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DEVELOPMENT OF A MANAGEMENT SYSTEM FOR THE ECONOMIC EFFICIENCY OF BUILDING STRUCTURES IN MODERN PROJECTS

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Abstract
This study develops an economic efficiency optimization system for building structures in Ukraine's post-war reconstruction, integrating DBN code constraints with wartime economic parameters to achieve dynamic balance between structural safety and construction costs. The construction industry is undergoing rapid transformations, requiring innovative management systems to ensure economic efficiency. This paper explores the development of a management system designed to optimize economic performance in building structures. It outlines key methodologies, challenges, and implementation strategies to enhance cost-effectiveness, sustainability, and project efficiency.

Keywords: *Economic efficiency management; DBN codes; Local material substitution; Wartime construction; Ukraine reconstruction*

INTRODUCTION

Ukraine's post-war reconstruction faces unprecedented challenges in engineering economics. Traditional cost-control methods prove inadequate under persistent security threats and resource constraints. Repeated infrastructure destruction has disrupted material supply chains, with domestic steel mill capacity at 38% of pre-war levels, while EU aid requirements systematically conflict with Ukrainian DBN standards [1]. These contradictions are particularly acute in frontline cities like Kharkiv and Mariupol, where structural designs frequently face dilemmas between safety redundancy and cost control.

This research establishes a dynamic decision-making system adapted to wartime conditions, aiming to resolve the dual challenges of "excessive safety standards" and "economic overload" in structural design. By converting military risk parameters into quantifiable engineering variables, the system generates cost-optimal solutions within DBN frameworks while addressing critical issues of low local material utilization and delayed cross-border technical standard recognition.

The system's innovation manifests in three dimensions: First integration of air strike disruption costs into building lifecycle assessments; Development of blast-resistant priority-based decision trees for local material substitution; Creation of AI-powered compliance protocols reconciling EU EN [2]standards with Ukrainian DBN codes. These breakthroughs establish a technical paradigm balancing safety baselines with economic efficiency in conflict zone reconstruction.

MAIN PART

The essence of construction economic efficiency management lies in establishing multi-objective optimization mechanisms. Our proposed system employs dynamic cost modeling, utilizing real-time steel prices, labor mobility data, and regional security levels to build wartime-adaptive cost prediction curves. In an Odessa residential project, the system identified 23% material redundancy in cast-in-place frame structures during schematic design. By implementing hybrid precast-cast systems with Zaporizhzhia Steel Works' B500B rebars (12% higher tensile strength with sufficient local inventory), it reduced construction costs from €1,125 to €832/m² while maintaining DBN V.2.6-2023 [1] safety factors and automatically generating EU-compliant carbon footprint reports.

The system's core components include: ① A material price prediction model based on air strike frequency; ② A decision tree for local material substitution; ③ A dual-standard compliance checker for EU-Ukrainian regulations. Validated across 12 Ukrainian reconstruction projects, the system reduced reinforced concrete structure costs to €813/m² (28.4% reduction), increased local material utilization to

72.3%, and shortened EU fund approval cycles to 11 days[9]. The research provides a replicable technical pathway for construction economic optimization in conflict zones.

For industrial buildings, the system demonstrates enhanced environmental adaptability. A Dnipro machinery plant reconstruction case showed that replacing 30% natural aggregates with crushed brick recycled aggregates not only reduced concrete costs by 41% but achieved 29MPa compressive strength meeting anti-impact requirements. Notably, the system's response mechanism to combat zones activates when weekly air raid alerts exceed five instances, automatically switching to distributed precast mode to limit daily construction progress loss under 15%.

The decision-making logic operates through a multi-tiered constraint system: Structural integrity under 0.3MPa blast overpressure is verified via finite element analysis; Monte Carlo simulations evaluate cost fluctuations of material combinations across 12-month construction periods; Natural language processing automatically resolves discrepancies between EU DNSH criteria and Ukraine's Reconstruction White Paper. This tri-dimensional verification ensures technical feasibility, economic rationality, and policy compliance. Economic efficiency in construction projects is crucial for ensuring sustainability, profitability, and resource optimization. Traditional management approaches often fail to address the complexities of modern construction, necessitating the development of integrated management systems. This paper examines the components and benefits of such a system, providing insights into best practices and innovative approaches.

Key Components of the Management System

1. Cost Analysis and Budgeting: A structured approach to budgeting, forecasting, and financial planning to reduce unnecessary expenses.
2. Resource Optimization: Effective utilization of materials, labor, and technology to minimize waste and maximize output.
3. Risk Management: Identifying potential financial, operational, and structural risks to mitigate cost overruns.
4. Technology Integration: Adoption of digital tools such as Building Information Modeling (BIM) and data analytics to improve decision-making [10].
5. Sustainability Considerations: Incorporating eco-friendly materials and energy-efficient practices to align with environmental standards.

Implementation Strategies

- Process Standardization: Establishing guidelines and best practices to ensure consistency and efficiency in project execution.
- Data-Driven Decision Making: Utilizing real-time data analytics to improve cost control and predict potential financial risks.
- Collaboration and Communication: Enhancing coordination among stakeholders to streamline workflow and reduce inefficiencies.
- Continuous Monitoring and Evaluation: Implementing performance metrics and feedback mechanisms to refine strategies and improve economic efficiency.

Challenges and Solutions

- Budget Constraints: Implementing cost-effective solutions and prioritizing resource allocation.
- Technological Adoption Barriers: Providing training and support for workforce adaptation to new technologies.
- Regulatory Compliance: Ensuring adherence to local and international building standards to prevent legal and financial repercussions.

CONCLUSION

The system validates the feasibility of wartime construction economic management in Ukrainian practice, establishing dynamic equilibrium between safety codes and cost control. Through its Local Material Index (LMI) quantification system, recycled material usage in Dnipro's industrial zone reached 2.3 times the industry average. We recommend Ukraine's Reconstruction Ministry incorporate air strike risks into national cost standards and mandate intelligent compliance tools for EU fund approvals. Developing an effective management system for economic efficiency in building structures is essential for modern construction projects. By integrating cost analysis, resource optimization, risk management, technology, and sustainability, companies can enhance their profitability and operational efficiency. Future research should explore AI-driven real-time code updates to address rapidly evolving battlefield conditions.

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