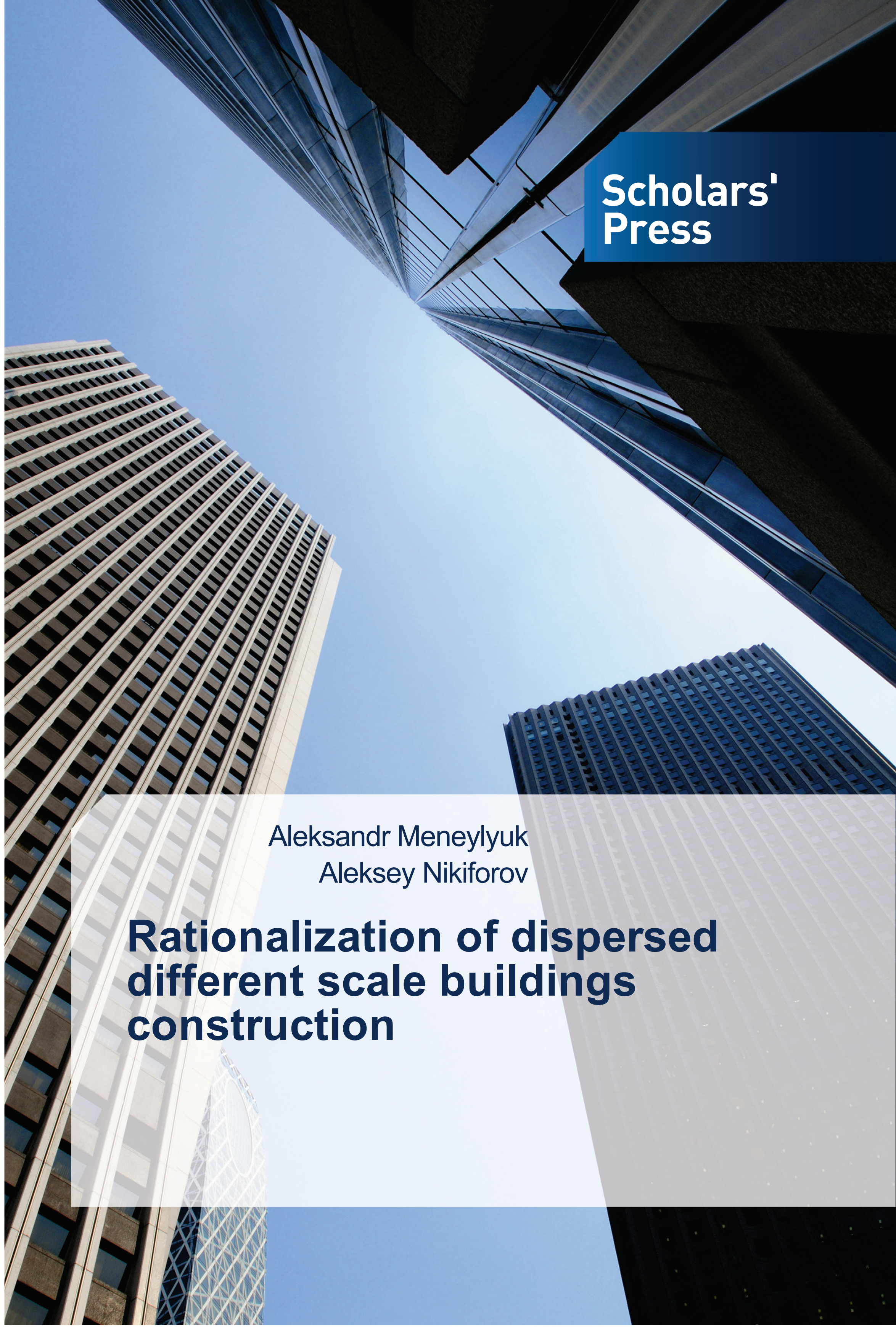
Rationalization of dispersed different scale buildings construction

The study presents a method for rationalization of organizational and technological solutions at enterprises for the construction of dispersed different scale buildings using the results of the authors' theoretical and experimental studies. The analysis of the conditions in which the operational activity of the enterprises under consideration is given. It is justified the relationship of organizational and technological solutions of the dispersed different scale buildings construction in the management of the enterprise as a whole and decisions on individual projects and submit this relationship in the form of a multidimensional organization structure. The model of business processes relationship, multidimensional organizational structure of such enterprises are developed and analyzed. The obtained experimental statistical dependencies of the change of indicators of such operational activity from the varied organizational and technological factors and the developed algorithms allow choosing rational organizational and technological solutions based on the analysis of the construction site conditions and on the effective planning.

A. MENEYLUYK Odessa State Academy of Civil Engineering and Architecture, Didrihsona st., 4, Odessa, Ukraine, 65029, ORCID 0000-0002-1007-309X A. NIKIFOROV Odessa State Academy of Civil Engineering and Architecture, Didrihsona st., 4, Odessa, Ukraine, 65029, ORCID 0000-0001-7002-7055

978-620-2-31697-2



Scholars' Press

Aleksandr Meneylyuk
Aleksey Nikiforov

Rationalization of dispersed different scale buildings construction

Aleksandr Meneylyuk

Aleksey Nikiforov

Rationalization of dispersed different scale buildings construction

Aleksandr Meneylyuk
Aleksey Nikiforov

Rationalization of dispersed different scale buildings construction

Scholar's Press

Imprint

Cover image: www.ingimage.com

Publisher:
Scholar's Press
is a trademark of
International Book Market Service Ltd., member of OmniScriptum Publishing Group
17 Meldrum Street, Beau Bassin 71504, Mauritius

Printed at: see last page
ISBN: 978-620-2-31697-2

UDC 658,511: 69,055
BBK 38.1

Recommended for publication by the decision of the Academic Council of Odessa State Academy of Civil Engineering and Architecture on August 31, 2018.

Meneylyuk A.

Rationalization of dispersed different scale buildings construction / A. Meneylyuk, A. Nikiforov. - Riga: OmniScriptum Publishing, 2018. – 48 p.

Reviewers:

Savyovsky V. Doctor of Technical Sciences, Full professor (“Expert Project Group”);

Tugai O. Doctor of Technical Sciences, Full professor, Head of the Department of Organization and Management of Construction (Kyiv National University of Construction and Architecture).

Abstract. The study presents a method for rationalization of organizational and technological solutions at enterprises for the construction of dispersed different scale buildings using the results of the authors' theoretical and experimental studies. The analysis of the conditions in which the operational activity of the enterprises under consideration is given. It is justified the relationship of organizational and technological solutions of the dispersed different scale buildings construction in the management of the enterprise as a whole and decisions on individual projects and submit this relationship in the form of a multidimensional organization structure. The model of business processes relationship, multidimensional organizational structure of such enterprises are developed and analyzed. The possibility of developing a computer model of operating activity of the organization in question is substantiated. The regularities of changes in the structure and amount of the total production costs of the construction enterprise under the influence of organizational and technological factors are calculated and investigated. The obtained experimental statistical dependencies of the change of indicators of such operational activity from the varied organizational and technological factors and the developed algorithms allow choosing rational organizational and technological solutions based on the analysis of the construction site conditions and on the effective planning.

Keywords. Construction of dispersed different scale buildings, business processes, multidimensional organizational structure, organizational and technological solutions, numerical optimization, experimental statistical modeling.
Fig. 18. Tables. 7. Bibliography: 20 references.

Table of contents

Introduction

A large number of infrastructure facilities and structures in Ukraine are located in different places. They are different in scales, volume of production and number of people involved. Many of them need repair works, reconstruction or at least continuous monitoring. Specific conditions of realization of such construction projects and the analysis of the traditional organizational structures of management show that the management structures of specialized enterprises require appropriate organizational transformation. Special conditions of construction of dispersed different scale buildings require systematic studies of the impact of organizational and technological factors on the cost structure of specialized enterprises. Such studies will improve the efficiency of organizational and technological solutions in the management of enterprises in focus and reduce the cost of work. As a result, it is an urgent task to rationalize organizational and technological solutions at enterprises for the construction of dispersed different scale buildings.

Analysis of the latest sources of research and publications

Data on the segmentation of the grain storages construction market in the world [1, 2] show that a significant proportion of the work is to upgrade existing storage facilities. Currently, Ukrainian railways operate about 19, 5 thousand manufactured structures. Among them, there are about 7500 railway bridges, 11000 tubes and trays, 80 tunnels, overpasses, pedestrian bridges and other engineering structures [3]. There are many other dispersed different scale buildings in Ukraine, which demand construction of renovation works. These facilities are located throughout the territory of Ukraine and can be different in scale [4]. However, many of them need repair works, reconstruction or at least continuous monitoring [5, 6].

Analysis of organizational structures types of enterprises showed that the most common types are linear, linear-staff, project, matrix, multidimensional. The difference of these structures lies in different priorities of vertical and horizontal managerial relationships between their elements. Matrix and at most multidimensional structures have the highest priority of horizontal relations among the considered structures. The development of such relations is effective in the variable environment in which the company sells its activity [7].

It is advisable to use a simulation to improve construction activity. The most effective for the simulation of the operating activity of the enterprises is to build analytical, deterministic, optimizing, imitative, static, correlative-regressive, network models [8, 9].

The fundamental works on the organization of construction process proved that there is a correlation between the management processes of the organization and construction projects [10, 11]. It is proposed [12], that the operations of construction enterprises may be modeled using multidimensional organizational structures.

In accordance with the common approach [13], a phased sequential development of conceptual, logical and physical models provides consistency and simplicity for modeling of enterprises. At each step, the models are specified, detailed and focused on the most important in the framework of the factors and relationships study. The use of statistical methods for solving optimization problems is widely used [14, 15]. Analysis of works, devoted to the optimization of organizational and technological solutions for construction and reconstruction [16, 17], allows us to conclude that the application of experimental statistical modeling is an effective way of solving similar problems and can be used in modeling and optimizing the operating activity of enterprises for construction of dispersed different scale buildings.

The application of experimental statistical modeling for the methods of optimization is discussed in [18, 19, 20]. It is advisable [16, 17] to use specialized programs for project management to create a model of the operating activity of the construction organization.

Special conditions of the construction of dispersed different scale buildings require systematic studies of the impact of organizational and technological factors on the cost structure of specialized enterprises. Such studies will improve the efficiency of organizational and technological solutions in the management of enterprises in focus and reduce the cost of work.

Formulation of the problem

The purpose of the work is to rationalize organizational and technological solutions at enterprises for the construction of dispersed different scale buildings by use of organizational and experimental statistical modelling.

– Develop the methodology of modeling of the operating activities of enterprise in focus: the modelling of organization processes and the experimental statistical modelling of enterprise operating activity.

– Analyze and develop the organizational models of enterprise in focus: the business processes relationship model, multidimensional organizational structure, computer model of operating activity in the graphical-analytical form.

– Select the most important indicators of the enterprise operating activity, the organizational and technological factors that have the greatest impact on them.

– Develop and analyze experimental statistical regularities of indicators changes (the change in total production costs, the ratio of direct and general production costs) under the influence of the studied factors.

– Create recommendations in order to implement results in construction or reconstruction of dispersed different scale buildings: algorithm for constructing a multidimensional organizational structure of enterprise management; organization of managerial interdependencies of organizational elements of the enterprises under consideration; organization of the company's operating activities with an emphasis on the different industrialization of the solutions used and the ownership of resources.

Methodology

Figure 1 shows a block diagram of a three-stage development of operating activity models of the enterprise for the construction of dispersed different scale buildings.

When analyzing the information sources it was identified the feasibility of a phased modeling of the enterprise operating activity. Each successive stage of the modeling is a continuation of the previous one, complements it and refines it. The minor details can be removed. Let us open the main stages of the developed diagram (Figure 1)

– Developing of business process interrelations model – is a stage of conceptual modeling, which identifies the main factors of the enterprise operating activity and the relationships between them. At this stage, it is necessary to structure the totality of the studied factors and identify specific impacts of construction process of dispersed different scale buildings.

– Creating a multidimensional organizational managerial structure – is a stage of logic simulation, which describes the operational activity of the reporting enterprise. It is a core of business process, through which the company creates product. At this stage, it is justified in the present work the relationship of organizational and technological solutions of the dispersed different scale buildings construction in the management of the enterprise as a whole and decisions on individual projects. The model also describes the major modifiable factors and the studied parameters of construction product.

– Construction of a computer optimization model – is a physical modeling phase, which formalizes the operating activity of the enterprise in question and substantiates the possibility to optimize such activity using a computer model.

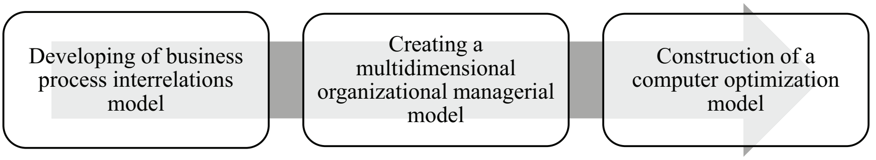


Fig. 1. Block diagram of a phased development of models of the operating activities of the enterprise for the construction of dispersed different scale buildings

It is proposed to use the theory of experimental statistical modeling to evaluate the efficiency and selection of optimal organizational and technological solutions in the management of the construction enterprise, which construct dispersed different scale buildings. The essence of this modelling lies in observing the investigated system by fixing the values of the outgoing indicators when specifying levels of input factors. At the same time, in this study the system is presented in the form of a computer model of the enterprise's operating activity. The algorithm of experimental statistical modeling is shown on Fig. 2.

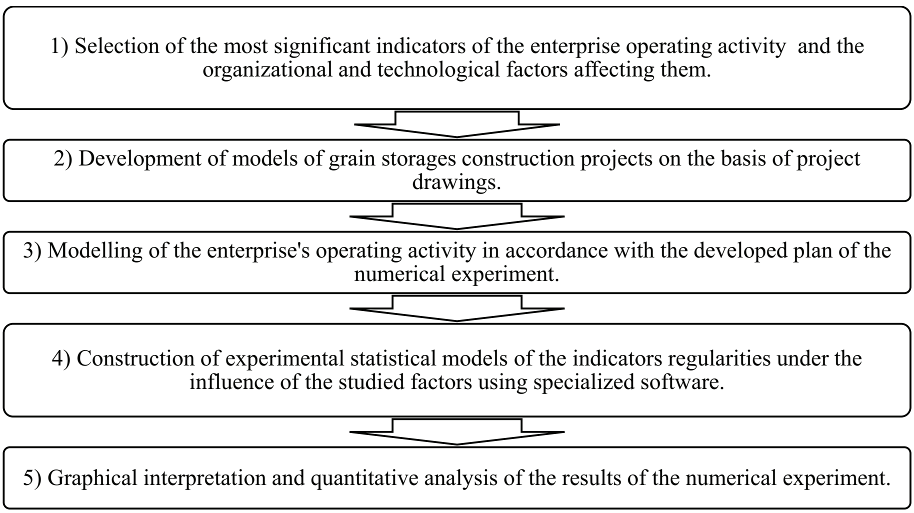


Fig. 2. Algorithm of experimental statistical modeling and optimization of management methods of enterprises, which construct dispersed different scale buildings

As the studied indicators, the following were considered:

– Change in total production costs (Y_1) – percentage change in total production costs, depending on the impact of organizational and technological factors. As a basic model, the change in costs of which is zero, a model has been adopted that reflects the most typical conditions of the enterprise's operating activity in the area of construction and renovation of dispersed different scale buildings. In the present study, such a model is observed at the middle levels of the factors considered. Total production costs are the sum of direct and general production costs. General production costs include: costs for technical and engineering workers, relocation of construction equipment, the construction cost of temporary buildings, engineering communications, warehouses, etc. Direct costs include the following:

- wages and travel;
- cost of consumables;
- cost of equipment operation;
- operation cost of construction machines and mechanisms;
- cost of basic materials;
- cost of subcontracting services.

– Ratio of direct and general production costs (Y_2) – the percentage ratio of total production costs to the amount of direct costs for a set of projects.

– Cost of construction product unit – direct costs, which are necessary for the production of a construction product unit of the enterprise (as basic model it was chosen grain storage construction enterprise): reinforced concrete structures (Y_3 – 1 m^3); load-bearing metal structures (Y_4 – 1 ton); cubic meter of grain silo storage (Y_5 – 1 m^3 of storage); section of transport equipment (noria (Y_6), conveyor (Y_7) – 1 m.).

Varying organizational and technological factors and their numerical characteristics are presented in Table 1.

Table 1. Variable factors

Name of factor	Variation characteristic
X_1 – average complexity of the project totality	The average arithmetic amount of complexity of construction and installation works of the project totality under consideration, mln. hours.
X_2 – average relocation distance	The average arithmetic amount of the relocation distances of resources between any two projects from the totality under consideration, km.
X_3 – attribution of resources	The percentage ratio of own resources to total resources use.
X_4 – industrialization of applied solutions	The percentage ratio of the use of industrial methods in the total amount of work.

The transition to the coded levels of factors is carried out according to the standard Eq. (1):

$$x_i = \frac{X_i - \frac{X_{i\,max} + X_{i\,min}}{2}}{\frac{X_{i\,max} - X_{i\,min}}{2}}, \tag{1}$$

where:

- x_i – given factor level in normalized counting;
- X_i – given factor level in ordinary counting;
- $X_{i\,max}$– the maximum factor level in ordinary counting;
- $X_{i\,min}$ – the minimum factor level in ordinary counting.

Calculation of the regression coefficients was carried out according to standard formulas using the COMPEX dialog system. The regression coefficients are statistical estimates of the true coefficients of the polynomial model, so they need to be checked for their significance. That is the checking whether the estimates of the experimental statistical model`s coefficients differ from zero. This check was carried out at a bilateral risk set at 10% ($\alpha = 0.1$), according to the Student's test due to the Gaussian distribution law. After deleting the coefficients, that were considered indistinguishable from zero by the results of the test, the experimental statistical model with all significant coefficient estimates was tested for adequacy by the Fisher criterion. If this criterion was less than critical for a given risk taking into account the obtained number of degrees of freedom, $F_a < F_{cr}$ (α, $f_{на}$, $f_э$), then the model was considered adequate for engineering solutions and analysis.

To solve optimization problems, a polynomial experimental statistical model was chosen in the framework of this study, the general form of which is presented in the Eq. 2.

$$\begin{aligned} Y = b_0 &+ b_1X_1 + b_{11}X_1^2 + b_{12}X_1X_2 + b_{13}X_1X_3 + b_{14}X_1X_4 \\ &+ b_2X_2 + b_{22}X_2^2 + b_{23}X_2X_3 + b_{24}X_2X_4 \\ &+ b_3X_3 + b_{33}X_3^2 + b_{34}X_3X_4 \\ &+ b_4X_4 + b_{44}X_4^2 . \end{aligned} \tag{2}$$

Study of organizational structure of enterprises for the construction of dispersed different scale buildings

Model of business processes interrelations for the enterprise, which construct dispersed different scale buildings, is shown in Figure 3. Abbreviations used are presented in Table 2.

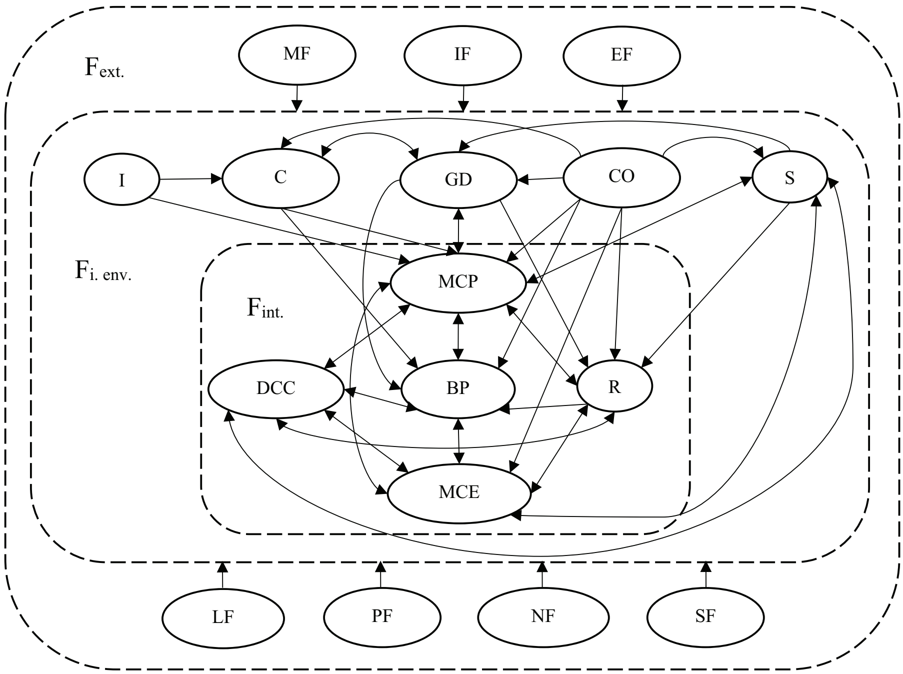


Fig. 3. Model of business processes interrelations for the enterprise, which construct dispersed different scale buildings

The factors in the model are grouped in three areas: external factors ($F_{ext.}$), factors of the immediate environment ($F_{i.\ env.}$) and internal factors of the enterprise ($F_{int.}$). In the present structure (Figure 2), the internal factors can be divided into two categories: factors of the management structure and management methods factors. The first category includes "departments of a construction company" and "resources for building production"; second – "management of construction enterprise" and "management of construction projects". Allocation of factors into two categories was done due to the following.

Widespread department structure of construction companies hardly varies depending on the type of construction organization (building the industrial or civil objects) and on the specific strategic decisions at the enterprise management.

The structure of the resources used in the manufacture of building production (labor, material, technical, intellectual, financial resources, and technologies), is not related to the organizational and technological solutions applied on individual sites.

At the same, though management structure factors may affect the management methods factors, but this influence is much smaller than the impact of management methods factors on management structure factors. This allows us to consider the management structure factors like the subsystem of management methods factors. Thus, both categories have their own specificity, though related.

Table 2. List of abbreviations

Abbr.	Definition	Abbr.	Definition
BP	– building product	WBS	– work breakdown structure
DCC	– departments of construction company	MCE	– management of construction enterprise
R	– resources for the building production	MCP	– management of construction project
I	– investor	C	– customer
GD	– general designer	CO	– controlling organizations
S	– suppliers	LF	– legal factors
MF	– market factors	PF	– political factors
IF	– information factors	NF	– natural factors
EF	– economic factors	SF	– social factors
X_1	– average labor input of the totality of projects	X_3	– membership of resources used
X_2	– average distance relocation	X_4	– industrialization of applied solutions
$\{Y_{tech.}\}$	– indicators of technical efficiency	$\{Y_{ecol.}\}$	– indicators of ecological efficiency
$\{Y_{econ.}\}$	– indicators of economic efficiency	$\{Y_{soc.}\}$	– indicators of social efficiency
Y_1	– change in total production costs	$Y_{3\text{-}i}$	– cost of building production unit
Y_2	– ratio of direct and general production costs	$\ni$	– operator of the affiliation to the superset
$\{Y\}$	– plurality of elements Y	$\wedge$	– operator of conjunction ("and")
$\cap$	– "intersection" operator	$\supset$	– "includes" operator
$\cup$	– "association" operator	$\supseteq$	– "strictly includes" operator

The novelty of the proposed model is as follows:

– at first such factors of the internal environment of the construction enterprise as "management of construction company" and "management of construction projects" were highlighted, and the relationship between them were described;

– at first time the factors of management structure and management methods (factors "management of construction organization" and "departments of construction company", "management of construction project" and "resources for the building production") were highlighted on the example of the enterprise, which construct dispersed different scale buildings;

– at first the specific factors of internal and external environment of the business processes of enterprise, which construct dispersed different scale buildings, were highlighted.

The relationship between the management of the construction organizations in general and individual construction project management was examined in the analysis information sources. In some of the reviewed works, this relationship was established as a one-sided influence of organizational and technological reliability of the ongoing construction project on the management intensity peaks within the enterprise. In the other – as the impact of market environment of construction projects realization on the formation of the optimal portfolio of construction organization. It is obvious that the change of organizational and technological solutions in the management of the enterprise influences these decisions on individual construction sites, and vice versa. For example, the company focus on the implementation of a specific totality of projects leads to the need to create the appropriate material and technical base. This in turn limits the possible technological solutions. Also, the choice of certain organizational and technological schemes necessitates the adaptation of means and methods of enterprise management, and may also require changes to the company structure. This causes necessity to allocate specific factors while making the organizational and technological solutions at the enterprise level or individual sites and find the relationships between them and the characteristics of building production.

In general terms, Figure 3 can be described by the following expressions (Formulas 3-4):

$$\begin{cases} F_{ext.} \ni \{MF, IF, EF, LF, PF, NF, SF\} \\ F_{i.env.} \ni \{I, C, GD, CO, S\} \\ F_{int.} \ni \{MCE, MCP, DCC, R, BP\} \end{cases}, \tag{3}$$

$$\begin{cases} (F_{I.envp.} \cup F_{int.}) = f(F_{ext.}) \\ (F_{i.env.} = f(F_{int.})) \wedge (F_{int.} = f(F_{i.env.})) \end{cases}. \tag{4}$$

It is possible to allocate the following when analyzing the external factors of the enterprise, which construct dispersed different scale buildings (Formulas 5-8):

$$MF \cap NF = F_{ter.}, \tag{5}$$

$$MF \ni F_{sc.}, \tag{6}$$

$$IF \ni F_{tech.}, \tag{7}$$

$$SF \ni F_{cont.}. \tag{8}$$

The impact of factors of the immediate environment on internal factors of the enterprise, which construct dispersed different scale buildings, in general does not differ from the effect on the internal factors of traditional construction organizations. However, the effect of specific external factors interacts these changes to some extent (Formula 9):

$$S = \begin{cases} f(F_{ter.}) \\ f(F_{sc.}) \\ f(F_{cont.}) \end{cases}. \tag{9}$$

Other factors of immediate environment can be omitted from consideration. Thus, the model of studied business processes interrelations for the enterprise, which construct dispersed different scale buildings, takes the following form (Figure 4).

Impact of the studied external factors on the internal factors of enterprise in question can be described by the following system of equations (Formula 10):

$$\begin{cases} (MCP = f(F_{sc.}))\cap(MCE = f(F_{sc.})) = X_1 \\ (MCP = f(F_{ter}))\cap(MCE = f(F_{ter.})) = X_2 \\ (MCP = f(F_{cont.}))\cap(MCE = f(F_{cont.}))\cap(R = f(F_{cont.})) = X_3 \\ (MCP = f(F_{tech.}))\cap(MCE = f(F_{tech.}))\cap(R = f(F_{tech.})) = X_4 \end{cases} . \tag{10}$$

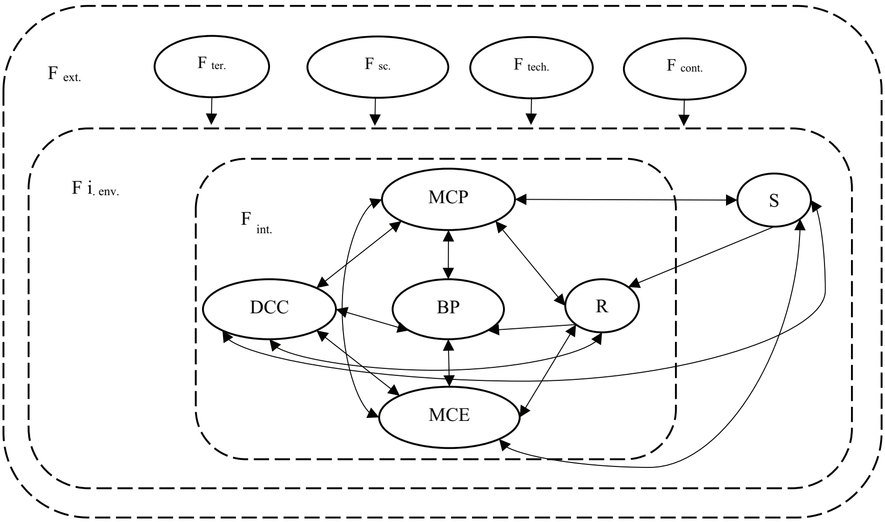


Fig. 4. Model of studied business processes interrelations of the enterprise, which construct dispersed different scale buildings

The relationship between internal factors of the enterprise, which construct dispersed different scale buildings, can be described by the following equations (Formula 11):

$$\begin{cases} (MCE \ni \{X_1, X_2\}) \cup (MCP \ni \{X_3, X_4\}) \\ WBS = f(MCP \subset R) \\ MCE \subset DCC \end{cases} . \tag{11}$$

Building product can be described as a set of indicators imposed on it. Thus, the performance of this product must demonstrate the effectiveness of operating activity at the level of individual projects and their combination. It can be written (Formula 12):

$$BP \supseteq \{\{Y_{tech.}\}, \{Y_{econ.}\}, \{Y_{ecol.}\}, \{Y_{soc.}\}\}. \tag{12}$$

Thus, it can be written for the present study (Formula 13):

$$\mathrm{BP} \supseteq \{Y_1, Y_2, Y_{3-\mathrm{i}}\}. \tag{13}$$

Varying factors and indicators, which were considered, as well as the internal factors may be presented in the form of multidimensional organizational managerial model of the enterprise, which construct dispersed different scale buildings (Figure 5).

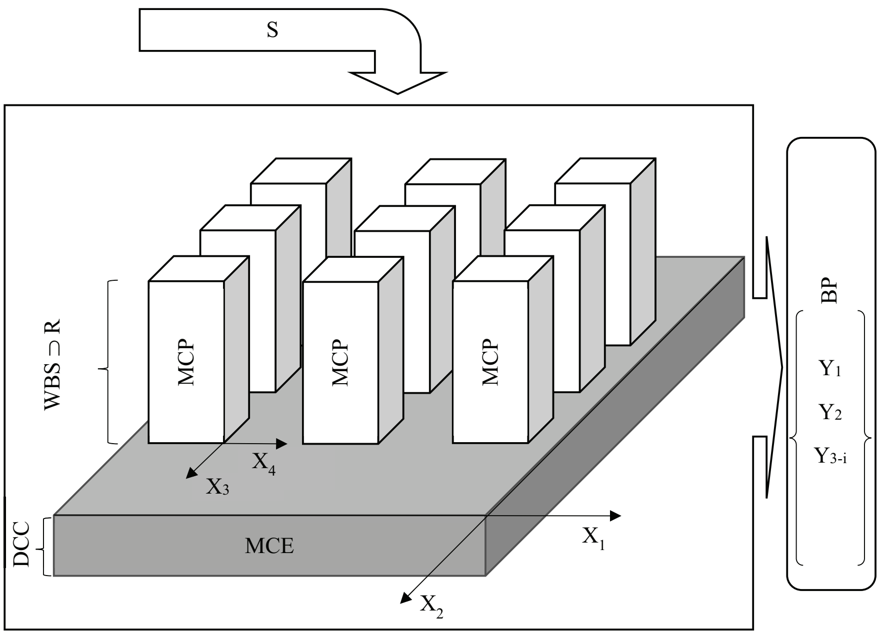


Fig. 5. Multidimensional organizational managerial model of the enterprise, which construct dispersed different scale buildings

Multidimensional structure shown in Fig. 5, allows to group projects performed by the organization, according to their scale (X_1) and territorial dispersion (X_2). This makes it possible to analyze the organizational and technological links between similar projects. There are different organizational and technological solutions at the specific projects:

various membership of resources used (X_3), different industrialization of applied solutions (X_4). The model shows that there is a connection between the structure of the organization (DCC) and its management methods (MCE), as well as between the structure (WBS) and management practices (MCP) of individual projects.

Let us note that the resources (R: labor, material, technical, intellectual, financial resources and technologies), used to create building product, can be ordered via the project work breakdown structure (WBS). As it can be seen from the figure, the multidimensional managerial model presents a conversion tool of external resources provided by suppliers into construction products.

The novelty of this model is as follows:

– at first the contrast between the following factors as part of a multidimensional structure was described: the management structure and management methods of construction enterprises;

– at first multidimensional organizational managerial model of construction enterprise was created, showing:

  – the process of building product creating;
  – bilateral causal relationships between the management of the construction enterprise and management of individual construction projects, consisting of the organizational, technological and managerial impact of the organization at the construction project, and vice versa.

The basis of all the information about the operating activity of construction organization are the resources that are necessary to implement this activity. The structure of the resources used in the creation of product of enterprise, which construct dispersed different scale buildings, as well as information about the values of their costs in physical and monetary terms allow to create accurate computer model of operating activity (Figure 6). Such model can be most easily created using the software for project management. Variation of the most significant factors and study of selected indicators change will allow numerically optimizing the operating activity of enterprise, which construct dispersed different scale buildings.

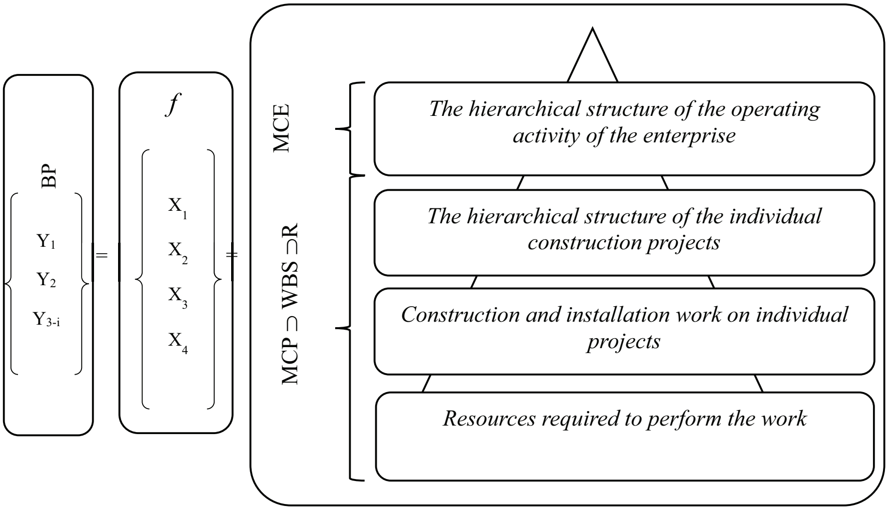


Fig. 6. Graphical analytical form of a computer model to optimize the operating activity of the enterprise, which construct dispersed different scale buildings

Numerical study of organizational and technological solutions for the construction of dispersed different scale buildings

As a result of the experimental statistical modeling, change dependencies of studied parameters (14-20) from the variable factors were obtained.

The results of the numerical experiment are shown in Table 3. Here and below, the coefficients recognized as indistinguishable from zero by the Student's test are not shown. For the convenience of engineering calculations, the dependencies were transformed using Eq. 1, which allowed using the ordinary values of the factor levels when calculating the indicator. In order to be used for a specific construction enterprise, the dependences 14-15 should be recalculated using unique enterprise data.

$$Y_1 = 0{,}557\ X_1 - 13{,}083 - 0{,}006\ X_1^2 - 2\times10^{-4}\ X_1X_2 + 8\times10^{-4}\ X_1X_3 - \\ - 0{,}002\ X_1X_4 + 0{,}018\ X_2 - 4\times10^{-6}\ X_2^2 - 5\times10^{-5}\ X_2X_3 + 0{,}06\ X_3 + 0{,}037\ X_4. \qquad (14)$$

$$Y_2 = 9{,}281 - 3{,}746\ X_1 + 2{,}469\ X_{12} - 2{,}839\ X_1X_2 + 1{,}3\ X_1X_3 + 3{,}745\ X_2 - \\ - 1{,}466\ X_2X_3 - 1{,}99\ X_3. \qquad (15)$$

When constructing diagrams of "squares on square" type, it is advisable to divide the factors into two pairs, each of which has its own sense from the viewpoint of the study of the system under consideration. In this study, the factors X_1 and X_2 reflect the strategic prerequisites, based on which, the construction enterprise does its operational activity; factors X_3 and X_4 - organizational and technological solutions, taken within the framework of a separate construction project.

Table 3. Results of experimental statistical modeling

№	Actual values of the factors				Indicators	
	X_1, thousand hours.	X_2, km.	X_3, %	X_4, %	Total production cost change, Y_1	Ratio of direct and general production costs, Y_2
1	6	7	8	9	10	11
1	37	1000	100	100	-0,222%	8,20%
2	37	1000	100	0	5,223%	7,75%
3	37	1000	0	100	-4,647%	10,68%
4	37	1000	0	0	0,373%	10,09%
5	37	100	100	100	-1,691%	6,61%
6	37	100	100	0	3,753%	6,24%
7	37	100	0	100	-7,587%	7,27%
8	37	100	0	0	-2,566%	7,27%
9	2,2	1000	100	100	2,301%	16,13%
10	2,2	1000	100	0	-1,015%	16,76%
11	2,2	1000	0	100	3,225%	27,84%
12	2,2	1000	0	0	0,333%	28,87%
13	2,2	100	100	100	-5,141%	7,69%
14	2,2	100	100	0	-8,457%	7,99%
15	2,2	100	0	100	-11,658%	9,41%
16	2,2	100	0	0	-14,550%	9,76%
17	37	550	50	50	-0,967%	7,93%
18	2,2	550	50	50	-2,274%	15,02%
19	19,6	1000	50	50	0,895%	10,98%
20	19,6	100	50	50	-2,125%	7,65%
21	19,6	550	100	50	1,896%	8,35%
22	19,6	550	50	100	0,063%	9,25%
23	19,6	550	0	50	-3,127%	10,35%
24	19,6	550	50	0	1,742%	9,08%
25	19,6	550	50	50	-0,615%	9,31%

Let us consider Fig. 7. It shows in graphical form the regularity of the change in total production costs (Y_1) from the attribution of resources (X_3) and the industrialization of applied solutions (X_4) in nine combinations of the average complexity of project totality (X_1) and the average relocation distance (X_2).

Here and below, the extremes of the exponent within the limits of two-factor diagrams are marked as bold, and as underlined – within the entire four-factor diagram.

The indicator "change in total production costs" (Y_1) reflects the relative financial effectiveness of certain organizational and technological solutions. As can be seen from Fig. 7, such efficiency is different when making certain organizational and technological decisions at sites under different strategic prerequisites for the operating activities of the enterprise in question. Moreover, the nature of the influence of such decisions (that is, the influence of factors X_3 and X_4) is different depending on the levels of factors X_1 and X_2.

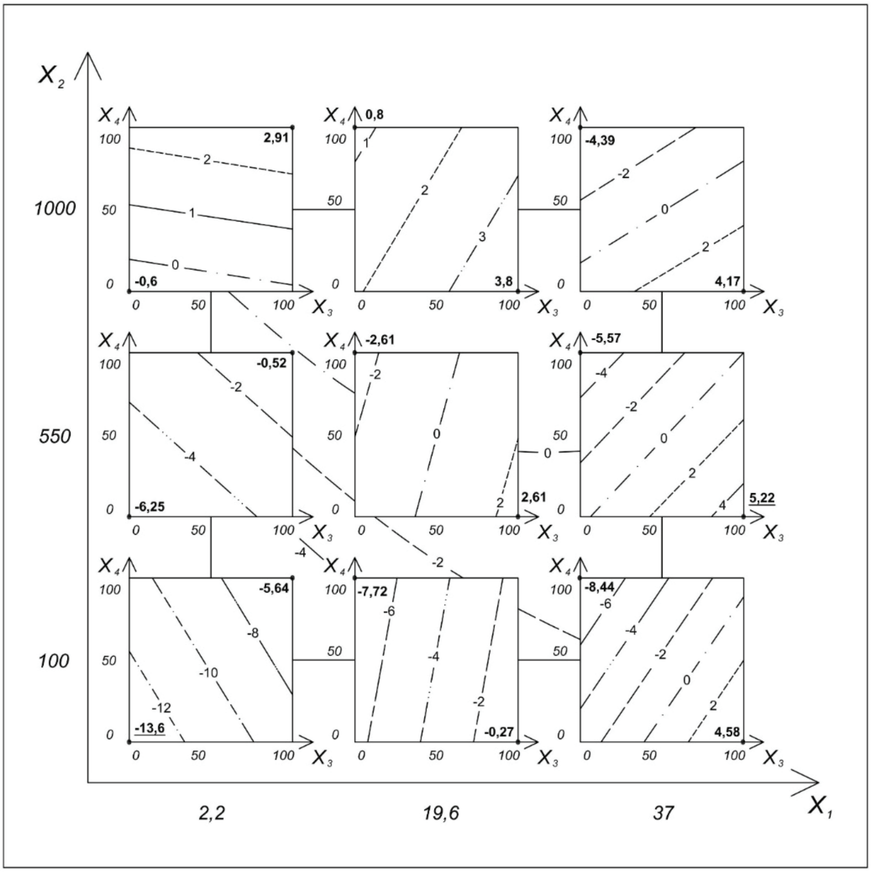


Fig. 7. The change in the total production costs (Y_1) from the attribution of resources (X_3) and industrialization of applied solutions (X_4) under different strategic decisions of the enterprise management

Table 4 reflects the relative effectiveness of the application of organizational and technological solutions under various strategic management decisions of the construction enterprise in question. The presented in the table estimates are calculated by finding the difference between the maximum and minimum change in the total production costs (Y_1) for each of the nine "small" squares on Fig. 7.

Table 4. Relative efficiency (%) of adoption of organizational and technological solutions for various management strategies of the enterprise, which construct dispersed different scale buildings

Level of factor X_2, km.	Level of factor X_1, thsd. hours		
	2,2	19,6	37
1000	3,51	3	8,56
550	5,73	5,22	10,79
100	7,96	7,45	13,02

It can be noted that the effectiveness of making the necessary organizational and technological decisions on a particular object increases with an increase in the average complexity of project totality ($X_1 \rightarrow$ max) and decreases with increasing the average relocation distance ($X_2 \rightarrow$ max).

The level of factors X_1 and X_2 also affects how factors X_3 and X_4 influence the value of Y_1. At low values of factor X_1, an increase of industrialization of applied solutions (X_4) increases the total production costs (at X_2 = 100 km - by 2.1%, at X_2 = 550 km - by 3.05%, at X_2 = 1000 km - by 3.1%), at high - decreases (at X_2 = 100 km - by 5.4%, at X_2 = 550 km - by 5.07%, at X_2 = 1000 km - by 4.9%). In other words, the use of high-performance methods of construction and installation works is advisable at large facilities. Analyzing the angle of isolines inclination to the axis of the factor "attribution of resources" (X_3), we can come to the following conclusion. An increase in the level of factor X_2 leads to a decrease in the effect of factor X_3 on the indicator. In other words, the use of subcontract resources is the more expedient, the further the sites are located from each other. Nevertheless, the use of own labor resources, machines and mechanisms for the construction and reconstruction of dispersed different scale buildings is more profitable than attracting them from the outside in any case.

The minimum value of the indicator "change in total production costs" (Y_1), equal to 13.6%, is observed with the average complexity of project totality X_1 = 2.2 thousand hours, the average relocation distance X_2 = 100 km. X_3 = 0%, industrialization of applied solutions X_4 = 0%.

Fig. 8 contains a graphical representation of the attribution of resources (X_3) and the industrialization of applied solutions (X_4) on the ratio of direct and general production costs (Y_2) in nine variants of the average complexity of project totality (X_1) and the average relocation distance (X_2).

The nature of the influence of the attribution of resources (X_3) on the ratio of direct and general production costs (Y_2) remains unchanged at all points of the factor space. Increasing the use of subcontracting resources reduces general costs and increases the amount of direct costs. In general, this leads to a decrease of Y_2.

The influence of factors X_1 and X_2 on the degree of influence of factor X_3 on the indicator should be noted. Table 5 gives estimates of the impact of attribution of resources (X_3) on ratio of direct and general production costs (Y_2). The estimates presented in the table are calculated by finding the difference between the maximum and the minimum ratio of direct and general production costs (Y_2) for each of the nine "small" squares in Fig. 8. The influence of the factor X_3 on the Y_2 indicator decreases with the increase in the average complexity of project totality ($X_1 \rightarrow$ max) and increases with the increase of the average relocation distance ($X_2 \rightarrow$ max).

The minimum value of the ratio of direct and general industrial costs (Y_2), equal to 4.99%, is observed at the following levels of factors: X_1 = 37 thousand hours, X_2 = 100 km., X_3 = 100%, and any degree of industrialization of applied solutions (X_4).

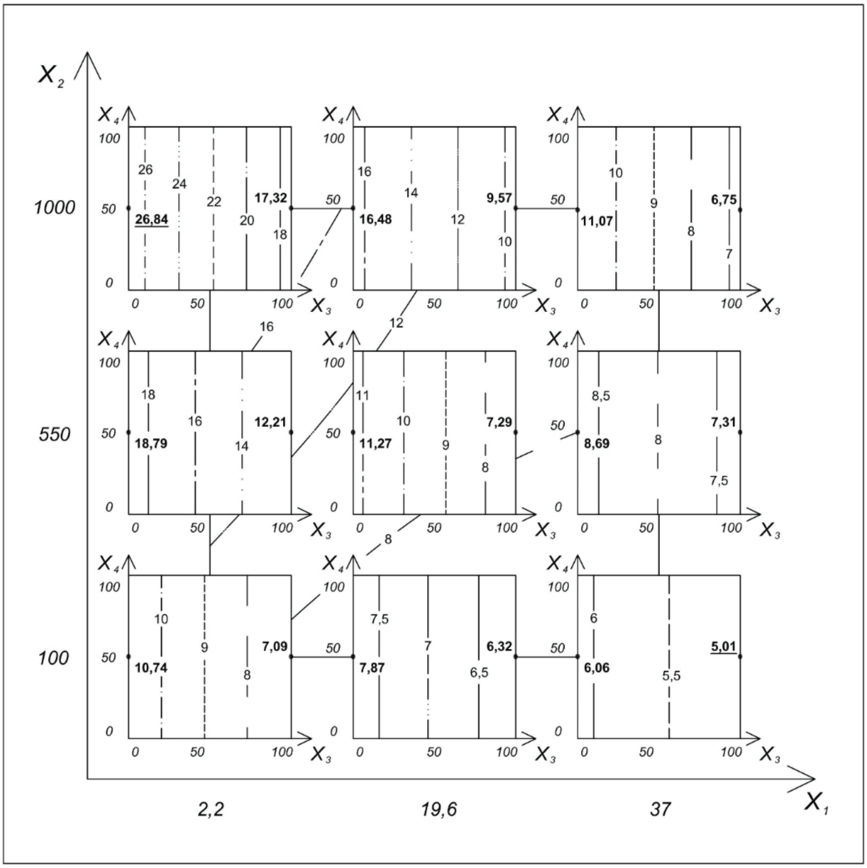


Fig. 8. Change in the ratio of direct and general production costs (Y_2) from the attribution of resources (X_3) and the degree of industrialization of applied solutions (X_4) under various strategic decisions in the enterprise management

Table 5. Changes in the ratio of direct and general production costs (%) from the use of own or subcontracting resources under various management strategies of construction enterprise

Level of factor X_2, km.	Level of factor X_1, thsd. hours		
	2,2	19,6	37
1000	3,51	3	8,56
550	5,73	5,22	10,79
100	7,96	7,45	13,02

Implementation of results in construction

Multidimensional structure, presented on Fig. 5, allows you to group projects executed by the organization, depending on their scale (X_1) and territorial diversity (X_2). This makes it possible to analyze organizational and technological interrelationships between similar projects. In the framework of individual projects, different organizational and technological solutions are possible (X_3, X_4). The model shows that there is a connection between the structure of the construction enterprise (DCC) and the management of the construction enterprise (MCE), as well as between the structure (WBS) and the management methods (MCP) of individual projects.

Let's consider examples of companies that have chosen as a development four combinations of strategic organizational and technological decisions:

1. Focusing on objects of a large scale and labor intension, which are located at a considerable distance from each other: MCE $\supset$ {$X_1 \rightarrow$ 37 thousand hours; $X_2 \rightarrow$ 1000 km.}.
2. Focusing on small objects located within a limited area: MCE $\supset$ {$X_1 \rightarrow$ 2.2 thousand hours; $X_2 \rightarrow$ 100 km.}.
3. Focus on large and small objects in the ratio of direct costs 75% to 25%: MCE $\supset$ 0,75 {$X_1 \rightarrow$ 37 thousand hours.; $X_2 \rightarrow$ 1000 km.} $\cup$ 0,25 {$X_1 \rightarrow$ 2,2 thousand hours; $X_2 \rightarrow$ 1000 km.}.
4. Focusing on large and small objects in the ratio of direct costs 25% to 75%: MCE $\supset$ 0,75 {$X_1 \rightarrow$ 2,2 thousand hours; $X_2 \rightarrow$ 1000 km.} $\cup$ 0,25 {$X_1 \rightarrow$ 37 thousand hours; $X_2 \rightarrow$ 1000 km.}.

In the case of intermediate combinations, the proposed solutions require appropriate adaptation.

These combinations were selected from all the possible options, as they reflect the most characteristic stages of development of the construction organization:

- first, it performs work of mainly small scale in the region of the location of their own material and technical base (combination 2);

- during the development of an organization it can implement projects of larger (combination of 4) and larger (combination 3) scale;
- becoming one of the leaders of the construction market, the company may not carry out work on small construction sites, focusing its operations on large objects (a combination of 1).

For combinations 1, 3, 4 there was selected the biggest value of the factor "average relocation distance " (X_2) as it is the most likely to perform work on various distance in case of an objects totality.

The allocation of management techniques for multidimensional structures generally extends for different methods of production, supply and marketing. The elements interact structures as suppliers or contractors. Due to this flexibility is achieved by the organization in the changing conditions, in particular, the organizational and technological. It was proposed in this work we

- As methods of marketing management elements – to consider the combinations of strategic organizational and technological solutions discussed above as they characterize the construction product of the enterprise.
- As methods of supply management – to consider the combinations of organizational and technological decisions made at individual sites ("attribution of resources " – X_3 and "industrialization of applied solutions" – X_4) as they describe the resources used in the work and the methods of supplying.
- As methods of production management – to consider the orientation on project-oriented or function-oriented method of construction management as the most common way to manage construction.

In accordance with these assumptions there were developed graphical representations of multi-dimensional organizational management structures for the combination of organizational and technological solutions given above. They are shown on figures 9-12.

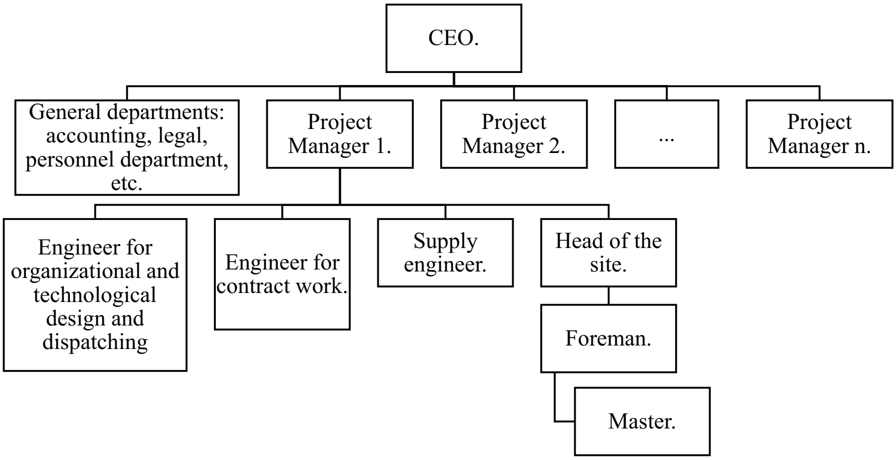


Fig. 9. The hierarchical subordination of organizational elements of multidimensional managerial structure of the enterprise for the construction of dispersed different in scale objects (combination 1)

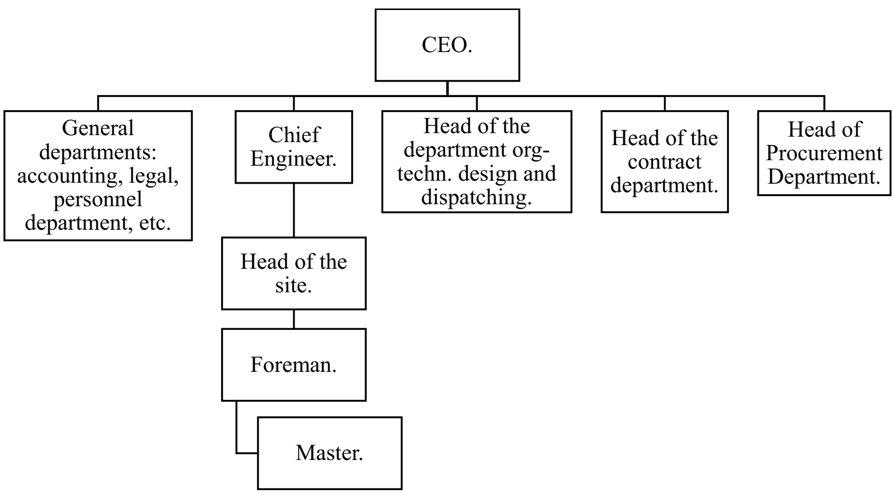


Fig. 10. The hierarchical subordination of organizational elements of multidimensional managerial structure of the enterprise for the construction of dispersed different in scale objects (combination 2)

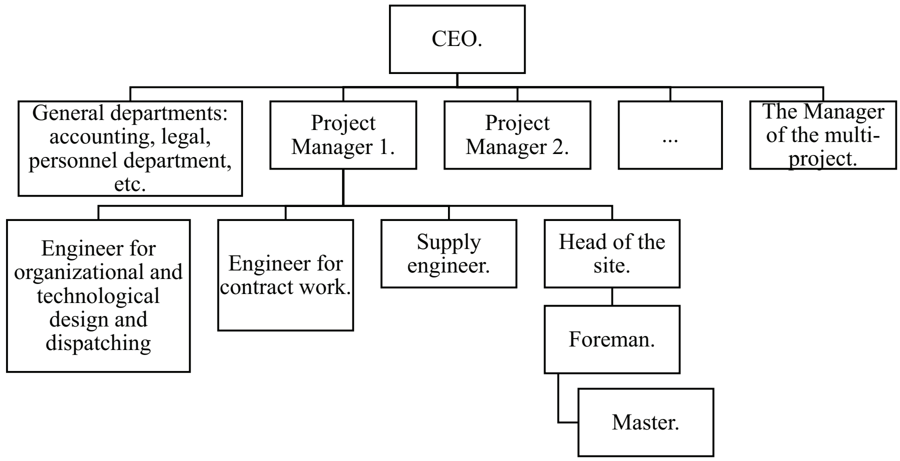


Fig. 11. The hierarchical subordination of organizational elements of multidimensional managerial structure of the enterprise for the construction of dispersed different in scale objects (combination 3)

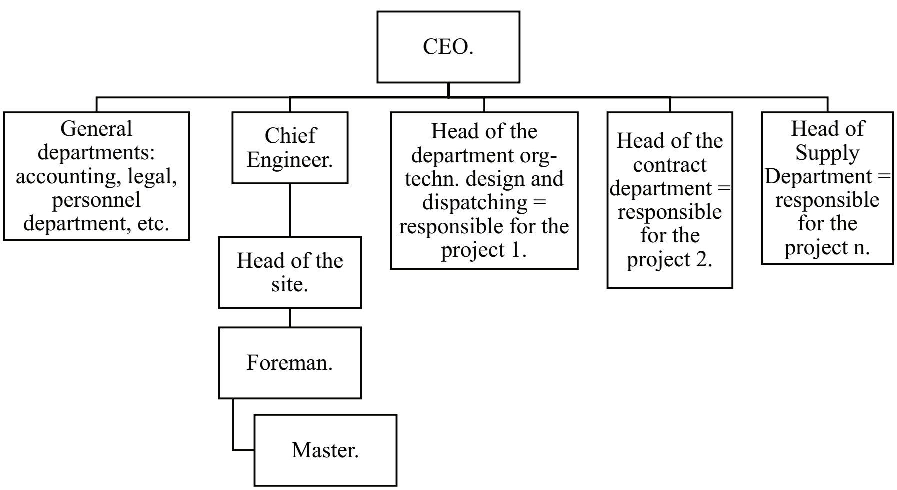


Fig. 12. The hierarchical subordination of organizational elements of multidimensional managerial structure of the enterprise for the construction of dispersed different in scale objects (combination 4)

The main feature of multidimensional organizational structures is flexible interaction between vertical and horizontal managerial relations. For project-oriented businesses, particularly for enterprises, which construct dispersed different scale buildings, the main elements of the multidimensional structures are separate projects and their groups, and enterprise management system in general (Fig. 5). Thus, vertical interactions can be carried out by the control system in the direction of individual projects and their groups, and vice versa; horizontal – between projects and their groups. Vertical interaction are performed through hierarchical operations of the enterprise, horizontal – levels within this structure.

Character of the interactions for each of the strategic combination of organizational and technological solutions contains in table 5.

In table 6 there are described features of the management of enterprises, which construct dispersed different scale buildings, depending on their orientation on own ($X_3 \rightarrow 0\%$) or contracted ($X_3 \rightarrow 100\%$) resources, high ($X_4 \rightarrow 100\%$) or low ($X_4 \rightarrow 0\%$) degree of industrialization of used technological solutions.

Analysis of the literature and analysis of tables 5-6 allowed developing an algorithm of creation of multidimensional management structure of the enterprises in focus. This algorithm should be used in conjunction with tables 5-6:

1. Definition of external and internal factors affecting the organizational structure of the company.
2. Identification of opportunities for continued existence within the strategy and prospects of forming a new organizational structure.
3. Building of management structure.
   - Development of the strategic concept of the enterprise as a whole.
   - Forming a working group to develop a plan of organizational change.
   - Preparation of business plans and strategic evaluation of the departments.
   - Estimation of pricing mechanism for building products.
   - Evaluate the possibility of integration with partner`s company.
   - Drawing up a new scheme of production structure.

Table 5. Management interactions between the elements of the enterprise operating activity, which construct dispersed different scale buildings

Connections type	1	Vertical	Horizontal	
Structure level of the of enterprise	2	All levels	Group of projects/operating activity as a whole	Projects
Combinations of strategic organizational and technological solutions: 1	3	Senior management has control of project managers and makes strategic decisions. The main center of org. tech. solutions - project management office.	The management team is formed for each project. The team performs all the functions of engineering, economic and material supplies for the project.	Participation/non-participation in the project and its linkage with other projects of the organization is measured by the presence of a sufficient number of project management
2	4	Senior management is involved in the management of all projects and executes them according to the department division of responsibilities.	Management of all projects is carried out by departments that perform each of its production function.	Participation/non-participation in the project and its linkage with other projects of the organization is measured by the presence of labor and/or equipment. Management personnel can be engage from the side.
3	5	Senior management has control of project managers and makes strategic decisions. One or more of project managers and their teams manage a portfolio of small projects.	Management of portfolio of small projects (multi-project) is assigned to the separate team. Management of large projects is performed according to the combination 1.	The decision on participation/non-participation in the project is carried out according to combination 1. Multi-project in this case is treated as a separate project.
4	6	Senior management is involved in the management of all projects and executes them according to the department division of responsibilities. Heads of departments are appointed responsible for major projects.	The workers within the functional departments of the organization are assigned for a large project. The rest of the staff is involved in the projects` management according to the comb. 2.	The decision on participation / non-participation in the project is carried out according to combination 2.

Continuation of table 5

1	2	3	4	5	6
Horizontal	Construction and installation work	It is vital to organize rationally planned engineering workflows within individual projects with their subsequent linkage	Work is intensified, and slowed down according to the workspace at other sites, in order for the company overall continuity of the process flow.	The portfolio of small projects considered as a multi-project with appropriate org. tech. linking work within it. Active flows link large projects and multi-	Repeats approach for combination 2. Major project receives priority in the overall enterprise for organizational and technological linking of works.
	Resources	Resources for projects are provided project management team. Sharing resources between projects impossible or severely	Projects centrally provided with resources by department of logistics. Intensive sharing of resources between projects is encouraged. Necessary for specialized work	Supply of resources is performed in two ways: individually for each major project and centrally for small projects portfolio. Approaches are	Supply of resources is centralized with the priority of major projects.
	Resources	Resources for projects are provided project management team. Sharing resources between projects impossible or severely	Projects centrally provided with resources by department of logistics. Intensive sharing of resources between projects is encouraged. Necessary for specialized work	Supply of resources is performed in two ways: individually for each major project and centrally for small projects portfolio. Approaches are	Supply of resources is centralized with the priority of major projects.

4. Justification of the kind of organizational management structure.
   - Determining the management principles, which are suitable for the enterprise.
   - The distribution of function operations.
   - Distribution of administrative powers between the higher management and the management of future departments/projects.
   - Drawing organizational structure (management structure and its relationship with the production structure).Selection and appointment of project managers.
5. Development of management mechanism in the new organizational structure.
   - Installing the relationship between management of departments and project management based on the intensity of horizontal management relations.

– Installing the degree of responsibility of project managers according to their degree of freedom in decision-making.
– Development of the general principles of relations between units.
– Creating a system of material incentives for project managers.
– Forming a steering committee to restructure the company.
– Organization of seminars to prepare managers and employees.

Table 6. Peculiarities of operating businesses in construction dispersed different scale buildings in the orientation on the different ownership of resources used and industrialization of solutions used

		Attribution of resources (X_3)	
		($X_3 \rightarrow 0\%$)	($X_3 \rightarrow 100\%$)
Industrialization of applied solutions (X_4)	($X_4 \rightarrow 0\%$)	It is appropriate to be involved in small-scale projects, located a short distance from each other. There is required to set qualified contractors, workers and to establish effective systems of operational management. The optimization of logistics methods is critically important. Production functions are distributed between specialized enterprise departments. It is irrational to invest in high-performance engineering and construction machines, because it can be more profitable to draw them from outside.	It is appropriate to be involved in large and medium scale projects at different distances from each other. Management of the work and workers, as well as entire construction projects, should be organized on the principles of engineering. Critically important is to create the system of periodic accounting and control the construction works course. Logistical supply may be a duty of the enterprise or responsibility of involved organizations and structures. It is rational to invest in high technology and construction machines.
	($X_4 \rightarrow 100\%$)	It is appropriate to be involved in projects large and medium scale, at different distances from each other. Qualification of technical staff in the use of effective organizational and technological solutions should be the best. Job function can be organized either by their distribution between the profile departments, and by forming project teams. Using high technology and construction machines requires the creation of depreciation funds.	It is appropriate to be involved in projects of large and medium scale at different distances from each other. Average production functions are efficiently implemented by forming project teams. Logistical supply is advisable to impose on subcontractors. Engineering and technical personnel involved from the side has to be certified in order to perform effective organizational and technological solutions. It may be rational to rent construction equipment and tooling by lease or short lease. It is critically important to create the of accounting and control the course of construction works and the system of economic accounting and control of operating machinery and equipment. This is mandatory to create depreciation funds.

– Development of the change plan and evaluation of results.

6. Matching the employee management plan with all stakeholders.

7. Determining the composition of interested/involved ones in the process of restructuring the company.

8. The decision to convert assets of construction enterprise, selling, leasing, renting.

9. Evaluation of the economic efficiency of organizational structure transformation and making the final choice of reorganization.

Hierarchical subordination schemes, shown on Fig. 9-12, are exemplary, and the composition of their elements can be adapted in accordance with the requirements of various enterprises. More detailed descriptions of these organizational structures are given in table 5. These circuit elements do not include supply management, since the implementation of these methods has no significant effect on a hierarchical subordination in multidimensional structures.

The submission of the project-oriented method is shown on Fig. 9 (combination 1). Each project manager generates its own team, responsible for the management functions. The general or service departments are separately derived. The submission of the function-oriented method is shown on Fig. 10 (combination 2). In this case, the traditional chief engineer office is organized for the works production. Fig. 11-12 (combination 3, 4) display the mixed managerial methods: on Fig. 11 – project-oriented, where one of the project managers manages a multi-project, there are several small construction projects; on Fig. 12 – matrix, where each manager is responsible for both a separate project and for the production management function.

The enterprise prepares project managers from among the existing managers (heads of departments and heads of construction sites) in case of change the organizational and technological conditions, bringing them to the sides as needed. In case of unfavorable changes in the organizational and technical conditions, project managers are transferred to the post of heads of departments or construction sites, or are reduced.

Analysis of table 5 shows that the main priority for the optimization of the enterprise , which construct dispersed different scale buildings, are: organization of the relevant management system, in-line long-term work performance and optimal scheme of supply.

In addition, it is possible to trace the tendency of increasing the role of qualitative horizontal ties in case of enterprise focusing on small scale objects and small remoteness. In this regard, horizontal managerial ties are normally installed between the projects and easily formalized and monitored in the case of orientation on large distant from each other objects. The intensity of managerial, organizational and technological relationships at various levels within the framework of a multidimensional structure are proposed on Fig. 13-16. The thickness of arrows indicates the relationship intensity.

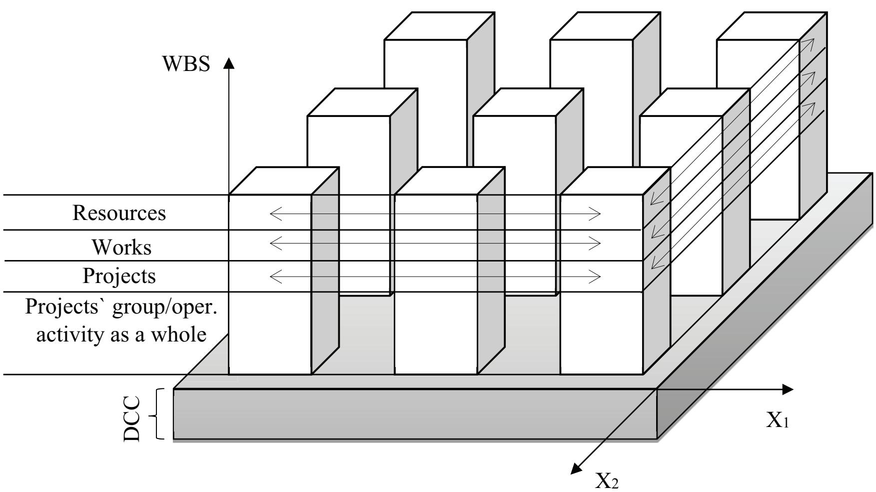


Fig. 13. The intensity of managerial, organizational and technological relationships at the structural level for the enterprise that focuses on large, distributed objects (combination 1)

Figure 13 shows the intensity of managerial, organizational and technological relationships at the structural level for the company that focuses on large, far-spaced objects (a combination of 1). It is shown that the relationship between the projects rather is weak, and project managers have almost no influence on each other.

Fig. 14 shows the intensity of managerial, organizational and technological interconnections on the structural level to the enterprise target small, closely placed objects (combination 2). Relationship for such a venture are strong at all levels, objects substantially independent of each other.

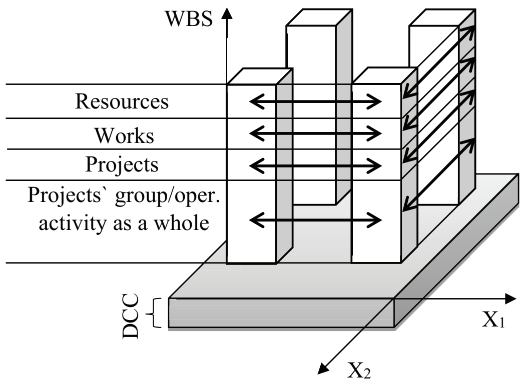


Fig. 14. The intensity of managerial, organizational and technological relationships on the structural levels for the enterprise that focuses on small, closely placed projects (combination 2)

Figure 15 shows the intensity of managerial, organizational and technological relationships on the structural levels for the enterprise that focuses both on large and on small far-spaced objects. The priority for such enterprise are the major projects, the small ones can be regarded as a multi-project (combination 3). In this case, the relationships are strong enough in a multi-project. The relationship at the level of project managers are not expressed between large projects and multi-project.

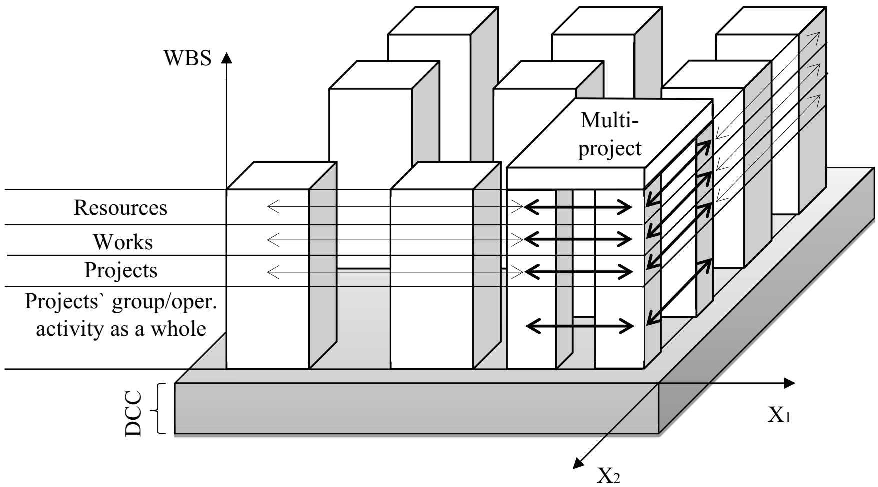


Fig. 15. The intensity of managerial, organizational and technological relationships on the structural levels for the enterprise that focuses on the large and small far-placed projects in the ratio of 75% to 25%, objects (combination 3)

Figure 16 represents intensity of managerial, organizational and technological relationships on the structural levels for the enterprise, that focuses on the large and small far- placed projects in the ratio of 25% to 75% (combination 4). As it can be seen from the figure, the relationships between all the projects at all levels are strong, including the project management level.

The strong correlation between the elements on Fig. 13-16 can be regulated, so that they are easy to monitor and maintain control over them. Weak relationships require more initiative and responsibility from the employees at a given level. Such relationships can only be qualitatively organized due to the establishment of rules and not procedures, and by maintaining a stable corporate atmosphere.

Basic principles of procurement by type of resources, depending on the organizational and technological orientation of the company are set out in table 7.

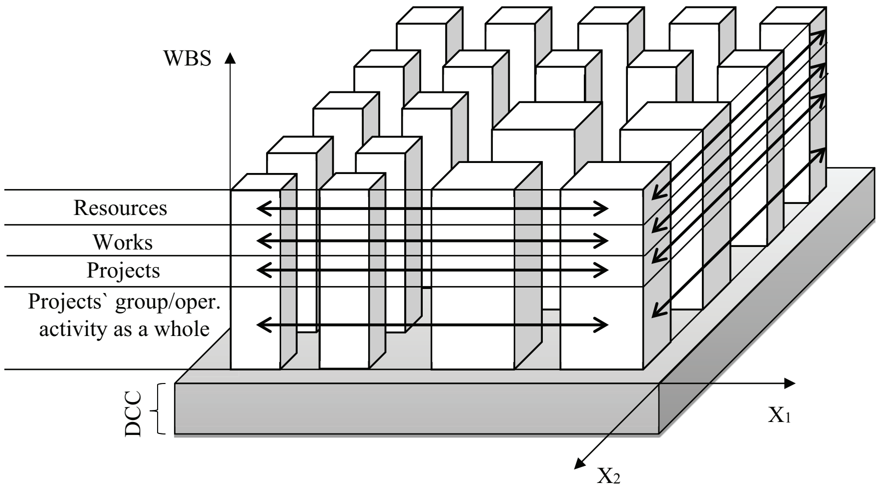


Fig. 16. The intensity of managerial, organizational and technological relationships on the structural levels for the enterprise that focuses on the large and small far-placed projects in the ratio of 25% to 75% (combination 4)

One of the keys to the effectiveness of the organizational structure of a construction company, multi-dimensional in particular, is the mainstreaming of the production of construction and installation works. The basis for the organization of long-term mass production of construction and installation works is a production plan. It is a document that regulates the planned volumes of construction and installation work by types in the reporting period, their temporary location within this period, the nomenclature, plan resources requirements. These articles can be reduced in cost and/or physical measurement. The production plan is the basis of all planning documents of the construction enterprise (Fig. 17). The algorithm for the development of the production plan of the enterprise, which construct dispersed different scale buildings, is shown on Fig. 18.

Table 7. Procurement of construction of dispersed different scale buildings by various kinds of resources, depending on the organizational and technological orientation of the enterprise

Resources types	Combinations of strategic organizational and technological solutions			
	1	2	3	4
1	2	3	4	5
Workforce	The supply of labor resources is carried out only after the finish of works on the project due to the large distances between the objects. Lack of manpower is compensated by attracting subcontractors. It is advisable to fully supply all of the sites by own electricians, metal constructions fitters; concrete workers can be recruited from local experts on short-term contracts.	In the case of unevenness of the scope of work it is permitted the transfer of the labor force in the short term (up to 1 week) between closely spaced sites using own or public transport. Manpower may hold 1-3 related specialties to perform different types of work on a single site. There is encouraged to appoint the fitters to foremen of the concrete workers in order to better perform concrete works prior to installation of equipment.	It is advisable to use the approach in accordance with the combination "1" for the large projects and a combination “2” - for small ones. A qualified and experienced staff should be appointed to carry out work on small projects group (multi-project).	Priority is given to the supply of manpower to major projects. Small projects are provided with their own human resources, freed from work on major projects or by attracting subcontracting resources.
Machinery	A plan for own machines usage should be designed so that the equipment can perform many kinds of work and stay on the site from the beginning to the end of construction. It should be assured that its loading for cars is no less than 6 hours. Plan for the use of subcontracting equipment must be designed so that it performs work completely in a short period of time.	Using of own machinery is planned by taking into account the possibility of frequent relining between sites. The machines must be able to perform different types of work with the minimum change of the working bodies. Subcontractors` machines usage should be designed similarly.	The use of machines and mechanisms should be designed in accordance with the combination 1 approach. The reline costs should be minimal.	The use of machines and mechanisms should be designed in accordance with the of the combination "1" approach. The reline costs should be minimal.

Continuation of table 7

1	2	3	4	5
Basic materials	Contracts for the basic materials supply at each site should be carried out on a tender basis at the beginning of the work. Delivery of basic materials to the object is made in accordance with the approved schedule.	Contracts for the supply of basic materials should be carried out by on a tender basis at the beginning of each financial period. Supply of the basic materials for each construction site is carried out at the request of producers.	Supply is made according to the combination 1 or 2 approach for different size projects.	Supply is made according to the combination 1 or 2 approach for different size projects.
Consumables	Contracts for the supply of consumables should be carried out on a tender basis at the beginning of each financial period. Procurement of supplies is made in advance according to the production plan. Purchased materials are stored on one or more of the material bases of the company. Purchasing supplies are made in accordance with the internal regulations of the construction enterprise. A possible flaw in the operating supplies can be compensated in the following way. Manufacturers work buy needed supplies in the near source, using for transportation vehicles assigned to the construction site.			
	Fixed assets are assigned to specialized teams. The appointed foreman is financially responsible person for them. Relocation of fixed assets is carried out together with the relocation of labor resources.	Basic means are assigned to the site of construction or renovation. The appointed foreman is financially responsible person for them. Relocation of fixed assets is carried out on the need for them on other sites.	Supply is made according to the combination 1 or 2 approach for different size projects.	Supply is made according to the combination 1 or 2 approach for different size projects.

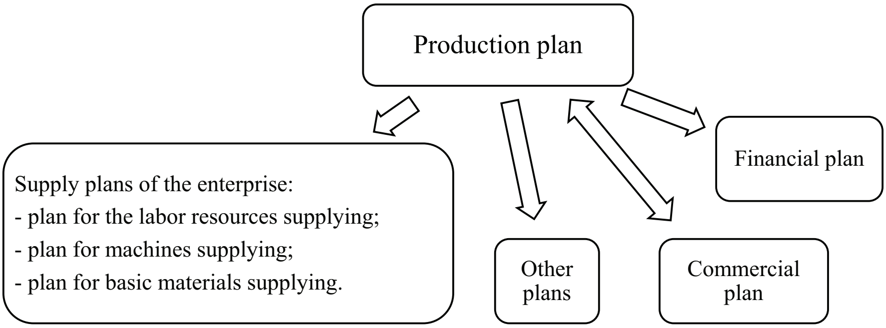


Fig. 17. Plans for construction organization, formed on the basis of the production plan

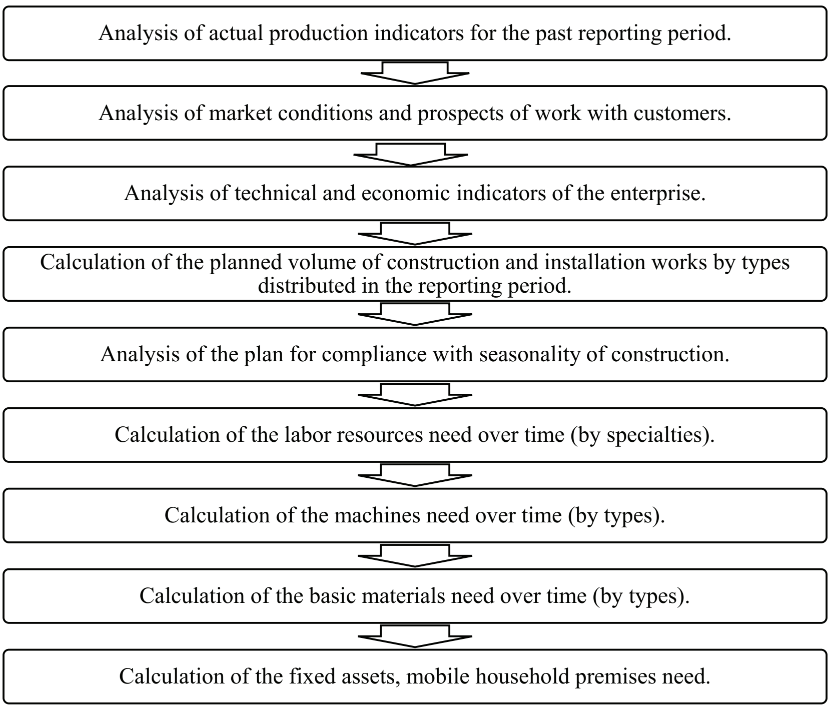


Fig. 18. Development of production plan of enterprise that construct dispersed different scale buildings

The actual execution of production plans mainly lies in the current work planning at the sites, and the alignment of process workflows. It is necessary to monitor the rhythm of work: at various sites: the brigades are appointed proportionally to the volume of works performed. Rhythm allows to release resources as planned and to properly plan the works timeline on different sites. This enable the optimal distribution of available manpower and equipment between construction projects, rational transferring of resources between sites and performing a lot of work during the reporting period.

Conclusions

1. Study of the features of the construction and reconstruction of dispersed different scale buildings, as well as the developed methodology of the study:

   – allowed to perform systematic review of this activity, to highlight the most important factors to establish the relationship between them and to optimize enterprises management techniques.
   – conditioned the development and analysis of the computer model operating activities of the enterprise, which construct dispersed different scale buildings;
   – allowed investigation of the experimental statistical regularities of indicators changes of such operating activity under the influence of the most important organizational and technological factors.

2. Construction of a multidimensional organizational model of enterprise, which construct dispersed different scale buildings, has made it possible to substantiate the relationship of organizational and technological solutions, taken in the management of individual construction projects and the organization as a whole.

3. The conducted numerical experimental research have quantitatively proved the interrelation of the organizational and technological solutions taken at the management of the enterprise, which construct dispersed different scale buildings, as a whole, with such decisions taken at separate construction projects.

4. The minimum value of the "change in total production costs" (Y_1), which is 13.6%, is observed at the average complexity of project totality X_1 = 2.2 thsd. hours, average relocation distance X_2 = 100 km., attribution of resources X_3 = 0%, industrialization of applied solutions X_4 = 0%. The minimum value of the indicator "ratio of direct and general production costs" (Y_2), equal to 4.99%, is observed at the average complexity of project totality X_1 = 37 thsd. hours, average relocation distance X_2 = 100 km., attribution of resources X_3 = 100%, and any degree of industrialization of applied solutions (X_4).

5. Analysis of the effects of multidimensionality of construction of dispersed different scale buildings allowed developing effective management tools of organizational and technological solutions selection.

6. The algorithm for constructing a multidimensional structure allows adapting the organizational structure of considered enterprises to different organizational and technological conditions.

References

1. Information portal "Proagro" (Informacionnyj portal "Proagro") [Electronic resource]. – 2016. – The mode of access to the resource (Rezhim dostupu do resursu): http://www.proagro.com.ua/.

2. Kovalchuk I. P. Elevator – as an object of evaluation (Jelevator - kak objekt ocenki) [Electronic resource] / Irina Petrovna Kovalchuk // Official site of the company PE "VITAL-PROFI" (Oficial'nyj sajt kompanii ChP «VITAL-PROFI»). – 2015. – The mode of access to the resource (Rezhim dostupu do resursu): http://vital-profi.com.ua/publications/elevator-kak-obekt-ocenki/.

3. Linnik G. O. Shliakhi udoskonalennya sistemi upravlenya stunichnih sporud on the halls of Ukraine (Shljahi udoskonalennja sistemi upravlinnja stanom shtuchnih sporud na zaiznicjah Ukraïni) / G. O. Linnik, V. I. Straw. // Bridges and tunnels: theory, research, practice (Mosti ta toneli: teorija, doslidzhennja, praktika). – 2012. – №3. – P. 106-110.

4. Pshin'ko O. M. Logistic systems of construction production functioning based on unity of modeling conditions (Logistichni sistemi funkcionuvannja budivel'nogo virobnictva na osnovi pidtrimki єdnosti modeljujuchih umov) / O. M. Pshin'ko, I. D. Pavlov, I. A. Harutyunyan. // Bridges and tunnels: theory, research, practice (Mosti ta toneli: teorija, doslidzhennja, praktika). – 2012. – №1. – P. 82-87.

5. Bilchenko A. V. Multi-Perspective Models of the Process of Operation of Bridge Structures (Mul'tiperspektivnye modeli processa jekspluatacii mostovyh sooruzhenij) / A. V. Bilchenko, A. G. Kislov. // Bridges and tunnels: theory, research, practice (Mosti ta toneli: teorija, doslidzhennja, praktika). – 2014 – №6. – P. 14-17.

6. Pshinko O. M. Analysis of modern approaches to the organizational and technological reliability of transport facilities (Analiz suchasnih pidhodiv do organizacijno- tehnologichnoї nadijnosti transportnih sporud) / O. M. Pshinko, A. V. Radkevich, I. V. Myyanky. // Bridges and tunnels: theory, research, practice (Mosti ta toneli: teorija, doslidzhennja, praktika). – 2012. – No. 1. – P. 88-92.

7. Typical organizational structures of enterprises (Tipovye organizacionnye struktury predprijatij) [Electronic resource] // Informational portal \"Sfin.ru\" (Informacionnyj

portal \"Sfin.ru\"). – 1999. – The mode of access to the resource (Rezhim dostupu do resursu):
http://www.cfin.ru/management/iso9000/iso9000_orgchart.shtml.
8. Kalinina N. M. Modeling of enterprise activity in the system of integrated controlling (Modelirovanie dejatel'nosti predprijatija v sisteme integrirovannogo kontrollinga) / Natalia Mikhailovna Kalinina. // Innovations (Innovacii) – 2006. – №7. – P. 113-116.
9. Economic-mathematical methods and applied models (Jekonomiko-matematicheskie metody i prikladnye modeli) / [V. V. Fedoseev, A. N. Garmash, D. M. Daiitbegov and others.]. – Moscow: UNITI, 1999. – 391 p.
10. Donenko V. I. Theoretical and Methodological Complex for Providing Adaptive Development of Building Organizations (Teoretiko-metodologichnij kompleks zabezpechennja adaptivnogo rozvitku budivel'nih organizacij): author's dis. abstract. for obtaining science degree of doc. tech. sciences (avtoref. dis. na zdobuttja nauk. stupenja dokt. tehn. nauk): speciality 05.23.08 "Technology and organization of industrial and civil construction (Tehnologija ta organizacija promislovogo ta civil'nogo budivnictva)". Donenko Vasyl Ivanovich – Kiev, 2011. – 40 p.
11. Mlodetskii V. R. Organizational, technological and managerial reliability of the functional system of a construction organization (Organizacijno-tehnologichna ta upravlins'ka nadijnist' funkcional'noï sistemi budivel'noï organizacii̇): author's dis. abstract. for obtaining science degree of doc. tech. sciences (avtoref. dis. na zdobuttja nauk. stupenja dokt. tehn. nauk): speciality 05.23.08 "Technology and organization of industrial and civil construction (Tehnologija ta organizacija promislovogo ta civil'nogo budivnictva)" / Mlodetskii Viktor Rostislavovich – Dnepropetrovsk, 2005. – 40 p.
12. Myakshev S. A. Multidimensional structure of management of a construction organization (Mnogomernaja struktura upravlenija stroitel'noj organizaciej) / Stanislav Andreyevich Myakshev. // Actual areas of scientific research: from theory to practice: materials VIII international scientific practical conference (Aktual'nye napravlenija nauchnyh issledovanij: ot teorii k praktike : materialy VIII Mezhdunar. nauch.–prakt. konf.) (Cheboksary, May 8, 2016). – 2016 – №2. – P. 201-205.

13. Volchkov S. Business modeling for improvement of the activity of the industrial enterprise (Biznes-modelirovanie dlja sovershenstvovanija dejatel'nosti promyshlennogo predprijatija) [Electronic resource] / S. Volchkov, I. Balakhonov // Web-site of the company "ComputerPress" (Sajt kompanii \"Komp'juterPress\"). – 2001. The mode of access to the resource: http://compress.ru/article.aspx?id=12258.
14. Beguin R. Pore-scale Flow Measurements at the Interface between a Sandy Layer and a Model Porous Medium: Application to Statistical Modeling of Contact Erosion [Електронний ресурс] / R. Beguin, P. Philippe, Y. Faure // Journal of Hydraulic Engineering. – 2013. – Режим доступу до ресурсу: http://ascelibrary.org/doi/10.1061/%28ASCE%29HY.1943-7900.0000641.
15. Fraccarollo L. Statistical Approach to Bed-Material Surface Sampling [Електронний ресурс] / L. Fraccarollo, A. Marion // Journal of Hydraulic Engineering. – 1995. – Режим доступу до ресурсу: http://ascelibrary.org/doi/abs/10.1061/(ASCE)0733-9429(1995)121%3A7(540).
16. Lobakova L. V. Organizational modeling of reconstruction of buildings during their re-engineering (Organizacijne modeljuvannja rekonstrukciї budivel' pri їh pereprofiljuvanni): author's dis. abstract. for obtaining science degree of candidate of tech. sciences: speciality 05.23.08. "Technology and organization of industrial and civil construction (Tehnologija ta organizacija promislovogo ta civil'nogo budivnictva)" / Lobakova Liliya Vyacheslavivna – Odessa, 2016. – 21 p.
17. Menelyuk A. I. Optimization of organizational and technological solutions for the reconstruction of high-rise engineering structures (Optimizacija organizacionno-tehnologicheskih reshenij rekonstrukcii vysotnyh inzhenernyh sooruzhenij) / A. I. Menelyuk, M. N. Ershov, A. L. Nikiforov, I. A. Menelyuk. – K .: LLC Scientific-Production Enterprise "Interservis", 2016. – 332 p.
18. Zadgenidze I. G. Planning an experiment for the study of multicomponent systems (Planirovanie jeksperimenta dlja issledovanija mnogokomponentnyh sistem) / I. G. Zadgenidze – Moscow: Nauka, 1976. – 390 p.

19. Nalimov V. V. Logical bases of experiment planning (Logicheskie osnovanija planirovanija jeksperimenta) / V. V. Nalimov, T. I. Golikov – Moscow: Metallurgy (Metallurgija), 1980. – 152 p.
20. Finny D. Introduction to the theory of experiment planning (Vvedenie v teoriju planirovanija jeksperimentov) / D. Finny, translation from English (perevod s angl.) Romanovskaya I. L. and Hus A. P., ed. Linnika Yu. V. – Moscow: Nauka, 1970. – 281 p.

Aleksandr Meneyluk,
Aleksey Nikiforov

RATIONALIZATION OF DISPERSED DIFFERENT SCALE BUILDINGS CONSTRUCTION

Recommended to publish on August 31, 2018.
The format is 65x92/16. Offset paper, offset printing.
Number of conditional printed sheets is 3.32 Printed
on demand, but no less than 300 copies

Publisher: OmniScriptum Publishing
Registration number: 40203102774
Brivibas gatve 197, LV-1039, Riga, Latvia, European Union
Telefax: +371 68620455
Email: info@omniscriptum.com