Systemic Integrated and Dynamic Approach As a Basis To Ensure Sustainable Operation of a Construction Company

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Abstract. Global and local experience in developing construction projects over the last 30 years suggests a clear dependence of the construction production volumes on the market demand. However, as the economic situation in this country gradually evolved into a systemic crisis, the industry has witnessed mass liquidation of large construction companies and a sharp decline in the number of construction and installation projects. Improvement of housing conditions for the population through implementing new construction and area renovation programs is a very relevant task indeed. Notably, the Russian government has recently been active in providing aid to the construction industry. In this regard, we can say that the construction industry is market-oriented and, given the best-case scenario, has good upside potential. When writing this paper, the author tasked himself with developing appropriate methodological provisions, approaches that helped identify the sustainability of an enterprise to enable effective managerial decision-making and efficient production planning within a given firm. The aim of this paper is the development of a multifactor simulation method for identifying the sustainability potential of a construction firm pursuing the systemic integrated approach to the production planning of a construction company program. In this regard, the article reviews and evaluates the main factors that influence the behavior of a mathematical model while applying the systemic integrated approach to determine the stability potential of structural divisions-construction enterprises that are separate elements of a construction system. The scientific problem reviewed has an important social and economic significance for both contractors and end-customers, and the scientifically substantiated technical and organizational solutions obtained as a result of the research will make a significant contribution to the development of the construction industry, increase the level of production activities undertaken by construction firms and help foster scientific and technical progress on the industrywide scale.

1 Introduction

An enterprise in the sense of an object of rights is recognized as a property complex used for implementation of entrepreneurial activities. A construction company may possess all types of property intended for its activities, such as buildings, structures, panel making plants (concrete plants), machines (special equipment, tower cranes, caterpillar cranes, concrete pumps, mobile solution stations), equipment, fittings (formwork), materials [1].

Prospects of housing construction development in Russia are directly related to changes in the overall economic situation in the country. The construction industry is a fundamental vector of
economic development; however, a decrease in the solvency of the population slows down the development of the investment climate in the real estate sector.

As a result, the market has seen special offers of installment payments and mortgage lending for the purchase of completed construction products.

At the same time, construction companies offering construction products are also forced to take appropriate steps for optimization of construction planning and implementation of construction investment projects in order to reduce costs and maintain the relevant technical and economic indicators of the projects [2, 3].

Construction planning is understood as a set of managerial actions aimed at increasing the productivity [4], balancing labor [5,6], material and technical resources that contribute to the goals set for the construction enterprise. An important construction planning task is to take into account all external environment factors, to ensure a rational coordination in the internal environment and to forecast correctly the future production activities [7,8,9].

The essence of construction planning optimization lies in the development of a comprehensive plan that takes into account the influence of various factors thus improving the corporate management efficiency and strengthening the company’s immunity to various impacts, in order to achieve its goals [9,10].

The main factors faced by Russian construction companies at the present stage of development of the domestic economy that have a certain influence on construction planning can be classified as external and internal factors.

External factors:
• Declining sales due to tight monetarist policies of the government and a sagging effective demand;
• Low quality of domestic raw and other materials and extremely high costs of foreign equivalents;
• Absence of a competitive market of a whole range of raw and other materials in a monopolistic environment;
• Economic instability;
• High costs of bank credits inconsistent with the actual return on capital in the industry;
• The need to operate in barter and set-off transactions.

Internal factors:
• Shortage of working capital that increases the risk of insolvency and reduces operational capital management capabilities;
• Obsolete equipment and technologies;
• Imperfect labor organization;
• Inadequate staff qualification in matters of corporate finance, securities transactions, advanced management;
• Inefficient marketing technologies;
• Overloading with information flows.

The most important conditions for efficient operation and development of an enterprise in Russia are setting new priorities and designing a new strategy of its functioning, mastering the methods of active integrated marketing of its products, and management teambuilding that ensures strategic thinking, self-organization, the necessary knowledge, skills and relevant capabilities.

Purpose of the article:
Development of a systemic integrated method of multifactorial modeling of external and internal environment in order to identify the potential sustainability of a construction company at the production planning stage with the view to increasing the efficiency of construction management.

The main construction management tasks are as follows:
1. Raising the company’s immunity to diverse factors;
2. Reducing the duration of construction;
3. Increasing labor productivity;
4. Reducing the risks of incomplete construction;
5. Ensuring a high quality of construction works;
6. Introducing innovative technologies;
7. Cutting the cost of construction and installation works;
8. Improving the quality and reliability of products;
9. Ensuring the company’s growth in the short and long terms;
10. Raising wages.

Multiplicity of objectives is particularly characteristic of construction companies and reflects the diversity of managerial decisions. This diversity is to a large extent associated with the variety of directions of production activities of modern construction companies.

2. Method

Existing basic methods:
- Monographic - the study of typical phenomena arising from long-term experience of the enterprise;
- Statistical - the study of the influence of various factors of production on the final result;
- Experimental - conducting experiments with technical and economic assessments of the applied techniques and methods of organizing the production process, as well as their impact on the performance;
- Modeling - is used in tackling the problems of production optimization and selection of rational solutions. [11]

For the purposes of the systemic integrated planning approach and mathematical evaluation of potential sustainability [12] of a construction enterprise, it is proposed to use the multifactor system statistical modeling technique.

With this end in view, it is necessary to evaluate the significance of each factor affecting the result of FAR (factors affecting the result).

Resource availability of the enterprise (internal factors):
- Sufficient working capital for high-quality operational management of the capital (FAR = +3);
- Shortage of working capital that increases the insolvency risks and reduces the capital operational management capabilities (FAR = -3);
- Information flows are reasonably minimized (FAR = +2);
- Overloading with information flows (FAR = -2);
- Availability of qualified personnel in matters of corporate finance, securities transactions, up-to-date management (FAR = +3);
- Absence of qualified personnel (FAR = -3);
- Availability of facilities: offices (+1), warehouses (+1), car parks (+1), concrete plants (+1) ($\Sigma$FAR = +4);
- Absence of facilities: offices (-1), warehouses (-1), car parks (-1), concrete plants (-1) ($\Sigma$FAR = -4);
- Availability of specialized construction machinery and equipment: tower and caterpillar cranes (+1), concrete pumps (+1), mobile cement stations (+1) ($\Sigma$FAR = +3);
- Absence of specialized construction machinery and equipment: tower and caterpillar cranes (-1), concrete pumps (-1), mobile cement stations (-1) ($\Sigma$FAR = -3);
- Availability of road machinery and equipment: excavators (+1), bulldozers (+1), graders (+1), compactors (+1) ($\Sigma$FAR = +4);
- Absence of road machinery and equipment: excavators (-1), bulldozers (-1), graders (-1), rollers (-1) ($\Sigma$FAR = -4);
- Availability of means of trasportation: dump trucks (+1), low bed trucks (+1), concrete mixer trucks (+1) ($\Sigma$FAR = +3);
- Absence of means of trasportation: dump trucks (-1), low bed trucks (-1), concrete mixer...
trucks (-1) (ΣFAR = -3);
- Availability of formwork and scaffolding (FAR = + 1);
- Absence of formwork and scaffolding (FAR = -1).
- Up-to-date equipment and technology (FAR = + 2).
- Obsolete equipment and technology (FAR = -2).

As a result, the information obtained to determine the market stability of a construction company and characterizing the significance of each factor that affects the final result (FAR) should be reduced to a general mathematical model.

The sustainability potential indicator of a construction company CRP (company’s resource potential) is calculated by the formula:

\[ CRP = \sum_{i=1}^{n} V_i = k(V_1 + V_2 + \ldots + V_n) \]  

where \( V_i \) is the aggregate FA.

Also, let’s consider as an example an external factor of economic instability, which affects the company’s potential sustainability. We deduct \( 0.2 \times 3 \) (0.2 is the probability of a negative event) from FAR=3 (having previously assessed the economic instability factor FAR=3).

Economic instability affects the sustainability of a construction company.

Economic instability has a probability of 0.01. It means that the final contribution to the company’s potential sustainability is \( 3 - 0.01 \times 3 \).

By generalizing the above example, we can modify the model as follows:

\[ CRP = k \sum_{i=1}^{n} V_i = k(V_1 + V_2 + \ldots + V_n) \]

where \( k \) is the ratio responsible for the factor’s positive or negative effect.

Having obtained the results, we can estimate the company's potential sustainability:
- \(-25 \leq ERP \leq 0\) - this company is not resistant to production and economic fluctuations in the market;
- \(0 < ERP \leq 10\) - this company is poorly resistant to production and economic fluctuations in the market;
- \(10 < ERP \leq 25\) - this company is resistant to production and economic fluctuations in the market.

3. Conclusions

This research has resulted in theoretical recommendations for an efficient assessment of potential sustainability of a company at the construction planning stage in order to improve the efficiency of production management. With this end in view, it is recommended to apply a systemic integrated approach that takes into account the significance of each factor affecting the final result and to use the mathematical model described herein.

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