

Cost Overrun and Financial Risk in Infrastructure Projects: An Overview

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ABSTRACT: Cost overruns and financial risks are major challenges in infrastructure project management and frequently affect project performance, investment feasibility, and financial sustainability. This study aims to provide an overview of the major factors contributing to cost overruns and financial risks in infrastructure projects based on previous studies and current industry issues. The study uses a qualitative literature review approach by analyzing relevant literature related to construction management, project finance, and infrastructure development. The findings indicate that inadequate project planning, inaccurate cost estimation, design changes, project delays, cash flow instability, material price fluctuations, and weak financial governance are the dominant factors affecting project cost performance. In addition, the increasing adoption of digital technologies such as Building Information Modeling (BIM) is considered to have significant potential in improving cost control and reducing financial uncertainty. This study highlights the importance of integrating engineering management, financial planning, and risk management strategies to improve infrastructure project performance and sustainability.

KEYWORDS: Cost Overrun, Financial Risk, Infrastructure Projects, Construction Management, Infrastructure Development.

1. INTRODUCTION

Infrastructure projects play a strategic role in supporting economic growth, regional connectivity, and social welfare development. Large-scale infrastructure investments such as highways, bridges, railways, airports, and public facilities are expected to enhance productivity and stimulate sustainable economic expansion. However, despite their significant contribution to national development, infrastructure projects frequently experience cost overruns and financial risks that negatively affect project performance, investment feasibility, and long-term sustainability.

Cost overrun remains one of the most persistent problems in the construction and infrastructure industry worldwide. Numerous infrastructure projects exceed their initial budgets due to inaccurate cost estimation, design changes, inflation, delays, poor project planning, contractual disputes, inefficient resource allocation, and external uncertainties. These overruns often lead to financial instability for project owners and contractors, reduce investor confidence, and increase the burden on public expenditure. In developing countries, including Indonesia, the issue becomes more critical due to regulatory complexity, land acquisition challenges, unstable economic conditions, and limited project governance capacity.

In addition to cost overruns, financial risk has emerged as a major concern in infrastructure project management. Financial risks may arise from fluctuating material prices, exchange rate volatility, financing uncertainty, cash flow disruption, interest rate changes, and economic instability. The increasing complexity of modern infrastructure projects

further amplifies financial exposure, particularly in projects involving public-private partnerships (PPP), international financing schemes, and sustainable infrastructure initiatives. Consequently, effective financial risk management has become essential to ensure project continuity, profitability, and stakeholder confidence.

Previous studies have investigated various dimensions of cost overrun and financial risk in infrastructure projects. Several researchers focused on technical causes such as design errors, scheduling inefficiencies, and construction delays, while others emphasized managerial and financial aspects including budgeting practices, procurement systems, and investment decision-making. Moreover, recent studies have increasingly highlighted the importance of integrating financial management, risk mitigation, and sustainable project delivery approaches. Nevertheless, the existing literature remains fragmented, with limited synthesis regarding the dominant factors, methodological approaches, emerging research trends, and future research opportunities in this field.

Although many empirical studies have discussed cost overruns and financial risks independently, there is still insufficient comprehensive review research that systematically maps the relationship between these two issues within infrastructure project management. Furthermore, previous review studies tend to focus either on technical construction performance or financial management separately, resulting in limited interdisciplinary understanding between engineering and economic perspectives. This condition indicates the need for a systematic literature review that integrates findings from both

construction management and financial risk management domains.

Therefore, this study aims to systematically review the existing literature related to cost overrun and financial risk in infrastructure projects. The review seeks to identify the primary causes of cost overruns, classify major financial risks, evaluate commonly used research methods, and explore emerging trends and future research directions in the field of infrastructure project management. By synthesizing previous studies, this article is expected to provide a comprehensive understanding for academics, practitioners, policymakers, and project stakeholders regarding strategies to improve financial resilience and project performance in infrastructure development.

The study uses a qualitative literature review approach by analysing relevant literature related to construction management, project finance, and infrastructure development. The findings of this review are expected to contribute theoretically by expanding interdisciplinary perspectives between construction engineering and financial management, as well as practically by supporting better decision-making and risk mitigation strategies in infrastructure project implementation.

2. LITERATURE REVIEW

2.1 Cost Overrun in Infrastructure Projects

Cost overrun is one of the most critical challenges in infrastructure project management and is generally defined as the difference between the estimated project budget and the actual project expenditure incurred during implementation. Infrastructure projects frequently experience budget escalation due to their complexity, long construction duration, multiple stakeholders, and exposure to uncertain external conditions. Previous studies have consistently shown that cost overruns occur across various types of infrastructure projects, including highways, railways, bridges, tunnels, airports, and public facilities (Cavalieri, et al, 2019).

Several researchers have identified that inaccurate cost estimation, design changes, poor project planning, weak scheduling systems, and ineffective coordination among stakeholders are major contributors to cost overruns. In addition, financial constraints, contractor inefficiency, material price fluctuations, labor shortages, and regulatory issues also significantly affect project cost performance. A systematic review conducted by Cavalieri et al. revealed that determinants of cost overruns are generally categorized into technical, managerial, economic, and institutional factors (Cavalieri, et al, 2019).

In road infrastructure projects, failures in design, inadequate project planning, scope changes, and material price variations are among the most dominant causes of budget escalation. Herrera et al. identified five critical factors frequently associated with cost overruns in highway projects: design failures, material price fluctuations, inadequate planning, scope modification, and design changes (Herrera, et al, 2020). Furthermore, large-scale transportation projects are highly

vulnerable to cost escalation because of their long implementation periods and high dependence on government policies and public financing systems (Flyvbjerg, et al, 2013). Recent studies also highlight the growing influence of sustainability requirements and technological complexity on project cost performance. The integration of advanced technologies, environmental regulations, and sustainable construction practices often introduces additional uncertainty during project execution. Therefore, infrastructure cost management increasingly requires interdisciplinary approaches that combine engineering, financial, and managerial perspectives (Afana, et al, 2024)

2.2 Financial Risk in Infrastructure Projects

Financial risk refers to uncertainties that may negatively affect project funding, investment returns, cash flow stability, and overall financial performance. In infrastructure projects, financial risks emerge due to fluctuating market conditions, inflation, interest rate volatility, exchange rate instability, and financing uncertainties. Infrastructure development requires substantial capital investment, making financial management a crucial component of project success.

One of the most common financial risks in construction projects is cash flow disruption. Delayed payments, financing shortages, and poor financial planning may interrupt construction activities and reduce project productivity. Financial instability can further create delays in procurement processes, labor payment issues, and material supply interruptions, which eventually contribute to additional cost escalation (Puteri, et al, 2024).

Material price volatility is another significant source of financial risk in infrastructure development. Construction projects rely heavily on commodities such as steel, cement, fuel, and asphalt, whose prices are strongly influenced by global economic conditions and inflationary pressures. Sudden increases in material prices may substantially reduce project profitability and create budget deficits. Additionally, exchange rate fluctuations can increase procurement costs for imported construction materials and equipment, especially in projects financed through international investment schemes (Zhasmukhambetova, 2015)

Financial risk is also closely associated with project governance and contractual management systems. Weak budgeting mechanisms, unrealistic financial forecasting, and ineffective risk allocation among stakeholders often increase financial vulnerability during project implementation. According to Flyvbjerg and colleagues, cost overruns in large infrastructure projects are not solely technical problems but are also related to economic, political, and psychological dimensions that influence decision-making processes.

Moreover, optimism bias has been recognized as a major contributor to financial risk and cost escalation in transport infrastructure projects. Decision-makers frequently underestimate project complexity and financial exposure during the planning stage, resulting in unrealistic budgets and inaccurate financial projections. Chen et al. argued that optimism bias significantly affects infrastructure cost

appraisal and often leads to severe financial consequences during project execution (Chen, et al, 2023)

2.3 Relationship Between Cost Overrun and Financial Risk

Cost overrun and financial risk are strongly interconnected within infrastructure project management. Budget escalation often increases financial pressure on contractors, investors, and project owners, while financial instability may simultaneously worsen project performance and operational efficiency. This reciprocal relationship creates a cycle in which cost overruns intensify financial risk, and financial risk further contributes to project delays and budget deviations. Several studies suggest that financial management capability significantly influences project cost performance. Projects with poor financial planning and weak risk management systems are more likely to experience cost overruns. Financial uncertainty may reduce organizational capability to manage procurement, labor productivity, and resource allocation effectively. Consequently, integrating financial risk management into project management practices becomes essential for improving infrastructure project sustainability (Afana, et al, 2024).

In transportation infrastructure projects, prolonged implementation periods are strongly associated with increasing financial exposure and cost escalation. Long project durations increase susceptibility to inflation, interest rate changes, political uncertainty, and market fluctuations. Flyvbjerg et al. found that delays in implementation phases substantially increase the probability of cost overruns in transportation infrastructure projects (Flyvbjerg, et al, 2013). The relationship between financial risk and cost overrun has also encouraged the adoption of advanced digital technologies such as Building Information Modeling (BIM), artificial intelligence, and predictive analytics. These technologies are increasingly used to improve cost estimation accuracy, monitor project performance, and reduce financial uncertainty. Hussain et al. emphasized that 5D-BIM has significant potential to minimize cost overruns in rail infrastructure projects through improved lifecycle cost management and project integration (Hussain, et al, 2023).

3. RESEARCH FRAMEWORK

This study conceptualizes that infrastructure project performance is strongly influenced by the interaction between cost overrun factors and financial risk factors. The systematic review framework aims to synthesize existing knowledge to develop a broader interdisciplinary understanding between construction management and financial management perspectives in infrastructure development.

The findings of this study are expected to provide theoretical contributions to construction management literature and practical implications for project owners, contractors, consultants, investors, and policymakers in improving financial resilience and project cost performance.

4. RESULT AND DISCUSSION

4.1 Overview of Selected Articles

The systematic literature review process identified a substantial number of studies related to cost overruns and financial risks in infrastructure projects. Following the PRISMA screening procedure, the selected articles primarily consisted of empirical studies, review papers, and conceptual research published between 2014 and 2025. The reviewed literature covered various infrastructure sectors, including transportation infrastructure, highways, railways, bridges, buildings, energy infrastructure, and public facilities.

The analysis indicates that research on cost overruns and financial risks has increased significantly in recent years, particularly after the global emphasis on sustainable infrastructure development and digital transformation in construction management. Most studies originated from developing countries where infrastructure expansion is rapidly growing and project financial vulnerability remains relatively high. (Cavaliere, et al, 2019).

The reviewed studies mainly employed quantitative approaches such as regression analysis, Structural Equation Modeling (SEM), Monte Carlo simulation, and risk assessment models. However, several studies also used qualitative approaches and mixed methods to explore organizational and managerial dimensions of infrastructure project performance (Herrera, et al, 2020).

4.2 Dominant Factors Causing Cost Overruns

The findings reveal that cost overruns in infrastructure projects are caused by multiple interconnected factors categorized into technical, managerial, financial, economic, and institutional dimensions.

A. Technical and Planning Factors

One of the most dominant causes identified in the literature is inadequate project planning and inaccurate cost estimation. Several studies found that unrealistic budgeting practices and insufficient feasibility studies significantly contribute to budget escalation during project implementation. Poor project planning often leads to inaccurate forecasting of labor requirements, material demand, project duration, and operational complexity (Cavaliere, et al, 2019).

Design changes and scope modifications were also consistently identified as major contributors to cost overruns. Infrastructure projects frequently experience changes due to stakeholder demands, regulatory adjustments, or unforeseen site conditions. These modifications increase project duration, procurement costs, and labor requirements, thereby reducing project efficiency. Herrera et al. emphasized that design-related failures remain among the most significant determinants of cost escalation in road infrastructure projects (Herrera, et al, 2020).

Furthermore, project delays caused by poor scheduling systems, contractor inefficiency, labor shortages, and equipment failure substantially affect project expenditure. Delays increase indirect costs, prolong resource utilization, and reduce overall project productivity. These findings

reinforce the importance of integrated project planning and operational control systems in infrastructure management.

B. Financial Risk Factors

The review indicates that financial risk is strongly associated with project cost performance and infrastructure sustainability. One of the most critical financial risks identified is cash flow instability. Delayed payments from project owners, financing shortages, and weak financial planning frequently disrupt construction activities and reduce organizational liquidity. Financial instability may ultimately delay procurement processes, labor payments, and material delivery (Puteri, et al, 2024).

Material price fluctuations also emerged as a major financial risk factor. Infrastructure projects depend heavily on construction commodities such as steel, cement, asphalt, and fuel, whose prices are highly sensitive to inflation and global economic conditions. Sudden increases in material prices significantly affect project profitability and create budget uncertainty (Zhasmukhambetova, et al, 2025).

Exchange rate volatility and interest rate uncertainty were identified as additional financial challenges, particularly in projects involving imported materials or international financing systems. Infrastructure projects with long implementation periods are highly vulnerable to macroeconomic instability because prolonged project duration increases exposure to inflation and market fluctuations.

The findings also indicate that optimism bias frequently contributes to financial risk in infrastructure projects. Decision-makers often underestimate project complexity and financial uncertainty during the planning stage, resulting in unrealistic budgets and inaccurate investment projections. Flyvbjerg and colleagues argued that political pressure and strategic misrepresentation significantly influence cost underestimation in megaproject development (Cantarelli, et al, 2013).

4.3 Relationship Between Cost Overrun and Financial Risk

The reviewed studies consistently demonstrate that cost overruns and financial risks have a reciprocal relationship. Cost escalation increases financial pressure on contractors, investors, and project owners, while financial instability simultaneously worsens project operational performance and productivity.

This relationship becomes increasingly critical in large-scale infrastructure projects due to their high capital intensity and long implementation periods. Financial instability often leads to procurement inefficiencies, resource shortages, and delayed project execution, which subsequently trigger additional budget escalation. Therefore, cost overruns and financial risks should be treated as integrated project management issues rather than isolated technical problems. Several studies emphasized that infrastructure project success strongly depends on effective financial governance and risk management systems. Projects with robust financial planning, contingency allocation, and integrated monitoring

systems generally demonstrate better cost performance and operational stability (Afana, et al, 2024).

The findings also reveal that institutional quality significantly influences financial resilience in infrastructure projects. Weak contractual arrangements, bureaucratic inefficiency, and ineffective stakeholder coordination frequently increase project uncertainty and financial exposure. Public infrastructure projects are particularly vulnerable because they involve multiple stakeholders with differing objectives and decision-making structures.

4.4 Emerging Trends in Infrastructure Project Management

Another important finding identified in this review is the growing adoption of digital technology and sustainability approaches in infrastructure project management.

A. Digital Technology Adoption

The literature indicates that technologies such as Building Information Modeling (BIM), artificial intelligence, predictive analytics, and digital project monitoring systems are increasingly used to improve cost control and reduce financial uncertainty. BIM-based cost management systems enable real-time project monitoring, improved cost estimation accuracy, and enhanced coordination among stakeholders.

Recent studies suggest that 5D-BIM has substantial potential to minimize lifecycle cost overruns and improve infrastructure financial management. Hussain et al. reported that BIM integration significantly enhances transparency and decision-making effectiveness in railway infrastructure projects (Hussain, et al, 2023).

B. Sustainable Infrastructure Development

The transition toward sustainable infrastructure development has also influenced project cost and financial management practices. Sustainable projects require compliance with environmental regulations, green construction standards, and resource efficiency objectives. While these requirements may initially increase project costs, they potentially improve long-term economic efficiency and operational sustainability.

The findings indicate that future infrastructure management frameworks should integrate sustainability principles, financial resilience, and digital innovation simultaneously to improve project performance under uncertain economic conditions.

4.5 Discussion

The findings of this systematic literature review confirm that cost overruns and financial risks remain persistent global challenges in infrastructure project management. The reviewed studies collectively demonstrate that infrastructure project performance is influenced not only by technical capability but also by financial governance, organizational management, institutional quality, and economic stability. One of the most important findings is that inadequate planning and weak cost estimation systems remain dominant causes of project budget escalation. This suggests that many infrastructure projects still lack effective front-end planning

processes capable of accurately predicting project complexity and uncertainty. Consequently, project stakeholders frequently face financial pressure during implementation phases.

The review also highlights the increasing importance of interdisciplinary integration between engineering management and financial management perspectives. Traditional infrastructure management approaches often focus primarily on operational and technical dimensions, while financial risks are treated separately. However, the findings demonstrate that financial instability directly affects operational performance, productivity, and project sustainability. Therefore, integrated project governance systems are essential for minimizing infrastructure project vulnerability.

Another important implication concerns the role of digital transformation in infrastructure management.

The increasing adoption of BIM, predictive analytics, and digital monitoring systems indicates that technology-driven management approaches can significantly improve cost control and financial decision-making processes. These technologies enhance project transparency, reduce uncertainty, and support proactive risk mitigation strategies. Moreover, the review confirms that sustainability considerations are becoming increasingly influential in infrastructure project development. Sustainable infrastructure projects require balancing technical performance, environmental responsibility, and financial resilience simultaneously. Therefore, future infrastructure management research should focus on developing integrated frameworks combining sustainability, digital innovation, and financial risk management.

Overall, this review emphasizes that effective infrastructure project management requires adaptive, collaborative, and financially resilient strategies capable of addressing both operational inefficiency and economic uncertainty in rapidly evolving construction environments.

5. CONCLUSION

The findings indicate that cost overruns remain one of the most persistent challenges in infrastructure development and are influenced by a combination of technical, managerial, financial, economic, and institutional factors. Inadequate project planning, inaccurate cost estimation, design changes, project delays, weak coordination, and inefficient resource management were identified as the most dominant contributors to project budget escalation.

The review also reveals that financial risks play a significant role in determining infrastructure project performance and sustainability. Cash flow instability, material price fluctuations, inflation, exchange rate volatility, and financing uncertainty frequently create financial pressure on project stakeholders. These financial risks not only affect project profitability but also contribute to operational inefficiencies and schedule delays, thereby intensifying cost overruns.

Furthermore, the findings confirm that cost overruns and financial risks have a strong reciprocal relationship. Budget escalation increases financial exposure, while financial instability simultaneously worsens project execution performance. Therefore, infrastructure project challenges should not be approached solely from a technical engineering perspective, but rather through integrated management frameworks combining construction management, financial governance, and organizational risk management.

Another important finding of this review is the growing role of digital technology and sustainability in infrastructure project management. Technologies such as Building Information Modeling (BIM), predictive analytics, and digital monitoring systems demonstrate significant potential in improving cost control, project transparency, and financial decision-making. At the same time, sustainable infrastructure development requires project stakeholders to balance economic efficiency, environmental responsibility, and long-term financial resilience.

This study also identifies several research gaps within the existing literature. Most previous studies focused primarily on identifying causal factors of cost overruns rather than developing integrated mitigation frameworks. In addition, limited studies comprehensively combine engineering, financial, technological, and sustainability perspectives simultaneously. Therefore, future research should focus on interdisciplinary approaches capable of improving infrastructure project resilience under uncertain economic and operational conditions.

Theoretically, this review contributes to expanding the understanding of the interconnected relationship between cost overruns and financial risks in infrastructure management research. Practically, the findings provide important insights for governments, contractors, consultants, investors, and policymakers regarding the importance of strengthening project planning systems, improving financial governance, enhancing risk management practices, and adopting digital technologies to improve infrastructure project performance. Finally, this study concludes that successful infrastructure project delivery increasingly depends on the ability of stakeholders to integrate technical expertise, financial management capability, technological innovation, and sustainable development principles within a comprehensive and adaptive project management framework.

A. Limitations of The Research

This study has several limitations. First, the review relied only on secondary data from published journal articles, which may exclude relevant studies from reports, conference papers, or non-indexed publications. Second, the study focused only on English-language articles published between 2014 and 2025, potentially limiting broader perspectives from earlier or non-English studies. Third, the reviewed articles covered different countries and infrastructure sectors with varying economic and institutional conditions, making the findings difficult to generalize universally. Finally, this study used qualitative synthesis rather than quantitative meta-analysis,

so the strength of relationships among variables was not statistically measured.

B. Future Research

Future research should develop more integrated models combining technical, financial, managerial, technological, and sustainability perspectives in infrastructure project management. Quantitative approaches such as SEM, machine learning, or predictive analytics are recommended to examine causal relationships more comprehensively. Further studies should also explore the effectiveness of digital technologies such as BIM and artificial intelligence in reducing cost overruns and financial risks. In addition, comparative studies between developed and developing countries are needed to better understand contextual differences in infrastructure project financial management and risk mitigation strategies.

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