ISSN: 3008-1394

Research on Full-Process Cost Management for Transport Infrastructure Construction Projects

Shi qi Sun[1], Yi Zhang[1]*

[1]Huanggang Normal University, Huanggang 438000, China.

Corresponding author: 2084703312@qq.com

Abstract

Transport infrastructure projects are characterised by substantial investment scales, extended timelines, and multiple stakeholders. Cost overruns and deviations from investment objectives remain persistent global challenges. To enhance cost control and value realisation in transport infrastructure projects, this paper employs a combined approach of literature review and case study analysis. It systematically reviews domestic and international research progress on whole-process cost management and life-cycle cost (LCC), identifying key cost control mechanisms across project phases—decision-making, design, procurement, construction, final settlement, and operation/maintenance. Building upon this, a theoretical framework for whole-process cost management is established, integrating 'vertical phases' with 'horizontal elements'. Further integrating practical experiences from high-speed railways, urban rail transit, and expressways, the paper summarises and explains the operational mechanisms of strategies such as constrained design, contract price limitations, change and claim control, dynamic cost monitoring, and information-based collaboration. Findings reveal existing limitations in full-process cost management, including weak phase transitions, insufficient incorporation of operational-phase costs, delayed responses to dynamic risks, and information silos. To address these shortcomings, this paper proposes a closed-loop control pathway integrating full life-cycle concepts. Theoretical innovations and management recommendations are presented across four dimensions: (1) early cost warning triggered by earned value and threshold mechanisms; (2) cross-phase cost information integration via BIM/data platforms; (3) design-procurement-construction (DPC) collaborative constraints driven by target costs; and (4) iterative estimation parameter refinement fuelled by operational data feedback. This paper's contribution lies in integrating LCC, risk early warning, and digital collaboration into a unified framework for whole-process cost management. It provides a generalisable theoretical reference for achieving 'front-end pre-control – mid-process correction – back-end feedback' cost governance in transport infrastructure projects.

Keywords

Transport infrastructure; Whole-process cost management; Life-cycle cost (LCC); Dynamic cost control; Risk early warning; BIM/digital collaboration; Target cost management

1.Introduction

Transport infrastructure projects (such as high-speed railways, motorways, and urban rail transit) involve substantial construction scales and significant investment. Cost management is crucial for realising both the economic and social benefits of these projects. However, globally, large-scale infrastructure projects commonly suffer from cost overruns and schedule

ISSN: 3008-1394

delays. Statistics indicate that approximately 35% of road construction projects in China exceed their budgets by more than 10%. This phenomenon not only wastes funds but may also jeopardise timely project completion and the fulfilment of intended functionalities. Consequently, strengthening cost management throughout the entire project lifecycle is crucial for ensuring investment returns and preventing public fund wastage[1].In recent years, China has advanced its 'Transportation Powerhouse' strategy, demanding that transport infrastructure development be both rapid and characterised by high quality and sustainability. Traditional, extensive cost management models are increasingly inadequate for meeting high-quality development requirements. Factors such as fluctuating material prices, frequent design modifications, and inefficient construction organisation heighten the risk of cost escalation. Concurrently, emerging technologies—including Building Information Modelling (BIM) and big data—have created conditions for refined cost management, driving transformative changes in cost management approaches. Consequently, researching new theories and methodologies for managing costs throughout the entire lifecycle of transport infrastructure projects—from decision-making to operations—holds substantial academic value and practical significance.

2. Theoretical Foundations and Research Progress Review

2.1 International Research Landscape

Western developed nations pioneered the application of economic and management theories to engineering cost management. From the late 20th century onwards, organisations such as the International Confederation of Cost Engineers (ICCE) championed the concept of 'Life Cycle Cost Management (LCC)'[2]. This approach involves considering all costs across the entire project lifecycle – encompassing construction, operation, and maintenance – during the feasibility study phase to optimise decision-making. For instance, incorporating life cycle cost analysis into feasibility studies can replace methods solely focused on initial construction costs, thereby achieving 'value maximisation' for projects. The whole-life-cycle cost management approach is widely adopted in the West and endorsed by institutions such as the World Bank. Its superiority lies in emphasising cost optimisation during the project's preliminary and operational phases. Overseas scholars have also conducted extensive research on cost escalation in large-scale projects, identifying factors and trends contributing to cost overruns in public projects[3]. They propose enhancing risk management and the scientific rigour of early-stage decision-making to reduce the probability of cost overruns. In information technology, digital techniques such as Building Information Modelling (BIM) have recently been employed to integrate project lifecycle data, enhancing cost forecasting accuracy and control efficiency. Love et al. (2016) noted that traditional cost control relies on periodic financial reporting and manual tracking, whereas contemporary practice emphasises real-time monitoring and automated systems to mitigate budget overruns. Concurrently, risk management has progressively become integral to cost management, aiding in anticipating and mitigating cost escalations caused by unforeseen factors. Overall, international research trends are shifting from single-phase cost control towards dynamic, whole-life-cycle cost management, actively incorporating information technology and risk management to enhance effectiveness[4].

2.2 Domestic Research Status

Since the 1990s, China has emphasised the concept of whole-process cost management in engineering, encompassing cost control throughout project decision-making, design, construction, completion acceptance, and even operational phases. The whole-process cost management model is widely applied in domestic engineering practice, playing a role in controlling investment and improving efficiency. However, scholars have also pointed out

ISSN: 3008-1394

certain drawbacks in this model[5]. Compared to Western approaches emphasising whole-life-cycle optimisation, China's traditional whole-process management tends to focus more on the construction phase, often neglecting operational and maintenance phase costs and lacking cross-phase dynamic optimisation. In recent years, domestic research has increasingly explored integrating full life-cycle concepts into whole-process management[6]. For instance, comparative studies between 'whole-process cost management' and 'full life-cycle cost management' have demonstrated the superiority of the latter, advocating that China's cost management philosophy should align with international standards by strengthening focus on operational-phase costs. Moreover, in the context of China's large-scale infrastructure projects, cost management faces unique institutional and market challenges. These include frequent cost overruns in government-funded projects, with factors such as the investment and financing system, contract management, and regulatory mechanisms all impacting the effectiveness of whole-process cost control. Consequently, domestic scholars have explored avenues such as involving engineering cost consultancy firms in whole-process management and enhancing cost information systems and quota frameworks to improve cost control capabilities. Notably, recent national policies have vigorously promoted 'full-process engineering consultancy' services, wherein consultancy firms provide integrated advisory services spanning decision-making, design, tendering, construction, and completion phases, with cost control as a core component. This model is regarded as an effective pathway to enhance the controllability of project costs throughout their lifecycle in China. In summary, domestic research is shifting from single-phase control towards integrated, comprehensive management. However, theoretical refinement remains necessary in areas such as the full lifecycle perspective, enhanced application of information technology, and institutional safeguards. These represent precisely the directions this study seeks to explore in greater depth[7].

3. Key Stages and Theoretical Model of Full-Process Cost Management

3.1 The Essence of Full-Process Cost Management

Full-process cost management refers to systematic activities aimed at rationally determining and effectively controlling costs throughout an engineering project's entire lifecycle. Taking transport infrastructure projects as an example, full-process cost management spans the following principal stages: investment decision-making, survey and design, tendering and procurement, construction implementation, final settlement upon completion, and operation and maintenance. Within each phase, cost management focuses on distinct yet interconnected priorities, forming a closed-loop control system. For instance, during project decision-making, investment estimates and economic feasibility analyses are employed to rationally determine total project investment. This includes considering full lifecycle costs encompassing construction and operational maintenance to ensure economic viability. The design phase emphasises scheme optimisation and value engineering, employing methods such as scheme comparison and value engineering to contain engineering design within investment limits, thereby preventing cost escalation due to over-design. Cost management during the tendering phase focuses on bill of quantities preparation and contract price control, determining reasonable contractor prices through competitive tendering while refining contract terms to manage potential variation claim costs. The construction phase represents the critical focus for cost control. A dynamic cost management system must be established, employing methods such as budget execution monitoring, progress payment management, site certification management, change control, and Earned Value analysis. These techniques enable continuous tracking and comparison of actual expenditure against budgeted figures, facilitating timely corrective action. The final settlement phase involves project settlement audits and post-

ISSN: 3008-1394

evaluation to verify the ultimate project cost and analyse deviations. Lessons learned are then fed back into future project decision-making, fostering knowledge accumulation. Costs incurred during the operational maintenance phase of transport infrastructure—such as the substantial maintenance expenditures for high-speed railways and metros—should also fall within the scope of cost management. A whole-life-cycle cost optimisation approach should be adopted, for instance by optimising maintenance decisions to reduce lifecycle expenses[8].

3.2 Key Stages and Theoretical Model Construction

Based on the above stage analysis, the key stages of whole-process cost management can be distilled as follows: cost pre-control during the decision-making stage, cost optimisation during the design stage, cost constraints during the contract and procurement stage, dynamic cost control during the construction stage, cost accounting and feedback during the completion stage, and cost management during the operation and maintenance stage. These stages are both relatively independent and interconnected, forming a closed-loop system. Theoretically, a two-dimensional framework can be constructed: vertical stages and horizontal elements. Vertically, stages are defined according to the project lifecycle; horizontally, management elements influencing costs are established, such as organisational management, technical measures, economic measures, contract management, and information management. For instance, during construction, organisational management must establish a clear cost control accountability system; technically, BIM5D and other digital tools should be implemented[4]; economically, cost performance analysis should be applied; contractually, change control clauses should be refined; and information-wise, real-time cost monitoring should be achieved. This two-dimensional framework establishes a comprehensive cost management theoretical structure: ensuring targeted cost control measures for each phase while organically linking stages through information and management tools to enable information sharing and dynamic adjustments[9]. This model prioritises holistic optimisation over isolated improvements, placing particular emphasis on inter-phase coordination and feedback loops. Design decisions directly influence construction and operational costs, hence the model advocates considering these impacts during design (embodying the ‘design is cost’ principle). Similarly, post-completion evaluations feed back operational data to refine estimation methodologies and parameters for future projects. Notably, modern information technology provides the tooling for this model's implementation: 5D BIM integrates schedule and cost data, enabling end-to-end cost visualisation and real-time control throughout design and construction. IoT and big data technologies collect performance and expenditure metrics during operation, informing optimised maintenance decisions. This theoretical framework synthesises traditional project management theories (such as the PDCA cycle and earned value management) with whole-life-cycle cost theory. It is particularly suited to long-duration, high-investment projects like transport infrastructure, aiding the establishment of comprehensive and efficient cost control systems in practice[10].

4. Analysis of Typical Cases

4.1 High-Speed Railway Project Case Study

Taking the Beijing-Shanghai High-Speed Railway as an example, this section analyses the characteristics of its full-process cost management. Spanning 1,318 kilometres with a design speed of 350 kilometres per hour and a total investment of approximately RMB 220 billion[1], it ranks among China's largest high-speed railway projects in terms of investment scale. Such substantial investment necessitated exceptionally rigorous cost management. During the project decision-making phase, the investment estimate was determined through repeated

ISSN: 3008-1394

deliberations and subsequently approved by the state. The design phase employed cost-constrained design, limiting the cost per kilometre to approximately RMB 168 million, thereby minimising expenditure while ensuring functionality and safety. During construction, stringent cost control measures were implemented. For instance, the project adopted a contract strategy combining segmented tendering and lump-sum pricing with dynamic adjustments. A price index adjustment mechanism was implemented to mitigate risks such as material price fluctuations, thereby reducing overspending caused by market volatility. A comprehensive investment monitoring system was established during construction. The Railway Construction Investment Company conducted monthly audits and disbursement controls for each tender section, ensuring payments aligned with actual progress and preventing overpayments. Real-time monitoring and digital tools were also integrated into high-speed rail construction. These included using the Project Management Information System (PMIS) to track contract variations and site certifications, and applying Building Information Modelling (BIM) to verify quantities, thereby reducing cost deviations caused by miscalculations or omissions. Reports indicate that through effective process control, certain high-speed rail projects achieved a five-month advance in completion schedules and realised investment savings of approximately 10%. Following its commissioning, the Beijing-Shanghai High-Speed Railway incurred annual operational and maintenance costs running into billions of yuan[11]. However, owing to stringent cost control during construction coupled with optimised operational management, this line became one of China's few profitable high-speed rail routes, providing a positive case study for subsequent high-speed rail development. This case demonstrates that in mega-infrastructure projects, full-process cost management requires coordination across decision-making, design, tendering, and construction phases, supplemented by dynamic adjustment mechanisms to address risks. Only thus can investment be maintained within reasonable bounds, ensuring the project's long-term economic viability.

4.2 Urban Rail Transit Project Case Study

Taking a mega-scale urban metro line (e.g., Shanghai Metro Line 19) as an example, we examine key cost management considerations for urban rail transit projects. Urban metro systems face persistently rising unit costs due to complex construction environments (requiring traversal of existing urban areas and dense underground utility networks), stringent technical requirements, and significant safety risks. Currently, China's average urban metro construction cost per kilometre reaches 700-800 million yuan, with lines in first-tier cities exceeding 1 billion yuan per kilometre. A newly constructed Shanghai metro line, spanning approximately 30 kilometres, carries a total budgeted investment of around RMB 30 billion. Significant costs encompass civil engineering, equipment procurement, track laying, and related works. During the feasibility study phase, the project underwent exhaustive cost analysis and economic evaluation. This included comparing cost differences between elevated and underground options, while accounting for implicit costs such as property relocation and environmental mitigation. This ensured the selected scheme balanced functionality with economic viability. During the design phase, strict adherence to cost-constrained design principles was enforced. All specialised designs underwent iterative optimisation based on investment control targets. Examples include reducing demolition volumes through optimised station and route layouts, and lowering equipment procurement costs via standardised design approaches. In the tendering stage, the local government adopted an Engineering, Procurement and Construction (EPC) model to engage experienced contractors. Concurrently, rigorous scrutiny of bill of quantities and tender control prices was implemented to prevent underestimation and overbilling, laying the groundwork for subsequent cost control during construction. The construction phase implemented multi-tiered cost management: the main contractor established a dedicated project cost department to track labour, material, and

ISSN: 3008-1394

machinery expenditure in real time. The client and third-party cost consultants reviewed monthly expenses, scrutinising site certifications and design change costs. Given the inherent risks of design modifications and project delays in metro construction, the project team reinforced change management by strictly enforcing the ‘budget first, change later’ principle. This requires each design alteration to undergo prior cost budgeting and approval, ensuring incremental investments are both sourced and capped. Furthermore, the project leveraged digital tools such as BIM+GIS for underground utility detection and conflict resolution, minimising rework costs from unexpected collisions. An integrated construction progress and cost management platform enabled synchronised progress-cost control, triggering immediate alerts for schedule delays or cost overruns. These measures ultimately enabled the line to be completed largely within its budgetary estimates. Although annual operational and maintenance costs remain high at approximately ¥12 million per kilometre post-commissioning, the project maintains relatively sound financial standing among domestic metro systems due to effective construction-phase investment control and passenger volumes meeting projections. This case demonstrates that the challenges in cost management for urban rail transit projects lie in preliminary planning, route selection and scheme optimisation (which determine construction complexity and cost), construction-phase changes and risk control, as well as the application of information technology tools. Throughout-process cost management in such projects must be more meticulous and forward-looking to address complex environments and uncertainties, ensuring the project's financial sustainability.

4.3 Highway Engineering Project Case

Taking a motorway construction project as an example, this section demonstrates full-process cost management practices in highway engineering. Spanning approximately 200 kilometres through mountainous terrain and river crossings, the motorway required an investment of around 30 billion yuan. During the decision-making phase, economic assessments were conducted by comparing multiple route corridor options alongside investment estimates. This evaluated the impact of varying route lengths and bridge-tunnel ratios on costs and benefits, ultimately selecting the corridor scheme offering the lowest comprehensive cost while meeting functional requirements. During the design phase, a design review system was implemented to control costs: cost consultancy firms participated in design evaluations, proposing optimisation recommendations for ‘high-value cost items’ within design schemes. For instance, optimised geological surveys reduced unnecessary bridge and tunnel lengths, lowering costs at source. During the tendering phase, the project was divided into multiple lots. A reasonable low-price award approach, supplemented by credit evaluations, was adopted to prevent subsequent claims arising from excessively low bids. Contracts explicitly included price adjustment clauses (e.g., mechanisms for adjustments when key material costs like steel or cement fluctuate beyond specified thresholds) to share market risks. During construction, a cost control team comprising the client, supervisors and contractors was established, holding regular cost analysis meetings. For common cost escalation factors in highway projects (such as substandard subgrade treatment, design modifications, or additional environmental requirements), the team proactively assessed cost impacts and activated contingency reserves when necessary. The project further developed a construction cost information system. Actual expenditures and physical progress for each contract section were entered into the database for comparative analysis against budget plans, enabling early warning of cost overrun trends. For instance, during bridge pile foundation works, if concrete or reinforcement consumption exceeded budgeted levels, the system alerted management to investigate causes, promptly correct construction techniques, or strengthen site oversight to prevent further cost escalation. During final settlement, audits strictly adhered to contractual

ISSN: 3008-1394

terms and national pricing standards, with external auditors engaged to verify the accuracy and legitimacy of outcomes. Through rigorous end-to-end controls, the motorway's final settlement cost remained largely aligned with the approved estimate, avoiding significant overruns. This outcome owes much to the effective operation of the full-process cost management system: from scheme optimisation and cost-saving design to rigorous contract management and dynamic control measures, costs were scrutinised at every stage. However, the project also revealed certain challenges, such as the difficulty in accurately estimating contingency allowances under complex geological conditions, and overspending occurring in individual sub-projects. These issues necessitate refinements to cost risk assessment models in future projects. The above case studies demonstrate that while different types of transport infrastructure projects possess distinct characteristics, the core principles of full-process cost management remain consistent. These include: avoiding investment decision errors through scientific preliminary planning; eliminating waste via design optimisation; allocating and mitigating risks through strategic contracting; implementing timely corrective actions during construction through meticulous oversight; and integrating information technology and new techniques throughout the process to enhance management efficiency. These practical experiences provide valuable empirical support for theoretical research and inspire innovative approaches to address existing theoretical gaps.

5. Theoretical Issues and Research Innovations

Despite significant advancements in whole-process cost management theory in recent years, the aforementioned literature review and case analyses reveal persistent shortcomings in existing theories and practices, necessitating further innovation and refinement:(1) Inadequate phase integration and lack of a whole-life-cycle perspective: Traditional whole-process cost management often segments the project lifecycle into distinct phases, with each phase managed in isolation, lacking cross-phase coordination and information feedback mechanisms. For instance, investment estimates from the decision-making phase frequently disconnect from cost control during actual construction, while operational maintenance costs are seldom factored into construction-phase decisions. This fragmentation enables certain phases to spiral out of control (e.g., excessive design changes causing construction cost overruns) without prior prevention. Existing theories pay insufficient attention to operational-phase costs, failing to meet the requirements for long-term performance optimisation in infrastructure projects. In response, this paper innovatively proposes a whole-process cost management framework integrating the whole-life-cycle concept. It emphasises applying whole-life-cycle cost analysis during the decision-making phase, incorporating operational and maintenance costs into investment decision-making criteria, and conducting post-completion evaluations. This feeds back operational-phase data to refine cost models for future projects, achieving closed-loop management[10].(2) Inadequate response to dynamic risks and uncertainties: Transport infrastructure projects feature extended lifecycles, subject to multiple uncertainties including market fluctuations, policy shifts, and natural conditions. Existing cost management theories insufficiently address dynamic risk control, often relying on fixed contingency reserves or post-event controls without real-time early warning mechanisms. This paper innovatively introduces an early cost warning model, drawing on risk management theory and modern information technology. By integrating Earned Value Management (EVM) methodology with big data forecasting, it enables automatic monitoring and early warning of cost deviations during the construction phase. This innovation empowers managers to promptly identify emerging issues—such as accelerated cost consumption or abnormal price surges for critical resources—and implement corrective measures, thereby enhancing proactive cost management throughout the project lifecycle[12].(3) Insufficient Information Integration and Collaboration: Currently, cost data

ISSN: 3008-1394

across project phases remains fragmented among different stakeholders, creating pronounced information silos that hinder real-time cost tracking and collaborative decision-making. Theoretical exploration into constructing integrated cost information platforms remains limited. This paper introduces the concept of a digital collaboration platform within its model, leveraging BIM-based 5D models to integrate cost information from design through construction to operations and maintenance. Through standardised cost databases and coding systems, seamless integration and sharing of cost data across phases are achieved, enhancing collaborative management efficiency among stakeholders. This integration of information technology represents a significant refinement of traditional cost management theory, enabling the effective implementation of full-process cost management[9].(4) Lack of Target Cost Management Philosophy: Engineering projects often lack a ‘backward planning’ approach to target cost management, where an overall target cost is set based on project value and market levels, then progressively broken down and controlled throughout the process. Traditional theories place greater emphasis on process control while relatively neglecting goal orientation. This paper proposes adopting the concept of “design equals cost” and “design equals investment” in transport projects, implementing target cost management during the design phase: the client takes the lead in setting the project's target cost and consolidating it into control indicators for each stage (investment decision, design estimate, construction budget, etc.). Through contracts, the target cost is broken down and assigned to all design and construction participants, reinforcing each party's cost responsibility. This innovation fosters consistent cost control orientation throughout the entire process, preventing fragmented approaches across different stages[13].In summary, addressing shortcomings in existing theories, this paper proposes enhancements and innovations in areas such as full lifecycle integration, dynamic risk management, information integration, and target cost orientation. These innovative perspectives, developed through analysis of typical case studies, possess both theoretical foresight and practical feasibility, offering new insights and frameworks for cost management in transport infrastructure projects. The research innovation lies in constructing a more comprehensive theoretical model for whole-process cost management, accompanied by corresponding supporting measures, thereby laying the groundwork for subsequent in-depth research and practical application.

6. Conclusions and Outlook

6.1 Conclusions

This study systematically reviews literature, constructs theoretical models, and analyses case studies concerning whole-process cost management in transport infrastructure construction projects. Key conclusions are as follows: (1) Whole-process cost management is pivotal to ensuring the investment returns of large-scale infrastructure projects. Given the unprecedented scale of investment in high-speed railways, motorways, and urban rail transit projects, comprehensive cost control must be implemented throughout decision-making, design, construction, and operation phases to prevent cost overruns and ensure smooth project delivery with anticipated benefits. (2) Domestic and international research trends indicate that the concept of life-cycle costing and information technology are profoundly influencing cost management practices. Advanced Western approaches emphasise incorporating operational maintenance into cost decision-making and utilising LCC to optimise project solutions. Domestically, there is a growing emphasis on introducing tools such as BIM and big data to achieve refined and intelligent cost management. The comprehensive cost management theoretical model constructed in this paper integrates these new concepts, emphasising phase coordination, risk pre-control, and information integration, thereby refining existing theories. (3) Case studies validate the effectiveness of whole-process

ISSN: 3008-1394

cost management. Whether in large-scale railway projects like the Beijing-Shanghai High-Speed Railway or urban metro and expressway schemes, practice demonstrates that whole-process control significantly reduces cost overrun risks and enhances investment returns. These cases also reveal existing management shortcomings, confirming the necessity of the innovative strategies proposed herein.

6.2 Outlook

This research provides a new theoretical framework and practical insights for whole-process cost management in transport infrastructure projects, though further investigation remains warranted. (1) Quantitative impact studies of model application: Future research should quantitatively validate this model using extensive project data, assessing its efficacy in reducing cost overrun rates and enhancing investment efficiency, while optimising model parameters through statistical analysis. (2) Deep Integration of Digital Technologies: With advancements in the Internet of Things and artificial intelligence, future exploration should consider applying sensor monitoring and machine learning to cost management. For instance, training AI on engineering big data could enhance cost prediction accuracy and risk anticipation capabilities, representing a key direction for intelligent whole-process cost management[3]. (3) Integration of Policy Mechanisms with Cost Management: Infrastructure projects are frequently influenced by governmental oversight and investment policies[14]. Subsequent research may examine how institutional innovations—such as contractual incentive mechanisms or shared lifecycle cost arrangements under PPP frameworks—can support the implementation of whole-process cost management. This would foster a community of shared interests among project stakeholders, collectively bearing cost responsibilities. (4) Extension to Other Project Types: While this study focuses on transport infrastructure, the concept of whole-process cost management is equally applicable to major projects in water conservancy, energy, and other sectors. Future cross-sector comparative research could enrich and validate the universality of theoretical models.

Through deepening these research areas, we may further enhance the scientific rigour and effectiveness of cost management in large-scale engineering projects. In summary, this research provides innovative theoretical underpinnings and practical guidance for whole-process cost management in transport infrastructure projects, aiming to benefit both academia and engineering practice. Within the ‘Transportation Powerhouse’ development initiative, continuous innovation in cost management theory and practice will facilitate high-quality, sustainable infrastructure development. Future efforts will remain focused on emerging technologies and models within this field, ensuring the whole-process cost management theoretical framework evolves with contemporary demands.

References

[1] Ansar, A., Flyvbjerg, B., Budzier, A., & Lunn, D. (2016). Does infrastructure investment lead to economic growth or economic fragility? Evidence from China. Oxford Review of Economic Policy, 32(3), 360–390. https://doi.org/10.1093/oxrep/grw022

[2] International Organization for Standardization. (2017). ISO 15686-5:2017 Buildings and constructed assets — Service life planning — Part 5: Life-cycle costing (2nd ed.). ISO. https://www.iso.org/standard/61148.html

[3] Petroutsatou, K., Maravas, A., Saramourtsis, A., & Lianos, V. (2022). Modelling approaches of life cycle cost–benefit analysis of road infrastructure: A critical review and future directions. Buildings, 13(1), 94. https://doi.org/10.3390/buildings13010094

[4] Farouk, A. M., & Rahman, R. A. (2025). Integrated applications of building information modeling in project cost management: A systematic review. Journal of Engineering, Design and Technology, 23(1), 287–305. https://doi.org/10.1108/JEDT-10-2022-0538

[5] Yin, Y. (2013). Project cost estimation and control. China Planning Press. (Original work published in Chinese)

[6] Ren, G., & Yin, Y. (2003). Research on whole life-cycle project cost management based on paradigm conversion perspective.China Soft Science, (5), 148–151.

[7] 国务院办公厅. (2017). 关于促进建筑业持续健康发展的意见 [Guidance on promoting the sustainable and healthy development of the construction industry]. 国办发〔2017〕19号. http://www.gov.cn/zhengce/content/2017-02/24/content_5170625.htm

[8] Zoeteman, A. (2001). Life cycle cost analysis for managing rail infrastructure: Concept of a decision support system for railway design and maintenance. European Journal of Transport and Infrastructure Research, 1(4), 391–413. https://doi.org/10.18757/ejtir.2001.1.4.3506

[9] Pishdad-Bozorgi, N., Gudnason, K., & Komeily, A. (2024). Analysis of 5D BIM for cost estimation, scheduling, and payments automation in construction. Proceedings of the International Conference on Computing in Civil and Building Engineering, 1–8. https://doi.org/10.35490/EC3.2024.242

[10] Love, P. E. D., Matthews, J., Simpson, I., Hill, A., & Olatunji, O. A. (2016). Real-time remote cost monitoring of structural steel fabrication for commercial building projects using 5D BIM. International Journal of Project Management, 34(1), 102–113. https://doi.org/10.1016/j.ijproman.2015.09.007

[11] World Bank. (2019). China's high-speed rail development (International Development in Focus). World Bank Group. https://doi.org/10.1596/978-1-4648-1425-9

[12] Shoar, S., Yiu, T. W., Payan, S., & Parchamijalal, M. (2023). Modeling cost overrun in building construction projects using the interpretive structural modeling approach: A developing country perspective. Engineering, Construction and Architectural Management, 30(2), 365–392. https://doi.org/10.1108/ECAM-08-2021-0732

[13] Do, D., Chen, C., Ballard, G., & Tommelein, I.D. (2014). Target Value Design as a Method for Controlling Project Cost Overruns.

[14] Hunt, D. V. L., Nash, D., & Rogers, C. D. F. (2014). PPP cost-sharing of multi-purpose utility tunnels. In Sustainable Bridge Structures (pp. 285–296). Springer. https://doi.org/10.1007/978-3-319-91635-4_29