

Research on the Application of Whole-Process Engineering Cost Consultation in Construction Project Management

Mei Zhao

Anhui Antai lixin Engineering Management Co., Ltd., Hefei, Anhui, 230000, China

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Abstract: The cost management of construction projects is often fragmented among different stages, and lacks coordination, which creates problems such as "creative overspending", "uncertain changes" and "reconciliation chaos", just like a travel without guiding introduction easily goes off the cost line. This article explores the application of whole-process engineering cost consultation in construction projects from the perspective of whole-life cycle collaboration. It includes investment estimation in the decision-making stage, quota control in the design stage, dynamic adjusts during construction stage and close-loop review after the completion and settlement. The research demonstrates how consulting firms implement the processes of "precision, penetration, real-time monitoring and rigor" in all stages including barriers to cost management.

1. Introduction

Think of a construction project as an intricate long-distance journey from the conception of blueprints through mid-construction progress and eventually completing final settlement. Each step is vulnerable to a deception known as "cost misdirection." Like an orchestra without a conductor, the siloed management style will not only create learning but will ensure it is discordant no matter how fine the instruments. Through whole-process engineering cost consultation, reasonable boundaries are established for creativity during the design phase, unintended expense risks during construction are quickly identified and controlled, and all expenses have a clearer definition during settlement. Cost management for construction projects is transformed from "remedial action" into "proactive planning" by using cohesive services to remove barriers between phases, enabling construction programs the possibility of their highest quality/efficiency balance.

2. Core Content of Whole-Process Engineering Cost Consultation

Whole-process engineering cost consultation¹ refers to the work of consulting agencies to perform professional cost management along the key links of the project life cycle from initiation to completion. This enables management: Keeps project costs under control and avoids disconnects across phases as well as cost overruns ^[1].

The consulting agency and the owner negotiate investment scale, expected return on investment and functional positioning. It compiles current prices of construction material, labor, and equipment rental with cost experiences on comparable projects to produce a true investment estimation report.

During the design phase, a consulting agency also becomes deeply involved in the overall design process and brings up limit design to the actual designers. And it divides cost control targets into design nodes according to the investment estimation made during the decision-making stage (e.g., building structure, finishing standards, equipment selection). It then provides optimization recommendations for potential cost wastage in the design scheme, including advice on how to change structural forms to save on material usage while keeping safety ensured. During the bidding stage, the consulting agency should accurately prepare tender control prices based on construction drawings and industry standards to establish reasonable upper limits for tender prices to prevent each bidding unit from using high-price bids or maliciously low-priced competition to disrupt the normal tender process. This facilitates the owner to go through most cost-related clauses in tender

documents earlier and to specify methods of adjusting contract prices, payment ratio as well as duration for progress payments so that disputes related to contracts can be minimized during construction ^[2]. After bid opening, the consulting agency conducts quote composition analysis for each bidding unit in the bid evaluation stage, analyzes whether quotes are reasonable and whether items are missing or inflated, provides professional advice and suggestions to assist the owner in selecting cost-effective contractors.

Construction stage, as the time when cost control is at its peak, even more so during this phase, the consulting agency regularly visits sites to ensure progress is on schedule determining if the quantities completed are in accordance with construction drawings checked against progress payment applications submitted by contractors. This ties the payment amounts to the actual progress so that you neither overpay nor underpay. Meanwhile, in case there are changes in engineering change or request for site visa, the consulting agency will calculate and estimate cost (cost and time) quickly as well as assess its impact on total project loss; thereby giving direction to owners of overall project on control costs, preventing change from becoming a cause of excessive costs.

At the completion and settlement stage, consulting agency reviews all quantity-based settlement documents provided by contractors to verify that calculated quantities are in line with unit prices specified in contracts and confirm fees among other issues. The consulting agency plays communication and mediation in disputes between the owner and contractors, negotiating based on actual conditions of project site and relevant regulations to achieve agreement. Eventually, the agency issues a complete settlement review report indicates the clear and accurate cost basis for the owner to finalize project cost accounting and asset handover.

3. Application of Whole-Process Engineering Cost Consultation in Various Stages of Construction Projects

3.1 "Precision in Investment Estimation" to Avoid Cost Mismatch Risks

At the decision-making stage of a construction project, whole-process engineering cost consultation agencies take "precision in investment estimation" as a core strategy to prevent the occurrence of risk due to cost mismatch from the very beginning. It confirms the maximum investment possible from the owner, and its prioritization of core functional requirements (e.g., a commercial project would define the spaces needed such as office space or storage areas; 100 square meters per unit for example in residential projects, practicality rates, etc.) to ensure that it can meet all the needs presented by its operators ^[3]. The agency then does multi-dimensional data research and collects current market prices for building materials, labor quotes, equipment rental costs at the project location, along with a cost fluctuation from past period trends in next 6–12 months as sourced through industry databases. It draws on cost cases from 3–5 comparable projects in the same area while excluding unique market conditions. According to this data, the agency can provide a modular investment estimation report (for example, disassemble a commercial complex project into civil engineering module, mechanical and electrical installation module, decoration module and landscaping module). It computes the cost ratio of each module, compares upfront and eventual operation & maintenance costs of different technical alternatives (e.g. steel vs concrete structures) and highlights critical cost points for each plan. Last but not least, the agency helps the owner conduct a feasibility analysis to see if expected returns can be obtained at current costs. In another practical embodiment of the system, when a module's quote exceeds the proper range (i.e. far outside a reasonable price for decorations), optimization directions are directly given to design from early stage on: Over segmenting might cause high model cost, discussed generally before → provide optimizing direction at concept level and together with categories to inform about excessive component category, or too far & wasteful reshape. Also, the agency adds a necessary buffer to the estimate for any potential hidden costs like underground obstacle removal fees in old plots or winter construction anti-freezing measures in special climate zones in order to avoid cost overruns caused by missing out expenses. It also employs "scenario simulation" to stress test the estimation results based on extreme situations such as a sharp rise in material price or sudden changes in policies,

studies their impact on total investment and proactively formulates contingency plans.

3.2 "Penetration of Limit Design" to Eliminate Source Waste

In the stage of design, full-process engineering cost consultation organization practice "design limit penetration," putting forward demand on cost control during the entire process of design, eliminating source waste. In operational terms, the agency decomposes total cost target from the decision stage to specific limit indicators by disciplines and phases. It breaks down the cost per square meter for aspects such as structural engineering and exterior wall decoration in residential projects, relays these parameters in written format to the design team, and makes it clear whether there are any experienced cost constraints ^[4]. The agency interjects at the same time during the schematic design stage, as cost pre-evaluations take place on initial plans provided by the design team. Once cost wastage is detected within specific design details (e.g., feature corridors that are too long resulting in reduced spatial utilization, material selections beyond limit standards), it synchronously communicates with the design team to propose alternatives; under certain circumstances, such as replacing the curved bay windows with right-angle ones to reduce construction difficulty and costs, or recommending economical material replacements. In the construction drawing design stage, the agency does detailed checks, that means comparing quantities, material specifications, process requirements in drawings with limit indicators. It helps the design team optimise the design parameters (e.g., increasing or decreasing the thickness of the waterproof layer, selecting more economical waterproof membranes), if a sub-project related to some elements has its limit exceeded at that stage; for example, roof waterproofing. At the same time, it makes a construction drawing budget, making limits comparison against limit indicators to control the budget within limits as far as possible and locking project costs at design stage.

3.3 "Real-Time Dynamic Control" to Stabilize Cost Fluctuations

There are many conditions that can impact costs during construction stage. Whole-process engineering cost consultation agencies establish the "dynamic control, real-time management" strategy dynamically to timely deal with the fluctuation of costs and stabilize project cost curve ^[5]. First, the agency sets up a progress payment review mechanism. Each month, upon receiving applications for progress payments from contractors, it sends professionals to take a close look and compare construction drawings with those provided in the progress plans, check actual quantities of completed work against written specifications and verify compliance with contract quality requirements ^[6]. The second is setting up a rapid response process for frequent changes and visa requests during construction: within 24 hours of receiving a change or visa request, it sends personnel to the site to verify the situation, determine whether the change is necessary and accurately calculate the cost of the change. The owner immediately gets notified if the change would lead to total cost overruns ^[7]. It also supplies 2–3 alternate solutions for the owner to select from, saving confusion over modification costs. Its audit for visas, is mainly to review the authenticity of content and completeness of procedures, to avoid contractors who can use fake visas to obtain fees. And third, the agency regularly updates the cost data for various markets on a weekly basis to reflect higher or lower prices for materials and labor. For example, if the price of a key material (e.g., steel, cement) increases more than 5%, it quickly queries the impact on total project cost and proactively provides countermeasures to the owner (i.e. suggest bulk purchasing in advance to lock prices, sign long-term supply agreements with suppliers). This keeps fluctuations in cost manageable. The project cost management ledger was developed from synchronizing site verification data, changes in visa records and market costs fluctuations information by the agency. It forms a dynamic cost database. It sends a weekly cost report to the owner, which shows variances between actual costs and target costs as well as reasons for variances. In the case of deviation approaching warning line, it arranges time to hold cost joint coordination meeting with construction party and supervision unit at first time to work out targeted response plan which realizes early prediction of cost risk and timely resolution, fully stabilizing project cost fluctuation curve.

3.4 "Rigorous Closed-Loop Review" to Safeguard the Final Cost Baseline

The completion and settlement stage, the last link in cost management, is managed by a whole-process engineering cost consultation agency through the application of a "rigorous closed-loop review" principle. First of all, the agency is very careful in checking whether the settlement materials are complete and compliance: after receiving the contractor to provide the settlement information (as-built drawings, quantity calculation book, visa form, contract, material invoice and other documents), check whether all documents are complete. It checks if the signing and sealing of as-built drawings is signed, sealed by the design unit, if visa forms are confirmed by the owner, supervisor or not and whether or not material invoices conform with brand specifications in the contract. Some documents are missing (e.g., visa forms for a sub-project) or suspected of frauds (e.g., invoice amounts significantly deviate from market prices), requiring the contractor to supplement or prove until the documents meet review requirements. Second, the agency reviews costs in detail: refers to as-built drawings and contract agreements, re-calculates quantities of each sub-project (earthwork excavation at roadbeds; pavement area at the road surface), checks whether unit prices used are accurate applied per areas of unit price(i.e. atmosphere compliance with contract rated standards)and cross-sectional representative surfaces compare check fee appropriate (i.e regulatory fees; tax). Where a contractor has overestimated quantities, inflated unit prices or double-billed items, the agency specifies item by item its reasons for adjusting the amounts and communicates with the contractor to verify them. Third, the agency that mediates negotiations between an owner and contractor based on terms of contract as well as industry standards for dispute resolution. In cases of disputes related to quality deductions, it verifies the on-site actual or potential impact of quality issues and provides objective mediation solutions based on contract-defined deduction standards by promoting consensus between both parties [8]. Finally, the agency will issue a formal settlement review report, including review results, adjustment details, and calculation basis and it also forms an entire closed loop from document review to dispute resolution and result output. This guarantees the authenticity and correctness of various settlement results, which is an important basis for the owner to complete project cost accounting.

4. Conclusion

As construction projects have gradually been implemented, the cost management model has shifted from the previous approach—where each party managed only its own segment—to a full-process construction cost consulting model. The transition from “fragmented control” to “full-chain collaboration” is intended to alleviate the pain points of traditional cost management like “but a universal flaw in traditional cost management, ‘many loopholes, slow response, large disputes’”. It also allows construction projects to realize technical cost-saving and meet the functional requirements and quality. With the in-depth integration of digital technology and cost consultation, the service model throughout the whole process may be further upgraded in the future, providing stronger support for constructing a new management mode integrating quality-cost-effectiveness in construction industry. This will lead the industry to a more refined development of stable and effective outreach.

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