ENHANCING THE METHODOLOGY FOR ECONOMIC ANALYSIS OF CONSTRUCTION SERVICE EXPENDITURES AT SOCIAL FACILITIES

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Abstract

The development of social infrastructure requires effective management of financial resources allocated for the construction, reconstruction and modernization of socially significant facilities. In this context, improving the methodology for economic analysis of construction service costs is important for ensuring the rational use of investment resources, controlling project costs and increasing the efficiency of construction activities. This article examines methodological approaches to the economic analysis of construction service costs at social facilities and identifies the main factors affecting their formation.

Keywords

construction services, social facilities, construction costs, economic analysis, cost methodology, cost efficiency, construction resources, estimate cost, factor analysis, digitalization, investment efficiency.

Introduction. Social infrastructure is one of the fundamental components of sustainable regional development. Educational institutions, healthcare facilities, cultural and sports facilities, social service centers and other public infrastructure directly affect the quality and accessibility of social services. Therefore, the efficient use of financial resources allocated for their construction and reconstruction is an important economic and managerial task.

The relevance of this issue is particularly evident in Uzbekistan, where the scale of construction activity has increased significantly in recent years. According to the National Statistics Committee, the volume of completed construction work in Uzbekistan reached **313.8 trillion soums in 2025**, increasing by 14.2% compared with 2024. At the same time, construction of civil facilities amounted to **64.9 trillion soums**, which was 43.9% higher than in 2024.

The expansion of construction activity creates a need for more precise approaches to cost planning and economic analysis. Traditional analysis based mainly on comparison of planned and actual expenditures is insufficient when construction projects involve changing material prices, labor costs, machinery utilization, technological innovations, project delays and changes in project specifications.

The regulatory framework of Uzbekistan is also moving toward more modern approaches. In particular, Resolution No. 165 of the President of the Republic of Uzbekistan dated April 29, 2024 established the transition, from January 1, 2025, to a **"volume" method of assessing construction costs**, taking into account volume and quality indicators. It also established the formation of estimated project costs based on the electronic platform of the **National Classifier of Construction Resources**.

Consequently, the economic analysis methodology should correspond to these changes and provide an integrated assessment of not only the amount of expenditure but also its structure, efficiency, quality and relationship with the physical results of construction.

Methodology.

The research process utilized methods such as systems analysis, comparative analysis, economic-statistical analysis, grouping, induction and deduction, and analysis and synthesis.

Literature review.

The economic analysis of construction service costs has been widely investigated in the fields of construction economics, project management, cost engineering and infrastructure investment. Existing studies demonstrate that construction cost analysis has gradually evolved from traditional estimate-based approaches toward integrated methods incorporating risk, digital technologies, life-cycle costing and data-driven analytical techniques.

Fazil, Lee and Tamyez [1], based on a systematic review of 238 studies published in 23 journals over a 31-year period, emphasize that the accuracy and performance of construction cost estimation are critical for preventing cost overruns. The authors identify organizational, technological and methodological factors affecting the effectiveness of cost estimation. Their findings indicate that improving the reliability of cost estimation requires consideration of both technical characteristics of construction projects and organizational factors associated with the estimation process.

Bottero, Caprioli and Oppio [2] conducted a bibliometric review of research on construction cost estimation and identified major trends in the development of cost assessment methodologies. Their study shows a transition from conventional cost estimation toward approaches based on **Building Information Modelling (BIM), Life Cycle Assessment (LCA), life-cycle costing and multicriteria analysis**. The authors emphasize that cost evaluation should increasingly be considered throughout the project life cycle rather than being limited to the initial investment stage.

The problem of cost overruns is another important direction in the literature. A recent scoping review by [3], based on more than 300 publications and 73 studies selected for detailed analysis, identifies a wide range of factors contributing to time and cost overruns in construction projects. The study demonstrates that cost deviations may result from both internal project-management factors and external economic and institutional conditions. This supports the need for analytical methodologies capable of

decomposing total cost deviations according to their individual determinants rather than simply comparing planned and actual expenditures.

Afana et al. [4] provide a systematic classification of factors associated with construction cost overruns. Their research emphasizes that cost overruns should be analyzed through a structured classification of influencing factors rather than treated as a single aggregated phenomenon. This approach is particularly relevant to social facilities because the cost of publicly financed construction projects is influenced by procurement, design changes, resource prices, project management, delays and other factors.

Another important direction concerns the application of digital technologies to construction cost management. Zhang et al. [5] systematically reviewed the literature on BIM and other digital tools for construction cost management. Their review, based on a dataset of 176 publications, identifies four major research areas: conventional cost estimation methods, new estimation methods and BIM applications, web-based BIM cost estimation and the causes of construction cost overruns. The findings demonstrate the increasing role of digital technologies in both estimating and monitoring construction costs.

Jadhav [6] specifically examined BIM-based cost estimation practices for building projects. The study emphasizes that BIM provides opportunities for improving quantity take-off, visualization and cost-management processes. At the same time, the literature review identifies challenges associated with data integration, cost databases and the practical adoption of BIM among cost-management professionals.

The relationship between BIM and life-cycle cost analysis has also received considerable attention. Alasmari, Martinez-Vazquez and Baniotopoulos [7] conducted a systematic literature review of BIM adoption in life-cycle cost analysis. Their findings indicate that BIM can facilitate the integration of information generated during the

design stage with subsequent operating, maintenance and end-of-life cost analysis. Consequently, the economic assessment of a construction project can be extended beyond initial construction expenditure toward a broader life-cycle perspective.

Similarly, Lu et al. [8] reviewed 45 peer-reviewed studies concerning BIM-based life-cycle cost analysis. The authors found that BIM can support data exchange, precision management, optimization and parameter analysis in life-cycle cost assessment. Their proposed methodological framework also demonstrates the possibility of combining life-cycle cost indicators with environmental and social dimensions of sustainability.

Analysis and results.

The construction of social facilities is characterized by a complex combination of economic, organizational, technological and social factors. Unlike commercial construction projects, the primary objective of social infrastructure projects is not necessarily to maximize direct financial returns. Schools, preschool institutions, healthcare facilities, sports complexes, cultural centers and other social facilities are primarily intended to satisfy public needs and improve the quality and accessibility of social services. Therefore, the economic analysis of costs associated with their construction should consider not only the amount of financial resources spent, but also the volume, quality, functionality and social outcomes achieved.

Construction service costs represent the monetary expression of resources consumed during the preparation, construction, reconstruction, modernization and commissioning of a facility. Their formation is influenced by the architectural and technical characteristics of the facility, construction technology, prices of construction materials, labor costs, machinery utilization, transportation expenses, project duration, financing conditions and organizational efficiency.

From the perspective of economic analysis, construction service costs can be divided into several interconnected components:

$$C = C_m + C_l + C_{mach} + C_t + C_o + C_f + C_q$$

where:

C represents total construction service costs; C_m represents material costs; C_l represents labor costs; C_{mach} represents machinery and equipment costs; C_t represents transportation costs; C_o represents overhead and administrative costs; C_f represents financial costs; and C_q represents quality-related costs.

Such classification makes it possible to move from a general assessment of total expenditure to a detailed analysis of individual cost-forming factors. This is particularly important for social facilities because even relatively small deviations in individual cost elements can result in significant additional expenditure when projects are implemented on a large scale.

The methodological approach proposed in this study is based on the principle of **"resource-cost-result-efficiency"**. According to this approach, each resource used in construction should be assessed in relation to its financial cost and the corresponding physical and qualitative result.

The first stage of economic analysis involves determining the structure of construction service costs. Structural analysis makes it possible to identify which expenditure components have the greatest influence on the total cost of a social facility.

The share of each cost component can be determined using the following formula:

$$S_i = \frac{C_i}{C} \times 100$$

where:

S_i is the share of the i-th cost component, C_i is the corresponding expenditure, and CC is the total construction cost.

For example, if material expenditure constitutes the largest share of total costs, the analytical process should focus on material prices, consumption norms, procurement conditions, transportation losses and inventory management. If labor expenditure has a significant share, labor productivity, working time utilization and wage costs should be analyzed.

Table 1. Proposed analytical structure of construction service costs[1]

Cost component	Main factors influencing costs	Main analytical indicators
Construction materials	Price, quantity, quality, losses	Material cost per unit of output
Labor	Number of workers, wages, productivity	Labor cost and productivity
Machinery and equipment	Operating time, fuel, maintenance	Machinery utilization coefficient
Transportation	Distance, tariffs, fuel consumption	Transportation cost per unit
Overhead	Management, administration, temporary facilities	Overhead cost ratio
Financing	Financing source, interest, payment schedule	Financial cost ratio
Quality-related costs	Defects, rework, delays	Quality loss coefficient

Dynamic analysis should then determine changes in total costs over time. The absolute change is calculated as:

$$\Delta C = C_1 - C_0$$

while the growth rate is:

[1]Author's development

$$T_c = \frac{C_1}{C_0} \times 100$$

where:

C_0 represents the cost in the base period and C_1 represents the cost in the reporting period.

However, simply identifying an increase or decrease in construction costs does not provide sufficient information about efficiency. Therefore, changes in costs should be compared with changes in construction output.

One of the most important methodological problems in construction is the difference between estimated and actual costs. The traditional approach generally determines the deviation between the planned and actual expenditure:

$$\Delta C = C_a - C_p$$

where C_a is actual expenditure and C_p is planned expenditure.

The relative deviation is:

$$D = \frac{C_a - C_p}{C_p} \times 100$$

However, the proposed methodology extends this approach by decomposing the deviation according to its causes.

For material costs, for example:

$$\Delta C_m = \Delta C_{price} + \Delta C_{quantity}$$

Thus, an increase in material expenditure can be caused by either an increase in the price of materials or excessive consumption. These causes require different management decisions.

The same approach can be applied to labor costs:

$$\Delta C_l = \Delta C_{wage} \mid \Delta C_{labor}$$

where:

the first component reflects changes in wage rates and the second reflects changes in labor requirements and productivity.

This approach allows management to distinguish between **external cost changes** and **internal inefficiency**. Such differentiation increases the practical value of economic analysis because the objective is not simply to explain why costs changed, but to identify which factors can be managed or reduced.

The formation of construction costs at social facilities is affected by a large number of factors. For methodological purposes, they can be grouped into five categories.

Resource factors include the quantity and quality of materials, labor resources, machinery, equipment and energy.

Price factors include changes in the prices of construction materials, wages, fuel, machinery services and transportation.

Technological factors include the construction technology used, level of mechanization, design solutions and application of innovative materials.

Organizational factors include procurement management, scheduling, contractor coordination, project management and quality control.

External factors include changes in legislation, market conditions, supply disruptions, climatic conditions and macroeconomic changes.

The total effect of these factors can be expressed as:

$$\Delta C = f(P, Q, L, M, T, O, E)$$

where:

P represents prices, Q represents quantities of resources, L represents labor, M represents machinery, T represents technological factors, O represents organizational factors and E represents external factors.

The practical significance of factor analysis lies in identifying the factors that have the greatest influence on the final cost. This enables construction organizations and project customers to develop targeted measures rather than applying generalized cost-reduction measures.

The use of digital systems enables the following analytical sequence:

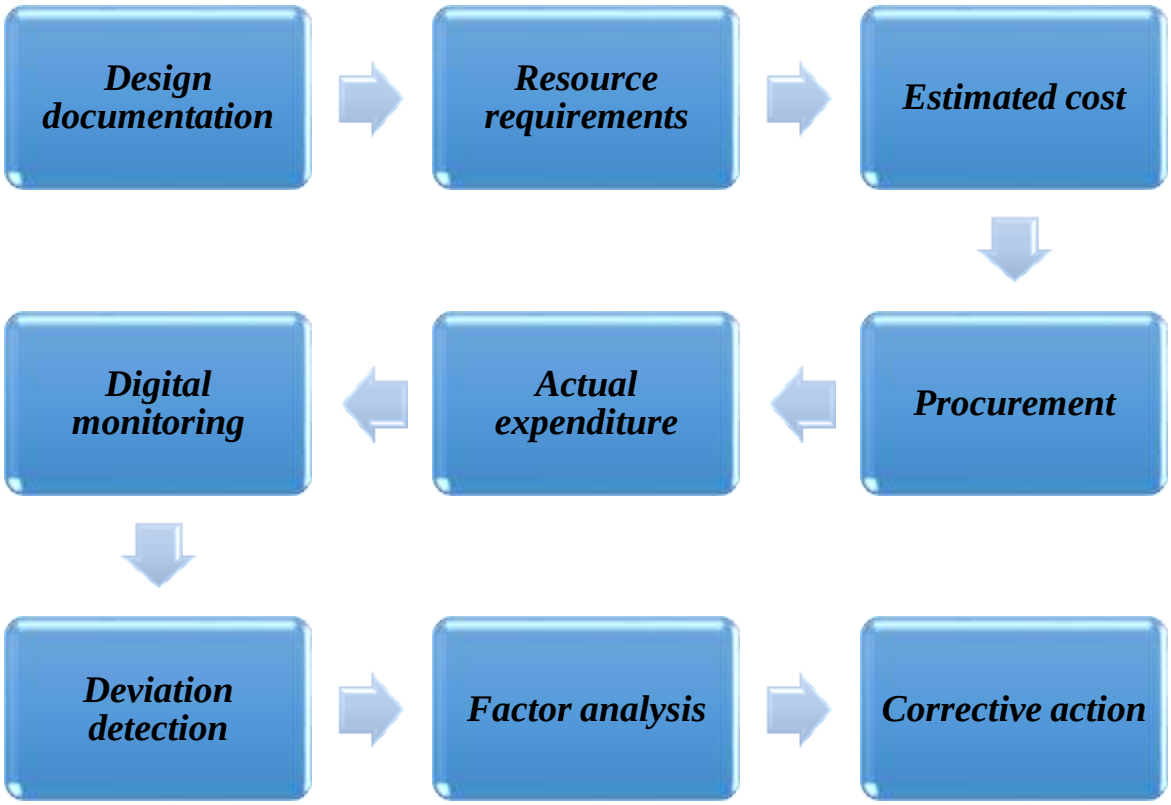


Figure 1. Methodological framework for digital monitoring and economic analysis of construction service costs[2]

This approach changes economic analysis from a predominantly retrospective activity into a continuous management instrument.

[2]Author's development

In particular, digital monitoring makes it possible to compare planned and actual consumption of materials, labor and machinery during construction. Significant deviations can therefore be identified before the completion of the project.

Based on the proposed methodological approaches, an integrated assessment can be formed using four main dimensions:

1. **Financial efficiency** – achievement of planned costs and prevention of unjustified expenditure;
2. **Resource efficiency** – rational use of materials, labor and machinery;
3. **Technological efficiency** – effective application of construction technologies and project solutions;
4. **Quality and social efficiency** – achievement of the required functionality, quality and social capacity.

The improvement of economic analysis of construction service costs at social facilities should focus on the following directions:

- expanding the analytical classification of construction costs;
- introducing systematic planned–actual deviation analysis;
- applying factor decomposition to major cost elements;
- calculating costs per unit of social infrastructure capacity;
- including quality-related losses in economic analysis;
- increasing the use of digital construction-resource databases;
- integrating financial, physical and qualitative indicators;
- conducting continuous monitoring throughout the construction lifecycle;
- strengthening comparative analysis between similar facilities;
- using analytical results as a basis for corrective management decisions.

Consequently, the proposed methodology transforms construction cost analysis from a simple comparison of financial indicators into a **comprehensive system for**

evaluating resource utilization, cost formation, project implementation, quality and social results. This creates a methodological basis for improving the efficiency and transparency of financial resources used in the construction of socially significant facilities.

Conclusion.

The study shows that improving the methodology for economic analysis of construction service costs at social facilities requires a transition from a traditional approach based primarily on comparing planned and actual expenditures to an integrated system that considers financial, resource, technological, organizational, quality and social factors. The complexity of social infrastructure projects necessitates a more comprehensive assessment of the relationship between the resources used, construction costs and the results achieved.

The proposed methodology makes it possible to analyze construction service costs according to their main components, including material, labor, machinery, transportation, overhead, financial and quality-related costs. The use of structural and dynamic analysis allows the main sources of expenditure and changes in their proportions to be identified, while planned–actual analysis and factor decomposition make it possible to determine the specific causes of cost deviations.

A significant methodological improvement is the application of unit-cost indicators. Assessing construction expenditure per square meter, student place, hospital bed, preschool place or other functional capacity indicator provides a more objective basis for comparing social construction projects of different scales. At the same time, the inclusion of quality-related costs associated with defects, rework and construction delays prevents cost savings from being interpreted independently of the quality and functionality of the completed facility.

The study also establishes the importance of digitalization in improving construction cost analysis. The application of electronic construction-resource databases, BIM technologies, ERP systems and digital project-monitoring tools creates opportunities for continuous comparison of planned and actual resource consumption and for timely identification of deviations.

The practical application of this approach can contribute to more rational allocation of financial resources, reduction of unjustified construction expenditures, improvement of resource utilization and strengthening of cost control at social facilities. It can also provide customers, contractors, design organizations and public authorities with a more comprehensive analytical basis for making economic and managerial decisions throughout the construction project lifecycle.

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