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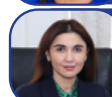
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IMPROVING THE METHODOLOGY FOR ECONOMIC ANALYSIS OF CONSTRUCTION SERVICE COSTS AT SOCIAL FACILITIES

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ABSTRACT. The development of social infrastructure requires effective management of financial resources allocated to the construction, reconstruction, and modernization of socially significant facilities. In this context, improving the methodology for the economic analysis of construction service costs is essential for ensuring the rational use of investment resources, controlling project expenditures, and enhancing the efficiency of construction activities. The study examines methodological approaches to the economic analysis of construction service costs at social facilities and identifies the key factors influencing their formation.

Keywords: construction services; social facilities; construction costs; economic analysis; cost analysis methodology; cost efficiency; construction resources; estimated costs; factor analysis; digitalization; investment efficiency.

ANNOTATSIYA. Ijtimoiy infratuzilmani rivojlantirish ijtimoiy ahamiyatga ega obyektlarni qurish, rekonstruksiya qilish va modernizatsiyalash uchun ajratiladigan moliyaviy resurslarni samarali boshqarishni talab etadi. Shu nuqtayi nazardan, ijtimoiy obyektlarda qurilish xizmatlari xarajatlarini iqtisodiy tahlil qilish metodologiyasini takomillashtirish investitsiya resurslaridan oqilona foydalanish, loyiha xarajatlarini nazorat qilish hamda qurilish faoliyati samaradorligini oshirishda muhim ahamiyat kasb etadi. Tadqiqotda ijtimoiy obyektlarda qurilish xizmatlari xarajatlarini iqtisodiy tahlil qilishning metodologik yondashuvlari o'rganilib, ularning shakllanishiga ta'sir etuvchi asosiy omillar aniqlangan.

Kalit so'zlar: qurilish xizmatlari; ijtimoiy obyektlar; qurilish xarajatlari; iqtisodiy tahlil; xarajatlarni tahlil qilish metodologiyasi; xarajatlar samaradorligi; qurilish resurslari; smeta qiymati; omilli tahlil; raqamlashtirish; investitsiya samaradorligi.

АННОТАЦИЯ. Развитие социальной инфраструктуры требует эффективного управления финансовыми ресурсами, направляемыми на строительство, реконструкцию и модернизацию социально значимых объектов. В данном контексте совершенствование методологии экономического анализа затрат на строительные услуги на социальных объектах имеет важное значение для рационального использования инвестиционных ресурсов, контроля проектных расходов и повышения эффективности строительной деятельности. В исследовании рассматриваются методологические подходы к экономическому анализу затрат на строительные услуги на социальных объектах и определяются основные факторы, влияющие на их формирование.

Ключевые слова: строительные услуги; социальные объекты; затраты на строительство; экономический анализ; методология анализа затрат; эффективность затрат; строительные ресурсы; сметная стоимость; факторный анализ; цифровизация; эффективность инвестиций.

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**, representing an increase of 14.2% compared with the previous year. At the same time, the volume of civil construction work 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 primarily on comparisons between planned and actual expenditures, can be enhanced by considering changes in material prices, labor costs, machinery utilization, technological innovations, project delays, and modifications to project specifications.

Uzbekistan's regulatory framework is also evolving toward more modern approaches. In particular,

Resolution No. 165 of the President of the Republic of Uzbekistan, dated April 29, 2024, established a transition, effective January 1, 2025, to a **“volume” method of assessing construction costs**, taking into account volume and quality indicators. It also provided for the formation of estimated project costs using the electronic platform of the **National Classifier of Construction Resources**.

Consequently, the methodology for economic analysis should reflect 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.

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 assessment, digital technologies, life-cycle costing, and data-driven analytical techniques.

Fazil, Lee, and Tamyaz [1], based on a systematic review of 238 studies published in 23 journals over a 31-year period, emphasize that the accuracy and reliability of construction cost estimation are critical to 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 the technical characteristics of construction projects and the 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 demonstrates a transition from conventional cost estimation toward approaches based on **Building Information Modelling (BIM), Life Cycle Assessment (LCA), life-cycle costing, and multi-criteria 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 issue of cost overruns represents another important area of research. A recent scoping review [3], covering 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 arise from both internal project management factors and external economic and institutional conditions. This finding highlights the importance of developing analytical methodologies capable of decomposing total cost deviations according to their individual determinants rather than relying solely on comparisons between planned and actual expenditures.

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

Another important research 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 to improve quantity takeoff, visualization, and cost management processes. At the same time, the literature review identifies areas for further improvement related to 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 analyses of operating, maintenance, and end-of-life costs. 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

potential to integrate life-cycle cost indicators with the environmental and social dimensions of sustainability.

RESEARCH METHODOLOGY

The research employed methods of systems analysis, comparative analysis, economic and statistical analysis, grouping, induction and deduction, as well as analysis and synthesis.

ANALYSIS AND RESULTS

The construction of social facilities involves 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 meet 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 expended but also the volume, quality, functionality, and social outcomes achieved.

Construction service costs represent the monetary value 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 technologies, 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 classified 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.

This 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 relevant to large-scale social infrastructure projects, where deviations in individual cost components may affect total project expenditure.

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 outcomes.

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 accounts for a significant share, labor productivity, working time utilization, and wage costs should be analyzed.

Table 1. Proposed Analytical Structure of Construction Service Costs¹

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 costs and productivity

¹ Author's development

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 sources, interest, payment schedules	Financial cost ratio
Quality-related costs	Defects, rework, delays	Quality loss coefficient

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

$$\Delta C = C_1 - C_0$$

while the growth rate is:

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

where:

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

Identifying changes in construction costs provides an initial basis for assessing efficiency, which can be further strengthened by examining changes in construction output. Therefore, changes in costs should be compared with changes in construction output.

An important methodological issue 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 may result from changes in material prices, consumption volumes, or their combined effects. These causes require different management decisions.

The same approach can be applied to labor costs:

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

where:

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

This approach enables management to distinguish between external cost changes and opportunities to improve internal efficiency. Such differentiation enhances the practical value of economic analysis because its objective is not only to explain changes in costs but also to identify factors that can be managed or optimized.

The formation of construction costs at social facilities is influenced by numerous factors. For methodological purposes, these factors 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 technologies used, the level of mechanization, design solutions, and the 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 developments.

The combined effect of these factors can be expressed as follows:

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

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 final construction costs. This enables construction organizations and project customers to develop targeted measures rather than relying exclusively on generalized cost-reduction approaches.

The use of digital systems enables the following analytical sequence:

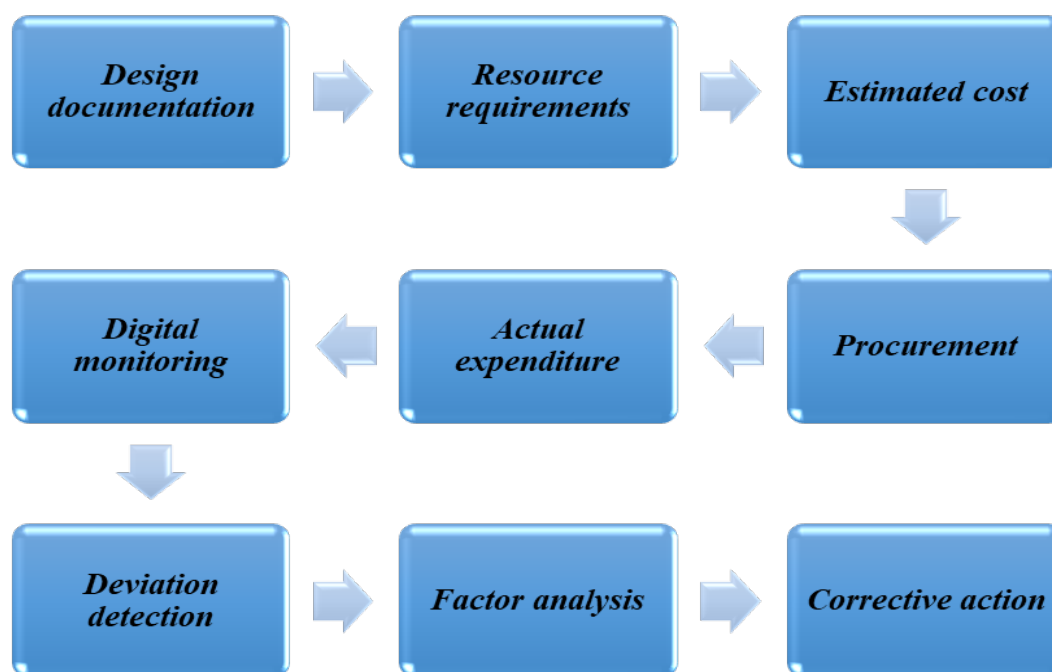


Figure 1. Methodological Framework for Digital Monitoring and Economic Analysis of Construction Service Costs

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

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

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

Financial efficiency – achieving planned cost targets and minimizing unjustified expenditure.

Resource efficiency – ensuring the rational use of materials, labor, and machinery.

Technological efficiency – ensuring the effective application of construction technologies and project solutions.

Quality and social efficiency – achieving the required functionality, quality, and social capacity.

Improvements in the economic analysis of construction service costs at social facilities should focus on

the following areas:

- Expanding the analytical classification of construction costs.
- Introducing systematic analysis of planned–actual deviations.
- Applying factor decomposition to major cost components.
- Calculating costs per unit of social infrastructure capacity.
- Incorporating quality-related losses into economic analysis.
- Increasing the use of digital construction-resource databases.
- Integrating financial, physical, and qualitative indicators.
- Conducting continuous monitoring throughout the construction life cycle.
- Strengthening comparative analysis between similar facilities.
- Using analytical results as a basis for corrective management decisions.

Consequently, the proposed methodology develops construction cost analysis beyond a simple comparison of financial indicators into a comprehensive system for evaluating resource utilization, cost formation, project implementation, quality, and social outcomes. This provides a methodological foundation for improving the efficiency and transparency of financial resources allocated to the construction of socially significant facilities.

CONCLUSIONS AND RECOMMENDATIONS

The study demonstrates that improving the methodology for the 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-related, and social factors. The complexity of social infrastructure projects necessitates a 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 application of structural and dynamic analysis enables the identification of major expenditure components and changes in their proportions, while planned–actual analysis and factor decomposition help determine the specific causes of cost deviations.

An important 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. Furthermore, incorporating quality-related costs associated with defects, rework, and construction delays ensures that cost efficiency is assessed alongside the quality and functionality of completed facilities.

The study also highlights the importance of digitalization in improving construction cost analysis. The application of electronic construction-resource databases, Building Information Modelling (BIM), enterprise resource planning (ERP) systems, and digital project-monitoring tools creates opportunities for continuously comparing planned and actual resource consumption and identifying deviations in a timely manner.

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

Based on the research findings, the following practical recommendations are proposed:

Introduce integrated cost-analysis systems combining financial, resource, quality, and social performance indicators.

Apply unit-cost indicators to compare the economic efficiency of similar social infrastructure projects.

Implement BIM and digital monitoring tools to improve cost transparency and resource management.

Conduct systematic factor analysis of planned–actual cost deviations to support timely management decisions.

Incorporate quality-related costs into project evaluations to ensure long-term economic efficiency.

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