

PAPER • OPEN ACCESS

## The Main Variants of Regional Construction Complex Development on the Basis of Increasing Enterprise Flexibility

To cite this article: Iuliia Artamonova *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **471** 102002

View the [article online](#) for updates and enhancements.



**IOP | ebooks™**

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the **collection** - download the first chapter of every title for free.

# The Main Variants of Regional Construction Complex Development on the Basis of Increasing Enterprise Flexibility

Iuliia Artamonova <sup>1</sup>, Boris Hrustalev <sup>1</sup>, Petr Grabov <sup>2</sup>

<sup>1</sup> Penza State University of Architecture and Construction, Penza, Russia

<sup>2</sup> Yaroslavskoe highway, 26, Moscow, Russia

pallpall1@mail.ru

**Abstract.** In the present paper we consider the issues related to the need of increasing the mobility of construction enterprises with the aim of achieving their forecast guidelines in the implementation of overall development strategy. The aim of the study is to research the formation of the construction industry economics with an accumulated productive enterprises' capacity, which could ensure the growth of the population welfare and living standards in the long term. The object of study is flexible construction enterprises. One of the strategic development directions of the regional economy is the growth of the construction industry to provide citizens of the region with affordable and comfortable housing and utility services, fixed assets reproduction of the national economy. Territorial peculiarity of such regions suggests that the development of the construction industry can be carried out in two main zones – the zone of effect when enterprises capacity of the construction sector exceeds the demand for housing and in the zone of loss when, on the contrary, the capacity is behind housing needs. The main ways for activity of such flexible construction companies are suggested as a solution to the general problem and raising their level in terms of functioning and development of regional construction industry.

## 1. Introduction

The construction sector is closely connected with industry, transport, housing and communal services. At the same time there are many problems in the construction industry now. One of them is creation of reliable and effective structures of management of the regional building enterprises at all stages of their development life cycle as construction systems («Proektirovanie» (Design), «Stroyindustriya» (Construction industry), «Stroitelstvo» (Construction), «Housing and utilities» (ZhKH) on the basis of ensuring the necessary flexibility of the enterprises. The analysis of activity of regional industrial sector enterprises and their development strategy showed that this problem is relevant and related to the fact that [2, 12, 13, 15]:

- a. All organizations operate autonomously from each other at the life cycle stages and have their specific, certain interests that are contradictory and do not go beyond the scope of life cycle stage;
- b. They all do not have a common motivation at the end of performance results of a regional building complex based on customer at housing market;



The presence of stringent limits between the life cycle stages in the activity of enterprises leads to the formation of negative risks, economic-organizing and administrative barriers at which the various types of losses both within the stage and within their ranges are formed and accumulated.

In terms of the overall strategy implementation and ensuring the required flexibility of the regional construction complex organizations there are the following ways of achieving these strategic priorities and achieving the goals of the enterprise.

## 2. The results of research

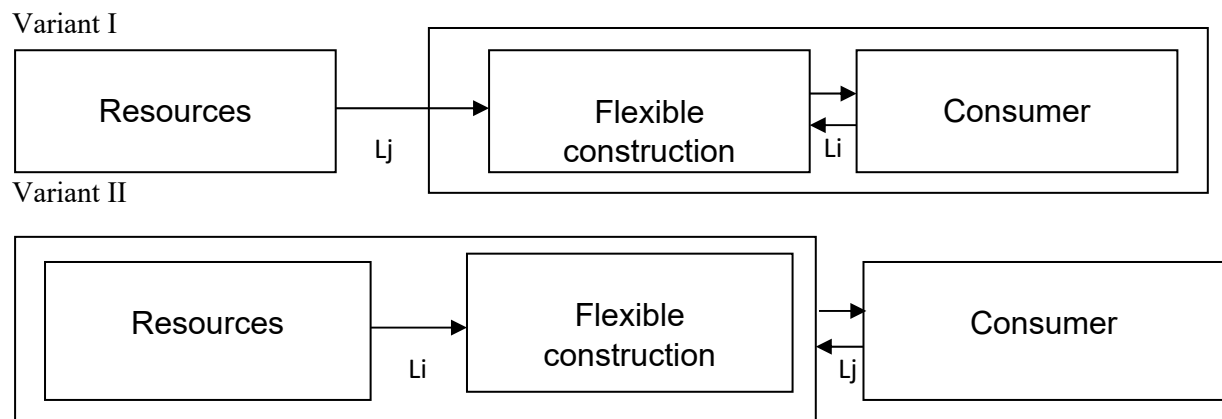
The main ways of the operation and development of flexible construction enterprises. Depending on the impact of factors of external and internal environment conditions, every construction company can function and develop in two main variants (Fig. 1) [9, 11].

Variant I («regional») corresponds to the situations when the main existing production basis  $An$  (the production and social spheres) and construction enterprise  $Bi$  are concentrated in one place. The erection of the object  $Ci$  is carried out at a range of  $Li$  of daily traffic resource availability. This variant requires minimum flexibility from all enterprises of a regional complex for their effective functioning and development. This variant is the basis for the formation and development of enterprises within the context of the creation of industry clusters.

Variant II («organizational and administrative») corresponds to the situations when the object  $Cn$  is at a greater distance from the main basis  $An$  than a daily transport accessibility. The enterprise  $Bn$  has to establish a production basis  $A'$  of secondary type (fixed or mobile) for its effective functioning and development and the division  $B'$  at a distance of  $L''j$  from the main base  $A$  and at distance  $L$  from the object  $Ci$  not exceeding a daily transport accessibility. This variant requires high degree of mobility from all the companies with the growth of total additional costs to ensure their effective functioning at the life cycle stages and at the main construction cycle stages.

The first stage of the construction process involves the formation of residential and manufacturing zones in its fixed or mobile placement. This requires the execution of works  $P1$  for the movement and concentrations of  $n$  components of subsystems (material and technical bases, social services, infrastructures and temporary construction infrastructure) with mass  $m_i$  at a distance during the time  $t1$ :

$$P_1 = \sum_{i=1}^k m_i L'_{ij} = A_1 \quad (1)$$



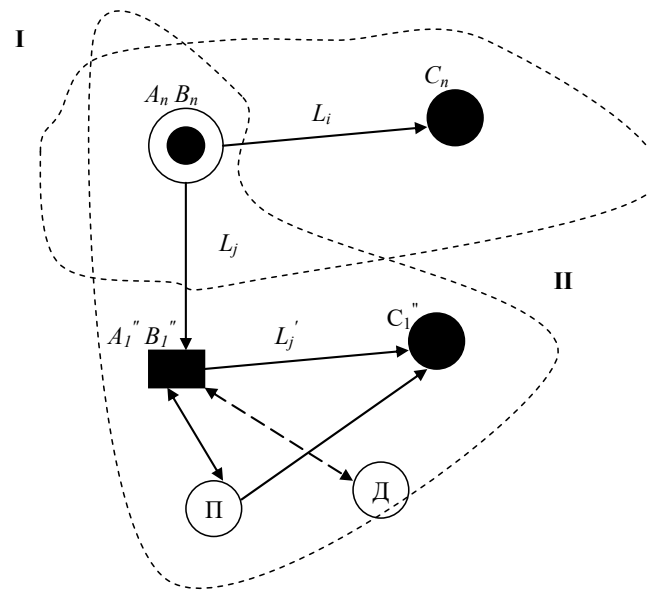


Figure 1. Variants of the development of construction complex enterprises and their flexibility in specific regions.

The second stage is referred to ensuring with the rational displacement and concentration of all building production resources for the reliable functioning of main manufacturing processes with required capacity. The peculiarity of the execution of works in this phase is that all the displacements and concentration of production resources are connected with the preparatory period of production processes functioning (support and service) but not with the actual functioning. The first two stages characterize the preparatory period of real estate construction.

The third stage is connected with the movement of building production resources within the temporary construction infrastructure (direct labour process). This stage characterizes the main period of real estate construction.

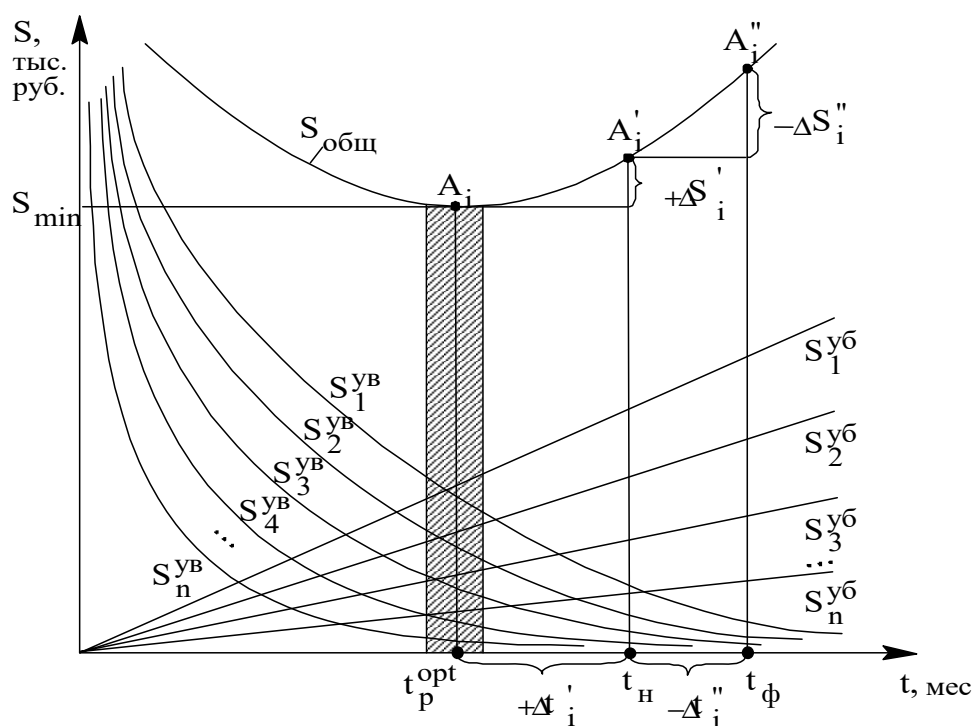
The assessment of the construction enterprises flexibility is made on the basis of various types of decreasing and increasing costs in the activities of companies at all life cycle stages of the construction system development (Fig. 2) [14]. The general formula of the functional dependence of the expenses

amount  $S_i^M$  from the mobility  $K_M$  has the form:

$$S_i^M = \frac{S_i}{K_M}; \quad S_i^M \geq S_i; \quad (2)$$

$$S_{\text{общ}_i}^M = \sum_{i=1}^{10} S_i^M. \quad (3)$$

The determination of activity parameters of the enterprises must be made from the situations when their mobility level corresponds to the minimum expenses at all stages of the construction cycle. The decrease of the enterprise mobility level leads to the arrangement of conditions for the losses at the construction cycle stages and within their ranges in the enterprises activity and to the increase of expenses for creation of real estate objects.



**Figure 2.** The generalized model of enterprise mobility level formation in the real property construction.

Legend:  $S_i^{y6}$ ,  $S_i^{yB}$  – the decreasing and increasing costs in terms of enterprise functioning;  $t$  – the time of enterprise functioning;

$+\Delta S_i$ ,  $+\Delta t_i$ ,  $-\Delta S_i$ ,  $-\Delta t_i$  – effects and losses of enterprises when construction of estate object.

When creating or updating a separate real estate object, the enterprise mobility takes into account the nature of the final product, which significantly limits the possible movement of all types of production resources within the temporary construction infrastructure.

The level of enterprise mobility can be defined by the value of the required labour costs in obtaining the final construction products in the form of the estimated cost of construction and erection works (the third stage  $C_3$ ) and the expenses on displacement and concentration of the building infrastructure elements during the preparatory period 31, 32 (the first and the second stages  $C_1$  and  $C_2$ ) [9]:

$$Y_M = (31 + 32)t_3 / [C_{cmp}(t_1 + t_2) + (31 + 32)t_3], Y_M \in (0-1) \quad (4)$$

For quantitative accounting of the mobility conditions effect and uncertainties of the construction production, taking into account all the three stages of development of the construction system, it is necessary to calculate the level of construction enterprise mobility, which can be calculated as:

$$K_{mi} = \frac{\sum_{\gamma}^k \sum_i^n \sum_j^m K_{\gamma pi} \cdot K_{\gamma hi} \cdot V_{\gamma ij}}{K_{\gamma pip} \cdot K_{\gamma hin} \cdot \sum_{\gamma}^k \sum_i^n \sum_j^m V_{\gamma ij}}, \quad (5)$$

where  $K_{mi}$  – the level of enterprise mobility in the  $i$  process;  $i, n$  are the main resources of the enterprise;  $j, m$  – the estimated period of enterprise functioning;  $\gamma, k$  – the number of simultaneously constructed real estate objects;  $V_{\gamma ij}$  – the volume of construction and erection works for all objects, roubles;  $K_{\pi pi}$  – the reliability coefficient of the enterprise under conditions of flexibility;  $K_{\pi hi}$  – the coefficient of reliability of the enterprise under ambient conditions;  $K_{\pi pi}, K_{\pi hi}$  – the flexibility and reliability of enterprises in the stationary conditions of their functioning (0.9 – 0.95).

To obtain the greater flexibility effect of construction companies it is necessary to create the conditions through the development of various mechanisms and approaches for ensuring the necessary conditions for sustainable strategic development and conformity between the major integrated units: the characteristics of construction products, the characteristics of the production potential of the construction system in the zones of stationary and mobile basing; the functioning conditions of building systems, the characteristics of economic stability. Most of the enterprises are in difficult situation with insufficient working of local manufacturing resources and with shortage of labour resources and new technologies of objects construction in regional areas. Some companies raise their level of flexibility due to the creation of new regional support bases and construction units to ensure their efficient balance between themselves.

Other enterprises improve their flexibility through the implementation of development measures to increase labour intensity in manufacturing processes and due to the transition to the new technologies and organizational forms and production management in the execution of the works.

With increasing of the activity zone radius of enterprise, the construction time reduction is achieved due to the greater flexibility of the organization. One of the ways to reduce the costs caused by the need for greater mobility of construction companies during the organizing the manufacturing processes of construction (the first and the second stages) is the concentration of production capacity, i.e. the formation of the system of fixed bases in one of the zones of territory activities. The implementation of these directions of the development of flexible organizations contributes to the new job formation and the development of industrial and social infrastructure in the regional districts for the long term within the approved development strategy of the regional areas and construction complex.

### 3. Conclusions

With increasing flexibility of enterprises at all stages of the life cycle development of the construction system, it is necessary:

- a. To determine the type of economic-organizing situations in which construction complex enterprises operate;
- b. To analyze the factor space affecting the level of enterprise flexibility;
- c. To determine the level of enterprise flexibility;
- d. To develop a set of measures, arrangements oriented to improve enterprise flexibility;
- e. According to the development strategy forecast of construction complex, it is necessary to calculate the economic efficiency of enterprises on the basis of flexibility level assessment.

All these directions have their rational application areas in a particular region and in its territories that allow to solve many strategic objectives as a whole and to select the relevant development of the construction industry.

Each of these main directions is focused on the implementation of a large number of tasks, requires the development of relevant regional programs, measures, normative legal documents, financial and investment fundamentals for their implementation. This problem solving process should

be carried out gradually, taking into account the perspective of construction complex development of the Penza region.

## References

- [1] Agapkin V. M., A. D. Khaitun The Mobility of construction industry. – M.: Stroyizdat, 1987.- 302 p.;
- [2] Artamonova I. S. The main directions of the strategic management of investment-industry complexes / Artamonova I.S., Khrustalev B. B., Eremkin A.A.,– Penza: PSUAC, 2006.-208 p.;
- [3] Barinova L. S., Mironov V. V. The construction materials industry is an integral part of the building complex of the Russian Federation. // Building material. - 2000. No. 8, p. 4-7.;
- [4] Bychkov V. P. Problems of market formation of accessible housing in Russia. // Construction economics. – 2004.-№ 11, pp. 2 - 13.;
- [5] Efimenko A. Z., Rybko A. N. Inventory management of raw materials and their optimization at the enterprises of the construction. // Construction economics. – 2005.- No. 10, pp. 36-41.;
- [6] Zyukin V. N. The mobility of the workforce in the construction industry of the innovation economy: Dis. Cand. Ekon. Sciences: 08.00.05. -M., 2006.-23 p;
- [7] Makarov E. I. The life cycle of the internal environment of the organization. // Management in Russia and abroad. – 2004.- No. 1, pp. 34-39;
- [8] Makarov E. I. to Accelerate the market development of affordable housing. // Construction economics. - 2005.- No. 12, pp. 46-55.;
- [9] Prikin B. V. Increase of efficiency of mobile construction organizations. - M.: Stroyizdat, 1988. - 240 p.;
- [10] Semochkin V. N. Flexible development of the enterprise. Efficiency and budgeting. – M: Business, 2000. -351 p.;
- [11] Khrustalev B. B. Activity of economic systems through the creation of flexible management structures in the industrial complex. - Penza: PGWC, 2004.- 211 p.;
- [12] Khrustalev B. B., Pakhalina Z. V., Spirin, M. E. Basic organizational and economic situation of the functioning and development of mobile construction enterprises in the conditions of influence of external environment // Competitiveness in the global world: Economics, science, technology. – 2016. – No. 8, part 3. – pp. 140-143;
- [13] Khrustalev B. B., Pakhalina Z. V., Spirin, M. E. The main approaches to the development of the construction complex on the basis of functioning mobile construction enterprises Competitiveness in the global world: Economics, science, technology. - 2016. – No. 8, part 3. – pp. 195-198
- [14] Khrustalev B. B. Regional ICC: The questions of formation of rational parameters of work of construction enterprises. -Penza: PSUAC, 2001.- 186 p.
- [15] Khrustalev B. B. Main directions of management of enterprises investment-construction complex. – Penza: PSUAC, 2004. - 195 p.