

Innovative Approaches to Construction Cost Management Under Policy Orientation

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Abstract: Construction cost management in China is entering a period of structural adjustment driven by national policy, in which market-based pricing reform, whole-process cost control, and green development requirements are reshaping the way construction costs are planned, monitored, and settled. This paper examines how these policy orientations can be translated into practical and innovative cost management approaches for construction projects. Based on a review of recent empirical studies of cost overruns and digital cost control, the paper analyzes the persistent weaknesses of traditional cost management, including fragmented stage-based control, reliance on outdated government pricing benchmarks, and weak dynamic monitoring during the construction phase. It then proposes an integrated framework that combines whole-process cost management, Building Information Modeling (BIM) enabled cost control, enterprise pricing databases, and dynamic cost early-warning mechanisms. The framework maps each policy instrument to a concrete management response and identifies the institutional conditions required for implementation, such as contract design, data governance, and personnel capability. The analysis indicates that BIM-based cost control can substantially improve the accuracy of cost estimation and the timeliness of cost information, while enterprise quota databases allow cost determination to keep pace with market fluctuations. The paper concludes that policy-oriented cost management innovation depends on the coordinated upgrading of technology, institutions, and professional capabilities, and offers a reference path for construction enterprises adapting to the reformed pricing environment.

Keywords: Construction Cost Management; Policy Orientation; Whole-Process Cost Control; Building Information Modeling;

Cost Overrun Prevention

1. Introduction

The construction industry remains one of the largest contributors to fixed asset investment in China, and the cost of construction projects directly affects the efficiency of public spending and the profitability of enterprises. In recent years, the policy environment surrounding construction cost has changed markedly. The General Office of the Ministry of Housing and Urban-Rural Development issued the Work Plan for Engineering Cost Reform in 2020, which calls for a market-based price formation mechanism, expanded pricing autonomy for enterprises, and strengthened cost data services across the whole life cycle of projects [4]. At the same time, requirements for green and low-carbon construction have added new cost items that traditional management systems were not designed to capture. Against this background, cost management is no longer a narrow technical activity of preparing budgets; it has become a comprehensive management task shaped by policy orientation.

Cost overruns, however, continue to be a persistent problem in construction practice. Flyvbjerg described the "iron law" of megaprojects, namely that they are consistently over budget, over time, and over and over again, and attributed this pattern to the interplay of technological, political, economic, and aesthetic incentives [1]. Similar evidence exists in infrastructure construction: Odeck documented systematic cost overruns in road projects and traced their determinants to project size, estimation routines, and the incentives of the parties involved [2]. In China, studies of large construction projects have identified long lists of delay and cost-related causes spanning owner, contractor, and external factors [3]. These findings suggest that cost overrun is not an accidental event but the cumulative result of management weaknesses distributed across the entire project process.

Existing research has provided useful building blocks for improvement. Wang and Ghazali prioritized 65 cost overrun risk factors in high-rise residential projects in Chongqing and showed that low bidding prices, force majeure, inaccurate geological survey data, and rising loan interest rates carry the greatest weights [5]. Chen, Fan, and Cai integrated DEMATEL, ISM, and system dynamics to identify key driving factors of cost overrun in China's expressway projects and derived corresponding control measures [6]. A separate stream of studies has examined how Building Information Modeling (BIM) improves cost estimation accuracy and collaborative decision making [7, 8, 9]. What remains insufficiently addressed is how these scattered advances can be organized into a coherent cost management approach that responds directly to current policy requirements. This paper attempts to fill that gap: it analyzes the policy environment and the weaknesses of traditional practice, proposes a policy-oriented innovation framework, and discusses implementation pathways and safeguard conditions. The remainder of the paper is organized as follows. Section 2 reviews the policy environment and existing problems. Section 3 presents the innovative approaches. Section 4 discusses implementation pathways, Section 5 examines safeguards and limitations, and Section 6 concludes.

2. Policy Environment and Persistent Challenges

2.1 Policy Orientation in Construction Cost Management

Three policy strands currently define the direction of construction cost management in China. The first is market-based pricing reform. The 2020 work plan explicitly requires the improvement of engineering metering and pricing rules, the removal of mandatory pricing benchmarks where market mechanisms can function, and the establishment of enterprise-led quotation systems supported by credible cost data [4]. This shift changes the information base of cost management: instead of relying on government-issued quotas and unit prices, enterprises must accumulate their own historical cost data and develop internal quota systems that reflect their actual technology and management level. The second strand is whole-process cost control. Policy documents and industry

standards increasingly emphasize that cost determination and control should cover investment decision, design, bidding, construction, and completion settlement as a continuous chain, rather than being confined to budget preparation at a single stage. The third strand is green and low-carbon development. Green building requirements extend the accounting boundary of cost management to the operation stage, so that initial construction cost must be weighed against long-term energy and maintenance costs [10].

2.2 Weaknesses of Traditional Cost Management

Traditional cost management in construction enterprises was built around stage segmentation and static pricing. In practice, this produces several recurring weaknesses. First, cost information is fragmented. The feasibility study, design estimate, bid price, and construction budget are prepared by different parties with different tools, and the data are rarely connected, so deviations detected in one stage cannot be traced back to their causes in earlier stages. Second, pricing lags behind the market. When material prices fluctuate sharply, quotations based on outdated benchmark prices systematically misstate the true cost, which transfers risk to whichever party bears the price adjustment clause. Third, control during the construction phase is weak. Field studies show that the construction stage concentrates many critical cost overrun risk factors, such as inaccurate geological data and rising financing costs, yet on-site cost monitoring often consists of periodic manual reconciliation that identifies losses only after they have occurred [5]. Fourth, settlement disputes are frequent. Incomplete process records and inconsistent quantity measurement create room for claims and disputes, prolong final settlement, and erode the value of earlier cost planning. These weaknesses indicate that incremental adjustment is not enough; a systemic innovation of methods and supporting institutions is required.

3. Innovative Approaches to Cost Management Under Policy Orientation

3.1 Whole-Process Cost Management Framework

The first innovation is to reorganize cost management as a continuous whole-process

activity. In the decision-making stage, cost management shifts from simple per-unit estimation to multi-scenario investment analysis, in which alternative schemes are compared on both initial cost and life-cycle cost. In the design stage, limit design is enforced through target cost decomposition: the approved investment is allocated to structural, architectural, and mechanical systems, and design schemes are selected and optimized against these targets, which addresses the fact that design decisions largely fix the final cost before construction begins. In the bidding stage, bill of quantities preparation and contract risk allocation are treated as cost management tools rather than administrative tasks, so that price adjustment clauses, unpriced items, and change valuation rules are set in accordance with the risk each party is best able to control. In the construction stage, cost control is embedded in daily project management through planned value allocation and monthly cost variance analysis. In the completion stage, process data accumulated in earlier stages are reused for settlement, which shortens settlement time and reduces disputes. The essential feature of this framework is data continuity: the same structured cost baseline is established before construction and progressively updated, so that every stage works on one consistent version of cost truth.

3.2 BIM-Enabled Cost Control

The second innovation is the use of Building Information Modeling as the technical carrier of whole-process cost management. BIM integrates geometric, physical, and commercial data of building components in one model, which directly supports quantity takeoff, cost estimation, and change impact analysis [8, 9]. Recent empirical evidence confirms its value for cost control. Zhang proposed a BIM-based cost control strategy with a risk identification algorithm and reported that the identification accuracy reached 99.7 percent and that the method significantly reduced cost expenditure in engineering projects [7]. Nsimbe and Di examined the Mombasa Port Area Development Project through a mixed-method study of 69 professionals and found that BIM improves cost estimation accuracy, facilitates the identification of cost-related risks, and promotes collaborative decision making among stakeholders [8]. In practical terms, BIM contributes to cost management at three levels. At the estimation

level, model-based quantity extraction replaces manual measurement, reducing arithmetic errors and the workload of recalculation after design changes. At the process level, the model links schedule and cost data, so that monthly planned values can be generated automatically and actual expenditure can be compared against them at component level, enabling early warning rather than after-the-fact accounting. At the collaboration level, owner, designer, and contractor work on a shared model, which reduces the information asymmetry that traditionally fuels claims and disputes. For construction enterprises, the practical entry point is to apply BIM first to collision detection and quantity extraction in the design and bidding stages, where benefits are immediate, and then extend model-based cost tracking to the construction stage as data management capability matures.

3.3 Enterprise Pricing Databases and Dynamic Risk Response

The third innovation responds directly to market-based pricing reform: building enterprise pricing databases and a dynamic cost early-warning mechanism. An enterprise quota database accumulates actual labor, material, and machinery consumption from completed projects, adjusted to standard working conditions, so that future quotations reflect the enterprise's real productivity rather than generalized government benchmarks. Combined with a price information system that tracks market prices of steel, cement, and other dominant materials, the database supports rapid re-pricing when market conditions change. The dynamic early-warning mechanism complements this by defining cost variance thresholds at activity and project level; when actual cost deviates from planned value beyond the threshold, the responsible department must analyze causes and submit corrective measures within a defined period. Risk-oriented studies provide useful guidance for prioritizing response. Wang and Ghazali showed that control measures for critical factors such as low bidding prices and rising loan interest rates need to combine bidding-stage discipline with financing-stage planning [5]. Chen, Fan, and Cai demonstrated that cost overrun factors interact across stakeholder groups, so that effective measures must be coordinated rather than applied in isolation [6]. Table 1 summarizes how the proposed approaches correspond to current

policy instruments.

Table 1. Policy Instruments and Corresponding Cost Management Innovations

Policy Instrument	Management Requirement	Innovation Response
Market-based pricing reform	Enterprise-led quotation and market pricing	Enterprise quota database and dynamic price information system
Whole-process cost control	Cost data continuity across all project stages	Unified cost baseline with progressive updating and stage linkage
Digital transformation of the industry	Information integration among project participants	BIM-based quantity takeoff, cost tracking, and collaborative change management
Green and low-carbon construction	Life-cycle cost accounting	Carbon and operation cost items embedded in design-stage comparison

4. Implementation Pathways

4.1 Organizational and Contractual Measures

Method innovation alone does not change outcomes unless the organization and contracts support it. At the enterprise level, a cost management committee should integrate the previously separate functions of bidding, design coordination, project finance, and settlement so that the whole-process framework has an organizational owner. Project-level cost responsibility is defined through target cost contracting: the project department signs an internal target cost agreement with the enterprise, and the variance between target and actual cost becomes the basis of performance evaluation. At the inter-organizational level, contract design must allocate risks to the parties best able to manage them. The critical factors identified in recent studies, such as low bidding prices and inaccurate geological survey data, can be mitigated contractually through reasonable bid evaluation methods, joint site investigation procedures, and clear price adjustment clauses for major material fluctuations [5, 6]. For projects delivered under general contracting, milestone-linked measurement and payment rules should be written into the contract so that model-based quantity data are accepted as the settlement basis, which in turn gives all parties an incentive to maintain the shared data.

4.2 Dynamic Monitoring and Data Governance

The operational core of implementation is a monitoring loop with defined frequency and responsibility. Cost data from invoices, subcontract settlements, and site records are entered weekly; variance analysis is performed monthly at activity level; and a quarterly review consolidates project-level trends into enterprise-level database updates. Data governance determines whether this loop works. Uniform coding of work items across estimation, contract, and accounting systems is a prerequisite for tracing variances to their causes, and model-based quantity data must be version-controlled so that every cost report can state which model revision it refers to. Personnel capability is equally important: cost engineers need training in model-based measurement and data analysis, and project managers need to treat cost variance signals as management instructions rather than accounting reports. Where enterprise resources are limited, implementation can start with pilot projects that apply the full framework, and the validated coding rules, quota data, and variance thresholds are then rolled out enterprise-wide.

5. Discussion

5.1 Synergies and Barriers

The three approaches reinforce one another. Whole-process management defines what data must be continuous; BIM provides the carrier that keeps geometric and commercial data consistent; and enterprise databases give the reformed market-based pricing a workable information base. Policy orientation supplies the external pressure that makes the investment in these capabilities worthwhile, since enterprises that retain outdated pricing routines will submit quotations that neither win bids nor cover costs. The barriers, however, are real. Model-based cost tracking requires upfront investment in software and training, and its benefits accrue over multiple projects, which discourages short-cycle thinking. Data sharing among owner, designer, and contractor raises concerns about commercial confidentiality that contract terms must address explicitly. In addition, the accuracy claims reported in BIM studies depend on modeling quality and disciplined updating; a stale model produces misleading cost information faster than a well-run manual

process. Enterprises should therefore treat technology adoption as an organizational change program with phased targets, rather than a one-time software purchase.

5.2 Limitations and Future Research

This paper is a mechanism-oriented analysis based on published empirical evidence rather than a statistical evaluation of a specific sample, so the framework should be validated through enterprise-level case application. Future research can quantify the cost effect of the proposed framework by comparing matched projects before and after implementation, examine how enterprise quota databases perform under sharp material price cycles, and extend the accounting boundary to operation-stage carbon costs as green construction policies tighten. The transferability of the framework to small and medium-sized contractors, whose data accumulation capacity is limited, also deserves attention.

6. Conclusion

Under the combined orientation of market-based pricing reform, whole-process cost control, and green development, construction cost management must move from static, stage-segmented budgeting to continuous, data-driven control. This paper proposed an integrated framework built on three innovations: a whole-process cost management structure with one consistent cost baseline, BIM-enabled cost estimation and dynamic tracking, and enterprise pricing databases supported by a cost early-warning mechanism. Evidence from recent studies indicates that these approaches can materially improve the accuracy of cost estimation and the timeliness of risk identification, while their effectiveness depends on organizational ownership, contract-based risk allocation, and disciplined data governance. For construction enterprises, the practical path is to start with pilot projects, accumulate validated cost data, and extend the framework progressively. As pricing reform deepens, the competitive position of construction enterprises will increasingly rest on the quality of their cost data and the speed with which that data is converted into management action.

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