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Empirical Assessment of the Operational Realities of Best-Value Procurement in Design-Build Transportation Projects

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Although best-value (BV) procurement has been increasingly adopted in design-build (DB) delivery, empirical evidence on the practical implementation of BV principles remains limited. This study examines the use of BV in DB projects by testing three hypotheses concerning (i) the extent of price dominance in BV evaluations, (ii) differences in schedule and cost outcomes across procurement methods, and (iii) variations in evaluator scoring patterns. Data from 42 highway construction projects (26 BV and 16 low-bid [LB]) were analyzed using Spearman's rank correlation, independent-samples t tests, and Wilcoxon rank-sum tests. The key findings show that final evaluation rankings in most BV projects exhibited perfect alignment with bid price rankings, indicating that award decisions were largely price-driven. No statistically significant differences in schedule growth were observed between price-dominant BV and LB projects; however, price-dominant BV projects exhibited lower cost growth, which reflects a partial influence of non-price criteria during pre-award planning. Furthermore, evaluator scoring patterns did not differ significantly between price-dominant BV and LB methods, as reflected in award margins and evaluation score variability. This study provides empirical insights into how BV procurement operates in practice, revealing constraints that limit value-oriented decision-making and underscoring the need for more robust evaluation approaches.

Keywords: Best-Value Procurement, Design-Build, Pre-Award Evaluation Practices, Project Performance, Scoring Behavior

Introduction

Public-sector construction procurement has increasingly shifted from the traditional lowest-bid-wins mentality toward more value-oriented selection methods (Nguyen et al. 2018). The best-value (BV) procurement approach allows owners to consider price alongside other factors such as contractor experience, technical capability, innovation, safety record, and workforce development programs. BV procurement is commonly defined as a process in which price and other key factors are jointly evaluated to enhance the long-term performance and value of construction projects (Scott et al. 2006). While BV procurement is formally defined as a balanced consideration of price and non-price criteria, limited empirical research has examined whether and to what extent this intent is realized during the proposal evaluation stage in practice.

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Several previous studies have examined the effectiveness of BV procurement, given its theoretical potential to improve project outcomes (Alleman et al. 2020; FHWA 2018; Oh et al. 2025a; Oh et al. 2025b; Oh et al. 2024; Scott et al. 2006). Early work by Scott et al. (2006) provided foundational evidence on BV procurement by reporting favorable schedule and cost performance outcomes, thereby establishing the potential benefits of BV relative to traditional procurement approaches. Subsequent studies have further explored BV effectiveness through outcome-based comparisons. For example, Alleman et al. (2020) found that design-build (DB) projects procured through a low-bid (LB) approach experienced greater cost increases than those procured through BV. Conversely, Oh et al. (2025a) found that DB/BV projects exhibited higher average schedule and cost growth than DB/LB projects, although these differences were not statistically significant. Specifically, the average schedule growth was 17.7% for DB/LB projects and 38.6% for DB/BV projects, while the average cost growth was 2.31% for DB/LB projects and 2.54% for DB/BV projects.

Despite these contributions, existing research has primarily focused on comparing project performance outcomes across procurement methods, offering limited insights into the evaluation and selection mechanisms through which BV award decisions are made. In particular, empirical evidence remains scarce regarding whether BV procurement functions as a genuinely value-driven selection process or instead effectively operates as a price-dominant mechanism in practice. Moreover, little is known about how such procurement characteristics are reflected in evaluator scoring behavior during the proposal evaluation stage.

To address these gaps, the present study focuses on DB projects where BV procurement has been increasingly adopted by transportation agencies seeking to balance cost considerations with nonprice factors. The study examines how BV implementation is manifested through evaluation practices, project performance, and evaluator behaviors. The research pursues three objectives: (i) to determine whether projects formally designated as BV actually use value-driven rather than price-dominant criteria; (ii) to compare project performance outcomes, including cost and schedule growth, across different procurement methods; and (iii) to assess whether the procurement approach influences evaluator scoring patterns, as indicated by winner margins and evaluation score variability. By fulfilling these goals, the study provides empirical evidence on the operational characteristics of BV procurement and offers insights to enhance its effectiveness, thereby improving project delivery performance in transportation construction projects.

Methodology

Data Collection and Preprocessing Procedures

This study utilized data from 42 highway projects delivered through the DB method and administered by a U.S. state transportation agency. Data were collected through direct collaboration with the agency and supplemented with publicly available information retrieved from the agency's official website. The collected projects span notice-to-proceed (NTP) years from 2010 to 2023 and were completed between 2011 and 2025. Data collection focused on three primary aspects: (i) project characteristics; (ii) bid-related data; and (iii) project delivery results.

Project characteristics included the procurement method, original contract amount, planned construction duration, and NTP year. Bid-related data were obtained from proposal evaluation records that included each bidder's scores for individual evaluation factors (e.g., cost, time, and technical nonprice criteria) and the final evaluation results. From these records, the study extracted data on the number of bidders, bid price rank, evaluation score rank, and each bidder's final score for every project. Because evaluation scoring systems varied by award criteria, all final evaluation scores were

normalized prior to analysis to ensure comparability across projects. Each bidder's final evaluation score was rescaled to a 0-1 range using min-max normalization. For projects evaluated under the weighted criteria method, where higher scores indicated better performance, standard min-max normalization was applied. For projects evaluated under the fixed-price, adjusted LB, or LB methods, where lower values indicated better performance, reverse min-max normalization was applied to maintain a consistent interpretation in which higher normalized scores represented better performance (SCDOT 2017). Project delivery results included the revised contract amount and actual construction duration, which were collected to assess project cost and schedule performance. Table 1 presents an overview of the variables derived from the collected project characteristics, bid-related data, and project delivery results.

Table 1. Definition of collected variables

Classification		**Description**
Project characteristics	Procurement method	Two procurement methods were considered within the DB framework: BV (26 projects) or LB (16 projects).
	Original contract amount ($)	Total contract value at the time of award. The average contract amount among the analyzed projects was $59,518,664.
	Planned construction duration (days)	Total number of days originally planned for construction completion. The average planned duration was 672 days.
	NTP year	The calendar year in which the NTP was issued.
Bid-related data	Number of bidders	Total number of contractors who submitted proposals for each project. The mean and median were both 3.
	Bid price rank	The rank of each bidder based on submitted bid price, where 1 represents the lowest bid.
	Evaluation score rank	The rank of each bidder based on the final evaluation score, where 1 represents the highest score.
	Evaluation score (0-1)	Normalized final score of each bidder in the proposal evaluation process, representing overall performance across evaluation factors. The scores were rescaled to a 0-1 range so that higher values indicate better performance regardless of the award criteria.
Project delivery results	Revised contract amount ($)	Final contract value reflecting all approved change orders and modifications during construction. The average revised contract amount is $65,402,409.
	Actual construction duration (days)	Total number of calendar days from NTP to substantial completion. The average actual duration is 890 days.

Measurement of Project Performance and Evaluator Scoring Patterns

Project performance under different procurement methods was analyzed in terms of schedule growth and cost growth. By using the variables listed in Table 1, including original contract amount, planned construction duration, revised contract amount, and actual construction duration, schedule growth was calculated as the percentage difference between the actual and planned construction durations, while cost growth was determined as the percentage difference between the revised and original contract amounts (Oh et al. 2025a).

To examine whether procurement methods lead to distinct evaluator scoring behaviors, this study employed two quantitative indicators, winner margin and evaluation score variability, as proxies for

scoring patterns. These indicators capture the extent to which evaluators differentiated among competing proposals within each project (Ballesteros-Pérez et al. 2016; Scott et al. 2006). The winner margin refers to the difference between the normalized final evaluation scores of the highest- and second highest-ranked bidders within a project. This metric represents how clearly evaluators distinguished the winning proposal from its closest competitor, with a larger margin indicating a more decisive preference for the selected proposal. The evaluation score variability quantifies the dispersion of normalized final evaluation scores among all bidders within each project. This measure reflects how widely evaluators differentiated across competing proposals and was calculated as the standard deviation of bidders' normalized final scores. Higher variability indicates greater differentiation among competing proposals as reflected in evaluators' scores.

Statistical Testing of Hypotheses

Research Hypotheses

This study examined whether BV procurement in DB projects operated as a genuinely value-oriented evaluation process and whether differences in procurement methods were associated with variations in project outcomes and evaluator scoring patterns. Based on these objectives, three hypotheses were established to guide the statistical analysis.

- Hypothesis 1: Within BV projects, the association between bid price rank and final evaluation score rank varies across projects, reflecting differing degrees of price dominance in the evaluation process. Consistent with the intended logic of BV procurement, this hypothesis expects that bid price and final evaluation rankings will not be perfectly aligned in most BV projects, indicating a reduced reliance on price in the final selection process.
- Hypothesis 2: Project performance, measured by schedule growth and cost growth, differs across procurement methods. This hypothesis assesses whether variations in procurement approaches translate into measurable differences in project delivery performance.
- Hypothesis 3: Evaluator scoring patterns, measured by winner margin and evaluation score variability, differ across procurement methods. Specifically, BV projects are expected to exhibit larger winner margins and greater score variability than LB projects, indicating that evaluators in BV settings may have more clearly differentiated among competing proposals compared to those in price-driven evaluations.

Rank-Based Analysis of Price Influence in BV Evaluations

To examine the first hypothesis, which investigates the extent to which bid price influences the final evaluation results in BV projects, Spearman's rank correlation analysis was conducted between the bid price rank and the final evaluation score rank for each project. Spearman's correlation coefficient (ρ) measures the strength and direction of a monotonic relationship between two ranked variables (Zar 2014). The coefficient ranges from -1 to +1. A value of +1 indicates a perfect positive relationship in which the final evaluation rank strictly follows the bid price rank, implying a price-dominant evaluation. A value near 0 indicates a weak or negligible relationship, suggesting that non-price factors played a more significant role in the final decision.

Comparative Analysis of Project Performance and Evaluator Scoring Patterns across Procurement Methods

Preliminary correlation and covariate screening. To test the second and third hypotheses, the study compared project performance and evaluator scoring patterns across procurement methods. Before

conducting hypothesis testing, a series of Pearson's correlation analyses (Fig. 1) were first performed to identify potential covariates that might confound the relationships between procurement methods and outcome variables. Specifically, the analyses examined linear associations between input variables (i.e., original contract amount, planned construction duration, NTP year, and number of bidders) and outcome variables (i.e., schedule growth, cost growth, winner margin, and evaluation score variability). Significant correlations were observed between cost growth and both the original contract amount and planned construction duration, as well as between winner margin and the number of bidders. To further assess whether these covariates (i.e., original contract amount, planned construction duration, and the number of bidders) vary across procurement methods, independent-samples *t* tests were conducted. The results revealed statistically significant differences ($p < 0.05$) in the original contract amount and planned construction duration, indicating the need to control for their effects when analyzing cost growth.

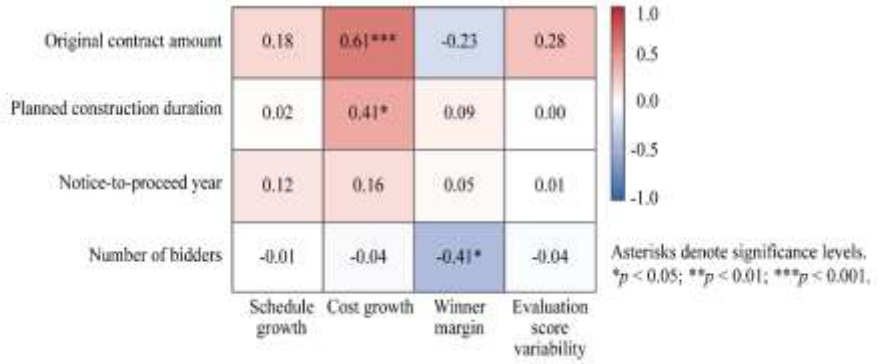

Figure 1. Results of the correlation analysis

Statistical testing procedures for project performance and evaluator scoring patterns. To analyze cost growth while controlling for potential covariates, an analysis of covariance (ANCOVA) was initially conducted, incorporating the original contract amount and planned duration as covariates. However, the assumption of homogeneity of regression slopes was not satisfied, as illustrated in Fig. 2, where the fitted slopes differed between procurement methods (Chatterjee and Bandyopadhyay 2019; Johnson 2016). Therefore, a residualized nonparametric approach was employed. Residuals were obtained from a linear regression model that accounted for the effects of the covariates, and the residualized cost growth values were then compared across procurement methods using the Wilcoxon rank-sum test, a nonparametric alternative to the independent-samples *t* tests for two groups (Wilcoxon 1992). For the remaining outcome variables (i.e., schedule growth, winner margin, and evaluation score variability) that were not statistically correlated with the covariates, independent-samples *t* tests were directly applied to examine differences between procurement categories (Beyer 2021). All statistical analyses were performed using R software, with significance determined at the 95 percent confidence level.

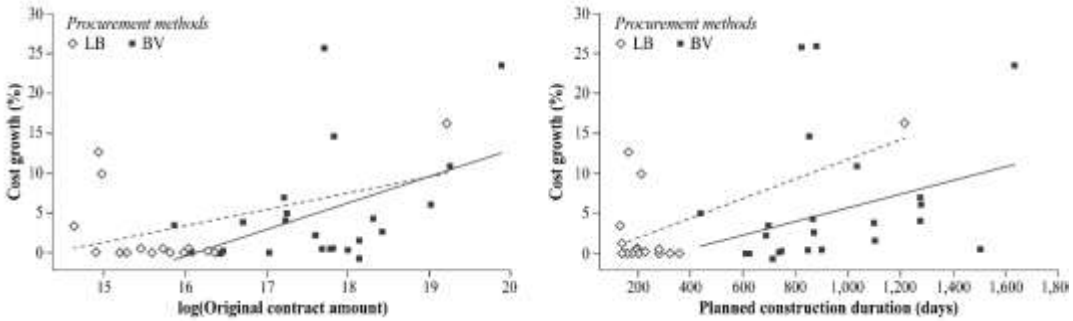

Figure 2. Assessment of homogeneity of regression slopes assumption for ANCOVA: relationship between cost growth and covariates (original contract amount and planned construction duration), by procurement method

Results and Discussion

Empirical Evidence of Price Dominance within BV Procurement

The results of Spearman's rank correlation analysis reveal a strong alignment between bid price rankings and final evaluation rankings across BV projects. Among the 26 BV projects examined, 23 showed a perfect positive correlation ($\rho = 1$), indicating that bidders' final rankings were identical to their bid price rankings. Only three projects exhibited weaker associations, suggesting that genuinely value-based evaluation occurred in a very limited number of cases. These results demonstrate that, although formally classified as BV procurement, most projects were effectively awarded based on bid price rather than a balanced integration of price and non-price criteria.

This pattern is consistent with prior research challenges in the early institutional adoption of BV procurement. Scott et al. (2006) reported that non-price criteria, such as technical qualifications, design alternatives, and quality-related criteria, were often perceived as more difficult to define, evaluate, and operationalize than cost-based parameters. Although BV frameworks are intended to incorporate technical quality, innovation, and managerial capability into award decisions, the persistence of perfect price-rank correlations in the present study suggests that these early implementation challenges have continued to shape evaluation outcomes over time.

The observed alignment between bid price rankings and final award outcomes further implies that non-price criteria provided limited effective differentiation among bidders. As a result, bid price emerged as the most objective and defensible basis for selection. This tendency may reflect institutional risk aversion within public-sector procurement environments, where transparency, auditability, and the avoidance of bid protests are critical considerations. Similar tendencies were noted by Scott et al. (2006), who reported that agencies frequently relied on price-driven decisions during early BV implementation due to the relative clarity and defensibility of cost-based evaluation.

As shown in Fig. 3, approximately 48% of price-driven BV awards were concentrated between 2010 and 2015, whereas the three value-oriented BV projects occurred in 2019 and 2022. This temporal pattern suggests that price dominance may not solely reflect initial experimentation with BV procurement, but rather a gradual institutional learning process in which non-price criteria gain influence as evaluation frameworks and evaluator familiarity mature.

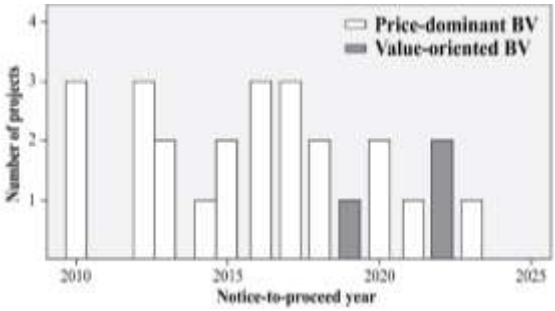

Figure 3. Temporal Distribution of price-dominant and value-oriented BV projects

Taken together, these findings suggest that achieving the intended objectives of BV procurement requires more than the formal adoption of BV procedures. A central issue lies in the weighting structure of evaluation criteria. Even when scoring practices are applied fairly, disproportionately high weights assigned to price inherently constrain the role of non-price elements, reinforcing price dominance and limiting the realization of value-based decision-making. Agencies should therefore establish balanced and transparent weighting frameworks that ensure meaningful differentiation among non-price factors. Moreover, the development of standardized methods for quantifying qualitative criteria, combined with evaluator training, is essential for enabling BV procurement to function as a genuinely value-driven evaluation system.

Procurement Strategies and Their Influence on Project Schedule and Cost Performance

This study also examined whether project performance differed significantly across procurement methods. Because the value-oriented BV group included only three projects, it was excluded from statistical testing to maintain analytical validity. The comparison thus focused on 16 LB projects and 23 price-dominant BV projects, reflecting a form of BV procurement that, while primarily price-focused, represents how BV has been most commonly implemented in practice and therefore warrants comparison with traditional LB procurement.

The results of the independent-samples *t* tests revealed no statistically significant difference in schedule growth between the two procurement types. The average schedule growth for LB projects was 34.0%, compared with 34.4% for price-dominant BV projects, indicating that procurement method had little observable impact on schedule outcomes (refer to (a) of Fig. 4). As shown in the correlation analysis results (Fig. 1), schedule growth was not significantly related to project characteristics such as contract amount and planned duration. These findings imply that schedule outcomes were largely shaped by project-specific uncertainties, including third-party coordination, permitting processes, and weather constraints, rather than by procurement approach.

In contrast, a statistically significant difference was observed in cost growth after controlling for project size and duration (refer to (b) of Fig. 4). Accordingly, differences in cost growth are interpreted after accounting for project scale effects, ensuring that the observed differences are not driven by underlying disparities in original contract amount or planned construction duration. The residualized analysis revealed that price-dominant BV projects had an adjusted mean cost growth of -0.8%, while LB projects showed 1.2%. This finding indicates that price-dominant BV projects achieved relatively better cost performance. Although most BV procurements in this study were strongly influenced by price, the inclusion of even limited non-price evaluation components may have encouraged more systematic cost planning during the bidding and design stages. Unlike purely price-based LB procurement, BV solicitations require contractors to submit technical and management

proposals alongside bid prices, which may have fostered more comprehensive pre-award cost coordination. Thus, the observed cost advantage of price-dominant BV projects does not necessarily imply fully value-based decision-making, but demonstrates that even partial implementation of BV principles can yield measurable performance benefits compared to traditional LB procurement.

Although the procurement method showed no significant effect on schedule growth, this outcome underscores a key area for improvement in BV implementation. The lack of differentiation suggests that existing BV frameworks may not adequately capture contractors' capabilities in schedule control and management. To enhance the influence of procurement on schedule outcomes, agencies should integrate explicit schedule-related evaluation criteria, such as sequencing strategies, resource allocation plans, and risk mitigation approaches, into BV assessments. Doing so would create stronger incentives for bidders to internalize schedule management practices at the proposal stage and ultimately translate value-based principles into tangible time performance outcomes.

Behavioral Insights into Evaluator Scoring under BV Procurement

This study further explored whether the BV framework led to measurable differences in evaluator scoring patterns. Two proxy indicators, winner margin and evaluation score variability, were analyzed to assess whether BV settings produced greater differentiation among competing bidders. The analysis found no statistically significant differences between LB and price-dominant BV projects in either indicator. As shown in panels (c) and (d) of Fig. 4, both procurement types displayed comparable distributions, suggesting that the implemented BV framework did not meaningfully affect how evaluators differentiated among proposals through scoring.
These findings suggest that, while BV procurement was intended to broaden the evaluation beyond price, its practical application did not result in discernible changes in scoring behavior. One possible interpretation is that, within price-dominant BV projects, the weighting structure or evaluation procedure did not provide sufficient scope of non-price criteria to influence the final assessment. Consequently, evaluators may have continued to mirror the scoring tendencies of price-based selection, revealing the limited operational maturity of the BV process.

Enhancing the functional effectiveness of BV procurement therefore requires refinement in how evaluation criteria are defined and operationalized. More structured and transparent scoring systems for qualitative elements can enable evaluators to distinguish proposals more effectively. Integrating multi-criteria decision-making approaches and establishing consistent evaluation protocols can further improve the reliability and transparency of BV assessments (Cheaitou et al. 2019; Scott et al. 2006; Štilić et al. 2023). Strengthening these methodological aspects will help BV procurement better achieve its intended balance between price and non-price dimensions in construction projects.

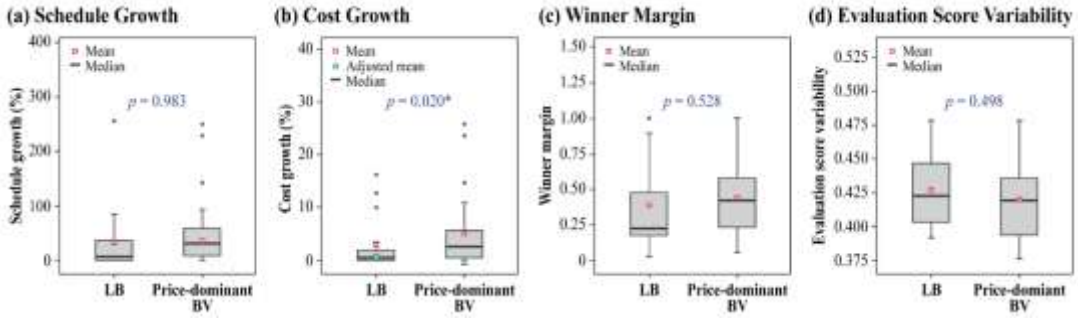

Figure 4. Comparison of project performance and evaluator scoring patterns by procurement methods

Conclusions

The study examined the implementation of BV procurement within DB projects by analyzing evaluation practices, project performance, and evaluator behaviors using data from 42 highway construction cases, including 26 BV and 16 LB projects. Three main findings emerged. First, 23 of the 26 BV projects exhibited a perfect correlation between bid price rankings and final evaluation rankings, demonstrating that bid price remained the decisive factor in award outcomes. Such a pattern indicates that many BV procurements functioned as price-dominant selections despite their formal BV designation. Second, when comparing project outcomes, schedule growth showed no significant difference between LB and price-dominant BV procurements, whereas price-dominant BV projects achieved slightly but significantly better cost performance. The observed improvement may stem from the inclusion of limited non-price evaluation components, which encouraged more deliberate cost planning and coordination before contract award. Finally, analysis of evaluator scoring patterns revealed no significant differences between LB and price-dominant BV projects in winner margins and evaluation score variability, implying that evaluators maintained comparable scoring consistency regardless of procurement type. Collectively, the findings highlighted that the effective implementation of BV procurement requires not only procedural adoption but also institutional capacity, including transparent weighting systems, evaluator training, and structured multi-criteria decision-making processes.

This study advances the understanding of BV procurement in DB projects by providing empirical evidence of how BV principles function in real-world implementation. It extends the discourse beyond theoretical design by emphasizing the importance of institutional and behavioral factors in achieving genuine value-oriented procurement. Future research should build on this foundation through qualitative investigations, such as evaluator interviews and cross-agency comparisons, to capture the decision-making processes and organizational dynamics underlying BV implementation. Such efforts will help clarify how BV systems evolve and how their capacity to deliver long-term value can be strengthened in public infrastructure projects.

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