

Research on the Application of Bidding and Evaluation Methods in Construction Engineering

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Abstract: This article researches the application of methods in the bidding and evaluation of construction engineering projects. It discusses four application approaches: quantitative scoring by weight in the comprehensive evaluation method, screening via the reviewed lowest bid price method, defining the quotation range using the reasonable low price method, and commercial bid ranking under a technically qualified system. It analyzes the operational processes and applicable scenarios of each method. Furthermore, it explores three optimization strategies: refining evaluation indicators to reduce subjective bias, dynamically adjusting weights to suit project needs, and introducing big data to assist review decisions, proposing targeted implementation paths. The aim is to demonstrate that by scientifically selecting evaluation methods combined with optimization strategies, the problems of traditional methods being disconnected from project requirements, insufficient review fairness, and low efficiency can be solved, achieving the effects of improving evaluation accuracy, ensuring review fairness, and increasing bidding efficiency, thereby providing practical reference for the standardized conduct of bidding and evaluation work in construction engineering.

1. Introduction

Bidding and evaluation in construction engineering are important links to guarantee the quality of project implementation and selecting high-quality contractors, which will directly affect the later stage of building effect of the project. Currently, among the industry, some of projects are so called "one-size-fits-all" way of choice of evaluational methods. Even though you have technically complex projects but you mostly use cost-directed methods like the least price process, this will result in contractors being chosen without a sufficient technical ability. At the same time, traditional evaluation takes manual judgment as its basis which is subject to a substantial amount of subjective bias and does not have efficient tool support throughout the review process leads to low efficiency and poor record keeping. Targeted and thorough study on the methods for application, optimization strategies and exploration of paths to improvement of evaluation quality regarding bidding and evaluation in construction engineering, which clarifies the applicable conditions or operational key points of each method is highly significant to standardize the bidding process, prevent risks during bidding procedure and ensure project construction quality.

2. Application Methods of Bidding and Evaluation in Construction Engineering

2.1 Quantitative Scoring by Weight in the Comprehensive Evaluation Method

Perform weight-setting: Determine the technical and commercial bid ratios during tender documentation based on your project type and key specifications. For projects that are difficult from a technical standpoint, use 60% for Technical Bid and 40% for Commercial Bid; while for conventional projects assign the bids 40%-60%, respectively. Weights need to be announced in tender documents themselves so that there is no dispute when weights change later. Perform the indicator refinement: Decompose technical bid into 4 level-1 indicators: construction plan, quality control, safety assurance and resource allocation. Each indicator is broken down into sub-items that

can be evaluated. E.g. "Construction Plan" is developed into "Reasonableness of Schedule(max 20 points and 5 points will be deducted for one speed node over three days before paying"- -Max15 points, by adopting the new industry technology,three points will be added each time)- -- The commercial bid is divided into three first-level indicators: the quotation deviation, the commitment to construction period, and payment terms. E.g., "Quotation Deviation" sets a rule that deducts 2 points for every 1% deviation from the benchmark price, higher score are those with smaller deviation. All sub-items should be defined with a range of scores possible (e.g. basic, intermediate and advanced) and band of point deduction so as not to allow scope for discretion from reviewers based on subjective factor. Conduct item-wise evaluation: Evaluators are grouped to independently evaluate technical and commercial bids. At technical bid review step, verify the responsiveness of original bid documents against these refined indicators one by one. "Quality Control": If there is no special testing plan, score 0 on this item; otherwise mark whether a special testing plan was provided. In commercial bid review, determine how far each bidder's quote deviates from the benchmark price and convert that difference into a score according to rules automatically. Evaluation record forms must be prepared throughout the review period, mentioning the reason for deduction. Total score calculation: The system sums the item scores (technical and commercial) from each evaluator, discards the highest and lowest scores, takes the average, and upon passing this score to a total score function which calculates with preset weights (Total Score = Average Technical Score Weight + Average Commercial Score Weight). Determine the top 3 winners by ranking the bidders high to low on total score At the same time, you must also create an evaluation report that details how scores were calculated and basis of ranking of each bidder.

2.2 Screening via the Reviewed Lowest Bid Price Method

Perform substantive analysis : Evaluators will sift through the bids to ascertain bidder qualifications, technical documents and commercial commitments all confirmed according to tender document. Bid documents will be checked for substantial non-compliance, with an outright rejection of bids that are not compliant entering the next stage ^[1]. Record management dictates that review results have to be formally written and signed off by the evaluators to verify. Implementation of price correction: Correcting arithmetic mistakes in the quotes of compliant bidders. When the unit price does not match with the total price, set total price according to the unit price. When the quantity and unit price multiplied is wrong, do it again using the right number of items. The bidder must be advised in writing to confirm the corrected price. If the bidder does not object, the review moves on to release it with a corrected price and must still go through offering the following step that would offer some level of protection of extreme monetary aspects, but if there is an objection by any party and an amicable resolution cannot be achieved, the bid is rejected. Deduct usable non-competitive costs: If there are any other parts of the proposal which are not re-quoted by a competitor e.g. provisional sums, dayworks or provisional estimates for specialist works etc then these should be removed from the adjusted offer leaving only competitive elements such as quantifiable work items and preliminaries. That allows the bidder's true competitive price to be reflected in its reviewed price. The deduction process should to the letter follow how the cost is structured as agreed in the tender documents for omissions and errors ^[2]. Price in ranking: Arrange the evaluated prices (based on deducting non-competitive costs) from low to high. Choose the one with lowest price reviewed in bidding as the first winning candidate. In cases where two or more bidders have the same lowest price, their technical documents will be compared to the highest completeness and those with better technology will rank. After that, you will form the rank result, and in the evaluation report, you enter the cost deduction details as well as reasons for ranking.

2.3 Defining Quotation Range Using the Reasonable Low Price Method

Benchmark Price Calculation: Valid bid prices are all prices > the cost price, < maximum limit price; Bid threshold, then select a benchmark price = arithmetic average after removing the highest and lowest bid or weighted average The process of calculating should be supervised together by the evaluators and a representative of the authority that is tendering, all registered in real time through an input in to a review system which will create a log for each calculation so that

any benchmark price is traceable^[3]. The second step is to determine a reasonable quotation range: Set the quotation range according to the project type based on a certain benchmark price: for residential projects, set $\pm 5\%$ of the benchmark price; For municipal projects $\pm 6\%$. This should be defined beforehand in the tender documents to avoid engineering adjustments during review. Any bid prices outside this range will be directly classified as "unreasonable quotes" and preserved from further consideration. Double-stage evaluation: First, determine whether the technical bid within range is qualified, and examine if the construction plan meets basic project technical requirements, as well as assess whether safety measures are adequate. Even if the price is within the band, bidders with technically disqualified bids are knocked out. After that, price assessment remains for the rest of technically qualified bidders where their bid will be evaluated against the benchmark price with a differentiation wherein lower deviation from the benchmark price is given a higher preference. At the same time, see it achieves this price development in a way that is not predatory and undercutting cost-price^[4]. Best winning candidate selection: Technically qualified and price closest to Benchmark price. If two bidders have the same deviation value, compare their performance bond amounts or enterprise credit ratings together. Last, identify the top 3 winning winners and describe how to calculate the benchmark price, how to set their ranges and cite reasons for rejection in the evaluation report.

2.4 Commercial Bid Ranking Under a Technically Qualified System

Carry out technical bid evaluation: The evaluator conducts a detailed compliance examination against the relevant compliance articles in the bidding documents for items such as construction qualification grade, special operation Personnel allocation, and whether there are any omissions in special construction plans. Bid documents not meeting qualification requirements, not following special plans for hazardous works or lacking safety assurance measures are simply classified as technically disadvantaged in the case of tender entry. In the review, tick marks are used to indicate responsiveness against each technical criteria, and reasons for disqualification must be provided^[5]. Longlisted stage: You are summarizing the result of technical bids and only retaining bidders who have passed it, to be evaluated by commercial ones. If a bidder has been disqualified on technical grounds, list them in the evaluation report along with the reasons and send the notification to bidders for signature confirmation. Bidders may raise an objection on site; evaluators must scrutinize the objections and return review opinions. Specific commercial bid evaluation: For bidders who have passed the technical test, make a comprehensive comparison of quotations, construction period, payment conditions, and performance bonds. Quotation review involves verifying mathematical errors and adherence to provisional sum agreements; construction period review compares the committed duration of a bid with any tender document requirements, awarding maximum bonus points for early completion; payment term review prioritises those options that would be in the best interests of the tendering authority; performance bond check includes both the amount and qualifications for issuing bank. Define norms per dimension in terms of scores and derive a commercial bid score against norm^[6]. Commercial bid score: Rank bidders by operational lease from high to low The first winning candidate is the one with the highest score. If scores are equal, evaluate the performance of both enterprises in similar projects started within these 3 years. The outcome of ranking is to be described in detail in the evaluation report which should have the commercial bid score breakdown and basis for ranking for each bidder such that the review should be done without any ambiguity or need for inference.

3. Optimization Strategies for the Application of Bidding and Evaluation Methods in Construction Engineering

3.1 Refining Evaluation Indicators to Reduce Subjective Bias

Identify core indicators that can be categorized and filtered based on the evaluation method. Extract the core review dimension of technical bids and commercial bids for different methods, such as evaluation method Comprehensive Evaluation Method Reasonable Low Price Method For

comprehensive evaluation methods, it mainly focuses on construction plan and quality control in technical bids and quotation and construction period in commercial bids, so some indicators cover the key review aspects. To use quantitative n-decomposition in each dimension to transform these abstract quantities into measures of smaller spatial units. E.g. split "Construction Plan" into "Schedule Reasonableness" and "Resource Allocation Adequacy". Elaboration of "Reasonableness of Schedule", define as "Key node deviation ≤ 3 days, full marks; extra 2 days deduction for each day." Be not vague with setting the standard for "Adequacy of Resource Allocation" → set it as "Full marks for mechanical equipment quantity compliance rate $\geq 90\%$ " [7], we set a metric for Adequacy of Resource Allocation to "Full marks if mechanical equipment quantity compliance rate 90% ". Clarify scoring rules and basis: Use annotation to mark out what you are scoring on, the deduction gradient for each sub-item with a visual scoring table. Dynamically calibrate indicators based on this and quarterly collect review feedback, readjust quantification standards for ambiguous indicators (within the scope of regulatory compliance with industry norms, the reserved quantitative ability of indicators has more room to adjust and set), and strive to achieve "regulatory compliance and conformity", reduce the differences in subjective discretion among evaluators.

3.2 Dynamically Adjusting Weights to Suit Project Needs

Set up project grade system: according to the technical difficulty(general residence, super-high-rise building, special engineering), investment scale (≤ 100 million CNY, 100-500 million CNY, >500 million CNY) and quality requirement (ordinary standard high-quality engineering Luban Prize target) are divided into several types [8]. Decide initial weight for each category: For technically complex projects, initially set technical bid to 60% and commercial bid to 40%, highlighting technical capability; For traditional residential projects, initially set technical bid to 40% and commercial bid at 60%, highlighting cost control; For larger-scale investment projects, appropriately increase the 'Payment Terms' weight in the "Payment Responsibility" of the Commercial Bid. Arrange expert demonstration to review the first weights by qualified experts with proposal for amendments based on learnings from a real project. The "Safety Assurance" sub-item can sometimes increase from 10% to 15% for certain engineering projects. Written opinions for archiving of the demonstration results. Implementation: The weights demonstrated to support would be added to the tender documents, defining the grounds of adjustment. While evaluating strictly compute scores using established weights and resist the temptation to make ad-hoc adjustments, ensure weights match your project needs very closely.

3.3 Introducing Big Data to Assist Review Decisions

Industry database: Track average quotes for similar types of projects across the past 3 years, enterprise performance scores and fluctuations in material prices by category. Data stored in the specific project type and by region At the same time, data such as enterprise qualification and discredit record is imported into government credit platforms to maximize authority of data sources and coverage rate. Establish a large data evaluation system: the system should have functions such as data comparison, risk early warning and automatic scoring, and realize the visualization of data to help evaluators make judgments quickly. Then, go for data in evaluation: When it comes to bid evaluation, the self-service system helps auto-fetch data from a database, compare bidder quotes with industry benchmark prices and prepare a "Quotation Reasonableness Analysis Report". It identifies "high-risk bidders" when combined with historical enterprise performance scores, serving as a reference for evaluator decisions. In addition, the system also calculates scores automatically to minimize human errors while calculating [9]. Preserve review traces the system logs every operation, data source, warning message: a complete review log. It generates an evaluation report with electronic signatures once the review is done. Logs and reports are archived at the same time and can be retrieved for verification as needed.

4. Conclusion

Counting the above analysis, Construction Engineering effective application of bidding and

evaluation methods in need of human multi factor: "method fit" + "process optimization". Each evaluation method of projects has a clear applicable scenario and operational logic: A weighted quantitative score comprehensive evaluation method is applicable to most technical complex high quality requirements projects, as it can comprehensively examine the bidder's technical strength from commercial perspective. The examined reviewed lowest bid price law targets compliant low prices in noncomplex initiatives with constant technical requirements, reinforcing cost control. The reasonable low price method adheres to the non-malicious low-price competition method, and gives a quotation range from two aspects of cost and technical reliability. Commercial bids are ranked under a technically qualified system first subject to technical thresholds, then commercial strength making this procurement type well suited for performance-based projects. The refinement of evaluation indicators can reduce the space for subjective discretion, the dynamic adjustment of weights can achieve accurate matching between method and project needs, and the introduction of big data technology can improve review efficiency and transparency.

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