development efficiency of the overall strategy of the entire investment and construction complex as a whole [6, 9]. Losses of the second kind, in comparison with other species, can be targeted under certain conditions of their functioning using effective technologies, methods of organization and management of construction production, as well as increasing the mobility of enterprises.

**Results**

Today, one of the areas of sustainable development of domestic enterprises of the investment and construction cycle is the organization of flexible organizational structures of the mobile type, which by their functioning reduce the number of joints between the stages of construction of a real estate object and thereby minimize the occurrence of hidden losses and increase their level of mobility.
The level of mobility of the construction system in the cost form can be expressed through the amount of necessary labor costs when receiving finished products at the fourth stage of the construction project in the form of the estimated cost of construction and installation work and the cost of moving and concentrating all types of resources and elements of the construction system in the preparatory periods of $z_1, z_2$:

$$Y_m = (z_1 + z_2) t_3 / [C_{esp} (t_1 + t_2) + (z_1 + z_2) t_3],$$  

(1)

In order to quantify the impact of mobility conditions and uncertainty factors of construction production, taking into account all stages of sustainable development of the construction system, it is necessary to ensure the required level of mobility of enterprises of the investment and construction complex, which can be determined and calculated using formula 2:

$$K_{mi} = \left( \sum_{i}^{k} \sum_{n}^{m} \sum_{i}^{j} K_{2ep} \times K_{2en} \times V_{yij} \right) / \left( K_{2epi} \times K_{2eni} \times \sum_{i}^{k} \sum_{n}^{m} \sum_{i}^{j} V_{yij} \right),$$  

(2)

where, $K_{mi}$ is the degree of mobility of the construction enterprise on the $i$-process, for a specific organizational, technological and economic situation; $i, n$ - are labor collectives of the construction division; $j, m$ - estimated period of time of their functioning; $\gamma, k$ - number of construction objects; $V_{yij}$ - scope of construction and installation works performed by construction subdivisions for all objects, rubles; $K_{rip}$ - reliability factor of the construction system; $K_{rip}$ - loss factor; $K_{rip m}$ - mobility and reliability of the construction system for normal operating conditions of its units, (0.9-0.95).

The level of mobility of the construction division, depending on the different conditions of the influence of risks and uncertainties, ranges from 0 to 1, that is, $K_{mi} = (0 - 1)$. The influence during these periods on their activities of various factors of mobility and uncertainty leads to a change in the level of their mobility upward.

With the sustainable development of the investment and construction complex enterprises, four main zones can be identified in terms of their mobility of divisions (Table 1).

**Table 1.** The main situations of sustainable economic development of enterprises in conditions of mobility of construction production

<table>
<thead>
<tr>
<th>Organizational, technological and economic situation</th>
<th>G1</th>
<th>G2</th>
<th>G3</th>
<th>G4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interval value of integral index of mobility level and investment attractiveness of region</td>
<td>0-0,25</td>
<td>0,25-0,5</td>
<td>0,5-0,75</td>
<td>0,75-1</td>
</tr>
<tr>
<td>Characteristics of the required level of enterprise mobility</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
</tbody>
</table>

It is necessary to form various information models of the facility at the preparatory stages, before the start of construction and installation work, and at the same time the model is verified (checked for compliance with the initial requirements) with the subsequent revision of the model at the stage of development of design documentation to do this, on the basis of organizational technological methods of construction organization. The process described above may be performed more than once, depending on the result requirements.

**Conclusion**

Losses of various kinds occur before the start of the design even at the stages of pre-design preparation with a minimum total impact, and on the next implementation of construction...
projects there is a process of their increase for various reasons and the nature of the influence of environmental factors. Thus, the insignificant possible impact in the initial stages has a greater impact on the sustainable development of enterprises in all subsequent stages.

The use of effective control mechanisms, taking into account the resulting losses in the development of the information model, makes it possible to minimize the occurrence of negative scenarios during the actual implementation of the facility at the main stage of construction of the capital construction facility. Thus, in the course of the study, the following main conclusions can be drawn:

1. Based on the research, it was established that one of the areas of sustainable development of the investment and construction complex enterprises is the need to increase the level of mobility of divisions of the construction system in the context of the formation of losses of the first and second types on the production processes of the construction of real estate objects.

2. The mobility of construction enterprises depends on the availability of industry and territorial characteristics of their functioning in the markets of final products, taking into account the specifics of the construction of a real estate object at all stages of the life cycle of construction projects.

3. The influence of external and internal factors leads to a decrease in the level of mobility of construction enterprises.

4. The use of various methods for assessing the specifics of the development of the investment and construction complex enterprises allowed the authors to identify groups of financial, production and management factors that determine the nature of the influence of the external and internal environment on the level of mobility of the construction system and its elements.

5. The activities of mobile construction enterprises can be carried out according to two options, depending on the territorial location of permanent, temporary, regional residential and production bases and the peculiarities of the construction of real estate objects, taking into account the stages of the life cycle.

6. In its development, the mobile construction enterprise can be in one of the organizational and economic situations (G1, G2, G3, G4), depending on its mobility level (from 0 to 1).

7. Most of the regional investment and construction complexes enterprises in Russia are in situations of low and medium level of economic stability. The introduction of effective approaches to increase their mobility will increase their mobility and efficiency of their activities, as well as expand the efficiency zones of all enterprises of investment and construction complexes.

References


