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Budgeting and Cost Control in Capital Construction Projects

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Abstract: This article is dedicated to exploring the aspects of effective financial management within the construction industry. The main focus is on optimizing the budgeting process in the context of construction projects and organizations, as well as controlling costs in capital construction projects. The importance of control is highlighted through the lens of mitigating financial risks, improving budget management, transparency, reporting, and ensuring efficient resource utilization.

In practice, many construction companies have not fully realized the potential of budgeting. Often, this occurs in a scattered manner without integration with other management functions. In most cases, budgets are statically formulated at the project's initial stage, limited to a detailed expenditure breakdown for various costs and types of work. It is emphasized that the budgeting system in the construction field should be developed considering overarching methodological principles, project-oriented orientation, and the peculiarities of pricing and estimating norms within the industry. Consequently, a transition from estimative documentation to a more structured construction budget is necessary, encompassing all direct costs for both types of work and expenditure categories, as well as indirect costs for a specific project.

The objectives of this research are as follows:

- Emphasize the importance of budgeting and cost control.
- Study budgeting methods.
- Explain the role of cost control.
- Examine the application of technologies, methods of modernization, and automation.

The tasks include the following:

- Studying the general characteristics of the budgeting process, control, and capital construction projects.
- Unveiling the role of budgeting in projects.
- Investigating cost control methods.
- Highlighting how cost control is connected to forecasting future expenses and managing project financial risks.
- Thoroughly examining tools and technologies.
- The methodology is based on studying scientific literature, practical materials, and regulatory acts governing the topic.

Keywords: budgeting, capital construction projects, cost control in capital construction project, AI.

Introduction

Capital construction projects play a significant role in infrastructure development and economic growth. However, the successful execution of such projects requires careful planning, budgeting, and cost control. Effective budget and cost management allow for minimizing financial risks and ensuring the quality execution of project tasks.

In contemporary conditions within the territory of the Russian Federation, numerous projects related to capital construction are actively being realized. This spectrum encompasses diverse tasks, ranging from small residential constructions to the creation of large-scale infrastructure and industrial complexes. It is important to underline that only a few of these projects manage to be executed with minimal deviations in terms of budget and timelines. As a result, budgeting has become a widely employed management tool in commercial organizations, particularly in the financial sector. Originally intended for the planning and monitoring of cash flows, it has evolved into one of the most sought-after technologies for managing production and business activities, encompassing all management aspects. Practice demonstrates the high effectiveness of budgeting implementation, owing to its focus on key economic indicators, regular result analysis, and prompt monitoring. However, the successful implementation of such a system requires its adaptation to the specificities of the organizations employing it.

Meanwhile, in construction organizations, the implementation of this tool still remains inadequate. Often, it is carried out in isolation and not integrated with other functions (e.g., cost estimating, construction process management, etc.). This problem arises due to the limited methodological foundation of budget management in the construction field. Consequently, cost control must also be employed, as it is directed towards continuous observation and analysis of actual expenditures during project execution. This process involves regular

comparison of actual expenses with planned budget indicators. The goal of cost control is to identify deviations, analyze the reasons behind these deviations, and take measures for correction. The significance of cost control manifests in timely reactions to unfavorable trends, prevention of overspending, and ensuring project financial sustainability at every stage of its implementation. In contrast, budgeting represents an initial phase where the overall financial framework of the project is determined. It involves the process of developing a detailed plan for allocating financial resources to various stages and tasks.

Below, Figure 1 illustrates the main principles underlying the budgeting methodology in construction organizations.

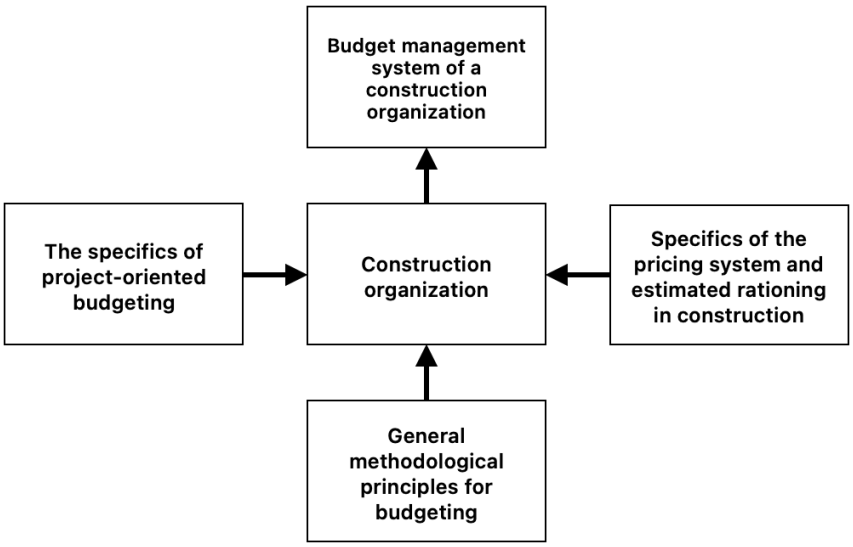

Fig.1. Methodological foundations of budget management formation

Furthermore, it should be noted that the construction industry exhibits several distinctive characteristics, including the dynamic nature of construction and assembly work, their duration, involvement of numerous external participants (including subcontractors), and the intricate relationship between work execution and its temporal changes. The construction process may involve adjustments to project and working documentation, as well as the redistribution of work volumes among various participants. The uncertainty factors inherent in the construction field often lead to changes in schedule plans, impacting cash flows and their temporal aspects. Consequently, to establish an effective budget management system in construction, it is advisable to adopt a flexible budgeting model, with a particular emphasis on managing the resources of construction projects [1].

1. General Characteristics of Capital Construction Objects:

In order to comprehensively address this topic, it is necessary to examine the characteristics of capital construction objects. These objects encompass buildings, structures, facilities, and unfinished construction projects (hereinafter referred to as unfinished projects), excluding non-capital structures, facilities, and inseparable improvements to the land plot (pavements, coverings, and others) [2].

Capital construction objects can also be classified, in which case reference will be made to the Order of the Ministry of Construction of Russia dated 02.11.2022 No. 928/pr "On Approval of the Classifier of Capital Construction Objects by Purpose and Functional-Technological Features (for the Purposes of Architectural and Construction Design and the Unified State Register of Expertise Opinions on Project Documentation of Capital Construction Objects)". According to this order, there are three types of capital objects based on their purpose:

- Industrial — structures for industrial and military purposes.
- Non-industrial — private and multi-apartment residential buildings, constructions for communal purposes, healthcare, culture, and sports.
- Linear — highways, roads, railways, power transmission lines, engineering networks [3].

Thus, one of the key characteristics of a capital construction object is its purpose. Each object has a clearly defined purpose, oriented toward specific types of activities.

Additionally, it should be acknowledged that another essential characteristic of a capital construction object is its long-term stable structure. This implies that the object must be designed and built with the preservation of its form and functionality over an extended period. The structural solutions must ensure the reliability and durability of the object.

Another significant aspect governing capital construction objects is legislation. There are specific norms and rules that must be adhered to for objects to be recognized as capital construction projects. The construction of such objects is regulated by a series of laws and regulations, including:

1. Urban Planning Code of the Russian Federation
2. Land Code of the Russian Federation
3. Federal Law "On Technical Regulation"
4. Federal Law "Technical Regulation on Safety of Buildings and Structures"
5. Federal Law "On Cultural Heritage Objects"

To construct a capital object, permission for capital construction must be obtained. It's important to note that when obtaining such permission, the presence of indicators of a capital object must be considered, as will be further explained [4-6].

There is no unified list of indicators for such structures. However, from the current regulatory acts, key characteristics can be selected:

Service life: A capital construction object is capable of serving for a century or even longer. Durable materials such as brick, stone, concrete, or wood are used in its construction.

Connection with the ground: This aspect is ensured through preliminary soil work (e.g., excavation of a foundation pit) and the installation of a deep foundation. Foundation options can vary, including piles or combined technologies.

Immobility: In this case, a capital construction object possesses a stable foundation that includes not only the foundation itself but also supporting structures such as pillars, columns, cantilevers, and other elements. Displacement, disassembly, or reassembly of such a structure elsewhere is impossible without compromising its integrity. Architectural, functional, and engineering solutions within such a structure form an integrated system.

Compliance with standards: This structure must be located on a plot that is owned or in accordance with other legal norms permitting such development. The building must also adhere to all established safety standards, norms, and rules.

Presence of utilities: In most cases, capital constructions are equipped with water supply, electrical supply, and, when conditions permit, gas supply or central heating.

Legal status: As capital objects can be registered and established as property, they are suitable for various transactions, including buying and selling, mortgages, insurance, and pledges [7].

2. Budgeting of Capital Construction Projects:

Budgeting is a financial management system of an enterprise achieved through the development and implementation of interconnected budgets that quantitatively and/or monetarily reflect controlled aspects of activities.

Budgeting is employed to achieve the following objectives:

1. Enhance the efficiency of managing material and financial resources.
2. Optimize the process of making economically balanced business decisions.
3. Assess potential consequences of business decisions [8].

In Russia, the determination of costs in capital construction projects is regulated by the Federal Law "On Investment Activities in the Russian Federation Carried Out in the Form of Capital Investments" dated February 25, 1999, No. 39-FZ (latest edition). This law defines the procedure and conditions for state regulation of investment activities, including capital construction. Specifically, it establishes rules for providing investors with state and municipal services, permits, licenses, as well as requirements for the formation and approval of budgets for capital construction projects.

For capital construction projects, methods like standard cost estimation, expert evaluations, similar projects analysis, and other tools are frequently employed to determine costs. It's important to note that precise methods and requirements can change depending on specific regulatory acts and regulations in force in Russia at the time of a given project [9].

To perform cost calculations, there is an order from the Ministry of Economic Development of the Russian Federation dated March 27, 2019, No. 167 "On Approval of the Test Passport Form of a Capital Construction Object and the Methodology for Assessing the Effectiveness of the Use of Federal Budget Funds Directed at Capital Investments" (with amendments). Appendix No. 2 of this order contains the methodology for assessing the effectiveness of using federal budget funds directed at capital investments. According to this methodology, the assessment of effectiveness based on qualitative criteria is calculated using the following formula:

$$Ч_1 = \sum_{i=1}^{K_1} \sigma_{1i} \times 100\% / \left(K_1 - K_{1НП} \right)$$

Fig.2. Formula for calculating the effectiveness assessment based on qualitative criteria

where:

σ_{1i} - score of the assessment of the i-th qualitative criterion;

K_1 - total number of quality criteria;

$K_{1НП}$ - the number of criteria that are not applicable to the investment project under review.

The effectiveness assessment based on quantitative criteria is calculated using the following formula:

$$Ч_2 = \sum_{i=1}^{K_2} \sigma_{2i} \times P_i ,$$

Fig.3. Formula for calculating the effectiveness assessment based on quantitative criteria

where:

σ_{2i} - score of the assessment of the i-th quantitative criterion;

P_i - the weighting coefficient of the i-th quantitative criterion, as a percentage;

K_2 - the total number of quantitative criteria.

The sum of the weighting coefficients for all quantitative criteria is 100 percent [10].

3. Estimate Documentation:

Following the calculations, it is necessary to create estimate documentation, within which the following estimate calculations are developed:

a) Summary of costs (if necessary);
b) Consolidated estimate calculation for construction costs;
c) Object-specific estimate calculations (estimates);
d) Local estimate calculations (estimates);
e) Estimate calculations for individual types of expenses.

Estimate calculations are developed according to the recommended templates provided in Appendices No. 2 - 7 of the Methodology mentioned above.

The estimate documentation includes:

a) Explanatory note;
b) Work volume statements;
c) Supporting documents.

Each estimate calculation is assigned a code comprising a letter designation and a number. The letter designation reflects the type of estimate calculation (estimate):

a) EC - estimate calculation for individual types of expenses;
b) LEC (LE) - local estimate calculation (estimate);
c) OEC (OE) - object-specific estimate calculation (estimate);
d) CECSC - consolidated estimate calculation for construction costs [11].

4. Automation of Construction Project Budgeting:

To effectively organize managerial accounting in the construction industry, specialized software solutions exist that automate all stages, including budgeting. A software solution tailored to the industry's specifics reliably tracks and controls every aspect of budget planning. The information system provides accurate data about the planned work completion dates, the availability of sufficient funds, predicts funding inflows and fund transfers. Making changes to the budget happens swiftly and error-free, eliminating the need for manual recalculations. Implementing automated budgeting programs significantly enhances the efficiency and transparency of managing construction projects.

The "Treasury and Budgeting" module within the "Bit.Construction" system aims to reduce unplanned payments, precisely consolidate and plan budgets for various directions of a construction company's activities, including contracts and projects. Key module functions encompass developing a forecast balance, budget control, profit and cost analysis, payment schedule creation, and more.

Additionally, the "Budgeting" subsystem in the software product "1C:ERP Construction Organization Management 2" enables the creation of various budget types, accounting for existing resources and capital attraction possibilities, actively monitoring fund utilization, and conducting analysis of actual data and forecasts.

These solutions collaboratively contribute to streamlining financial planning and budgeting processes, ensuring more effective management in the construction industry.

5. Cost Control in Capital Construction Projects:

Cost control in capital construction projects plays a pivotal role and holds significant importance. It ensures effective management of project financial aspects and enables the achievement of several crucial objectives:

1. Prevention of Overspending and Risk Management: By helping to avoid overspending and undesirable financial risks, cost control aids in mitigating potential losses. Monitoring expenses allows for early detection of budget deviations and taking measures to rectify them, thus minimizing potential losses.
2. Budget Management: In this context, systematic cost control allows for efficient project budget management. This entails allocating funds to different stages and categories of expenditures, ensuring a balance between available resources and project requirements.
3. Decision Making: It is based on information about actual and projected costs, which subsequently provides a foundation for deciding how to allocate resources, when to adjust plans, and what changes to make to the project.
4. Transparency and Reporting: Stakeholders such as investors, clients, and managers can track resource expenditures and be confident in the effective utilization of funds.
5. Process Improvement: Analyzing deviations and their causes helps identify errors and deficiencies in project planning and execution. This can serve as a basis for process improvement and prevention of similar issues in the future.
6. Achievement of Planned Results: Cost control contributes to achieving planned project results.
7. Efficient Resource Utilization: Cost control allows for efficient utilization of financial resources, subsequently helping to avoid excessive spending and enhancing the project's economic efficiency.

In general, cost control in capital construction projects ensures financial stability, minimizes risks, and facilitates the successful completion of projects within budget constraints. This can be achieved through the following measures.

Monitoring Financial Indicators: Regular monitoring of financial indicators helps identify deviations from the planned budget. By utilizing relevant indicators, such as the cost-to-actual work performance ratio, budget adjustments can be made in a timely manner, and decisions can be taken to minimize potential risks.

Risk-Oriented Cost Control: Risk-oriented cost control involves identifying potential risks related to the project's financial aspects and developing strategies to manage them. This enables preemptive prevention of potential expenses associated with unexpected situations.

Application of Artificial Intelligence in Budgeting and Cost Control: The utilization of artificial intelligence in budgeting and cost control has become possible due to its ability to analyze large volumes of data, contributing to accurate cost forecasting and identification of financial trends. Machine learning algorithms can uncover relationships between various variables and aid in creating more precise budgets. Artificial intelligence also enables the automation of many processes related to budgeting and cost control, reducing the likelihood of human errors and ensuring more efficient financial management [12].

Conclusion

In conclusion, based on the conducted research, it can be stated that effective budgeting and cost control are critical aspects for the successful implementation of capital construction projects. Both traditional and flexible budgeting methods, along with the utilization of artificial intelligence, enable companies to more accurately plan expenditures, respond to changes, and minimize risks associated with project budgets.

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