Exploring Long-Term Performance in Design-Build Best-Value Evaluation Criteria

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Abstract: Improving long-term performance in highway projects is an imperative goal for public administrations. Project delivery and procurement methods might provide an opportunity to align design and construction processes with this goal. Previous studies have explored whether project delivery methods impact the long-term performance of highway projects. However, these studies did not focus specifically on how core elements within the procurement might relate to long-term performance. Thus, this research aims to fill this gap by exploring to what extent and how long-term evaluation criteria are considered in design-build best-value procurement of highway projects. To this end, content analysis was conducted on 100 projects procured between 2009 and 2019 by 19 DOTs across the U.S. The analysis of 365 evaluation criteria found that (1) roughly 11% of them related to long-term performance. (2) The weight given to these criteria in the overall technical proposal was lower than 30%. (3) Sixty-five percent (65%) of long-term evaluation criteria focused on design while 15% related to materials and technology, respectively. The results of this study are a first steppingstone to initiate a deep exploration of the relationship between procurement practices and actual project performance. Currently, with sustainability and life cycle assessments being top concerns in infrastructure projects, this line of research might be of particular interest to DOTs and highway agencies across the U.S. and worldwide.

Keywords: best-value procurement, highways, evaluation criteria, long-term performance

1. INTRODUCTION

Nowadays, improving long-term performance in highway projects is imperative for Departments of Transportation (DOTs). Highways that perform better in the long term might optimize life cycle costs [1]. Further, better long-term performance leads to enhance sustainability in these types of infrastructures [2]. Currently, there is a call for innovative approaches to enhance life cycle cost and sustainability in transportation systems [3]–[5]. Considering long-term performance under the lens of contracting strategies—such as project delivery and procurement methods—is an innovative approach to improve long-term performance and, in turn, life cycle cost and sustainability in highway projects.

The long-term performance of highway projects results from the design, procurement, and construction processes, whose management depends on each DOT's project delivery and

procurement method. Alternative project delivery and procurement methods—such as design-build and best-value—have the ability to play an essential role in establishing the tone to work towards pre-determined goals. For example, design-build project delivery provides room for design-builders to innovate in their proposals [6]. Best-value procurement, on the other hand, enables highway agencies to select the best proposer based on criteria aligned with the project's goals [7]. In both cases, procurement is the starting point in which highway agencies, potential designers, and constructors share the project's goals and draft the action plan for design and construction in alignment with those goals [8]. In other words, procurement can incentivize design-builder's design and construction performance [9].

In design-build best-value procurement, highway agencies convey their goals, expectations, and evaluation criteria in the Request for Proposals (RFPs). Based on these expectations, design-build firms can prepare their proposals; the firm that best meets the DOT's goals and expectations would be selected based on the established evaluation criteria. The procurement provides then an opportunity to align construction with long-term performance goals. However, are DOTs taking advantage of this opportunity? If so, what is the approach that they are taking?

Previous studies have explored whether project delivery methods impact the long-term performance of highway projects. They found that highway projects delivered using design-build delivery systems performed better than those delivered using design-bid-build [10], [11]. However, these studies did not explore the reasons for these results. Other studies examined how goals and evaluation criteria should be defined in the RFPs in order to be effective [6], [8], [12]. However, they did not focus specifically on goals and evaluation criteria related to long-term performance.

Thus, this research aims to fill this gap by exploring to what extent and how long-term evaluation criteria are considered in design-build best-value RFPs.

The study is structured as follows. First, a theoretical framework about evaluation criteria and long-term performance is presented. Second, the methodology conducted in this research is explained. Finally, results, discussion, and conclusions are exposed.

2. EVALUATION CRITERIA AND LONG-TERM PERFORMANCE

This study focuses on design-build projects that use best-value procurement. Best-value procurement considers other technical criteria in addition to price to evaluate and select the design-builder that will develop the work. This type of procurement provides an opportunity to meet long-term performance expectations if teams are selected with this goal in mind. Two core elements in best-value procurement are parameters and evaluation criteria [7], [13]. Best-value parameters relate to and are based on the project goals, and using these parameters, highway agencies should determine the evaluation criteria for a given project.

The most relevant best-value parameters are cost, time, qualifications, and performance [13]. On the other hand, the evaluation criteria assess the requirements—established by the Departments of Transportation (DOTs)—that companies need to accomplish within their proposals. These evaluation criteria are project-specific and should depend on the project goals. Evaluation criteria should "represent the key areas of importance and emphasis to be considered in the source selection decision"; and "support meaningful comparison and discrimination between and among competing proposals" [14]. Qualification, quality, past performance, management solutions, technical solutions, and proposed design approach are some of the most common primary evaluation criteria used in best-value procurement [7], [13], [15]–[17].

Long-term performance in this study refers to how highway projects perform during their lifecycle. An improved long-term performance might be related to either an increased duration of the lifecycle of these projects, a reduction of the costs associated with their maintenance, or both.

Long-term performance is not listed as one of the most commonly used primary evaluation criteria. However, according to Gransberg and Molenaar [18], design-build best-value contracting might serve DOTs to assess each proposer's design alternatives and award the contract based on criteria that include capital cost pub and pub life cycle considerations. Life cycle considerations are becoming more relevant as the industry moves toward smart maintenance. According to Johannes et al.[19], maturity in smart maintenance implies data-driven decision-making. This means that maintenance data and feedback should inform the procurement. In other words, there should be an alignment between DOTs' goals, evaluation criteria (established in the procurement), and performance measures (obtained during the service of the project). In the design-build project delivery, each DOT defines functional performance requirements and construction behavior and practices as performance requirements in the procurement[20].

Long-term performance requirements, according to Van Dam et al.[2], might relate to design, materials, and construction methods. In design, for example, achieving longer pavement life might imply using mechanical empirical design to evaluate alternative materials, require higher construction and materials quality, or improve construction specifications (for example, requiring less variability or greater density) [2]. Examples of materials that can extend the life of asphalt pavements might be the use of Warm Mix Asphalt (WMA) –which can improve compaction by reducing compaction temperatures—polymers, or rubberized asphalt[2]. Finally, through construction methods, an extended pavement life can be obtained by using equipment for placement and compaction equipped with smart technology, including thermal cameras and/or transfer vehicles to prevent segregation, or using quality assurance technology such as nondestructive testing, infrared thermographic scanning or intelligent compaction [2].

In summary, best-value evaluation criteria should be defined based on each project's goals, and improving long-term performance might be one of these goals. In the procurement, goals should be conveyed into evaluation criteria, which should assess meaningful focus areas—such as design, materials, and methods—that contribute to achieving the related goals.

3. RESEARCH METHODOLOGY

This research aims to explore (1) to what extent design-build RFPs include long-term evaluation criteria (2) how long-term evaluation criteria relate to the areas of design, materials, and methods.

To this end, the study follows a three-step approach, as shown by Figure 3
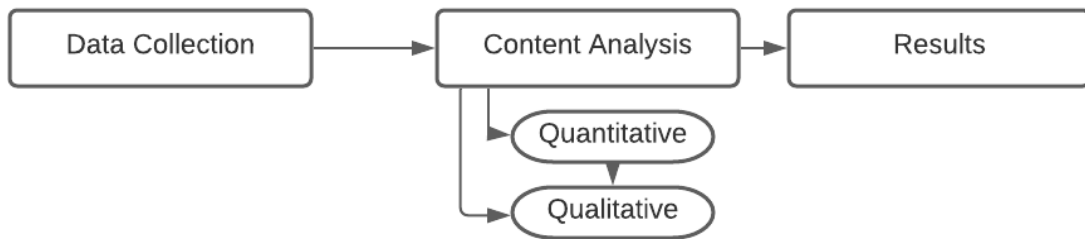
. **Figure 3.** Research methodology

3.1. Data collection

In design-build best-value procurement, highway agencies convey their goals and expectations in the RFPs. They also include the evaluation criteria used to assess proposers and select the best firm to develop the work. Thus, the authors collected 100 design-build RFPs from 19 Departments of Transportation (DOTs) across the U.S. (Table 1).

Table 4. Research data

State	Number of RFPs	State	Number of RFPs
Arizona	1	Mississippi	6
California	3	New York	5
Colorado	4	North Carolina	5
Connecticut	1	Ohio	6
Florida	8	South Carolina	9
Georgia	3	Tennessee	4
Kentucky	3	Texas	5
Louisiana	7	Virginia	4
Maryland	10	Washington	10
Minnesota	6	**Total**	**100**

Request for Proposals (RFPs) are public documents that can be downloaded from DOTs' websites. The RFPs collected for this research were used in highway projects procured between 2009 and 2019.

3.2. Content Analysis

According to Fellows & Liu [21], there are three types of content analysis, quantitative, qualitative, and structural. The quantitative content analysis aims to obtain numerical values such as rankings and frequencies from the categorical data obtained from the documents. The qualitative content analysis focuses on exploring the meanings of the data. Finally, the structural content analysis seeks to examine the relationship between categories of data.

In this research, the content analysis' objective is twofold. First, it aims to identify (1) to what extent RFPs include long-term performance evaluation criteria. To this end, the researcher used quantitative content analysis. Second, the study seeks to explore (2) how long-term goals and evaluation criteria relate to various assessment categories. To this end, the researchers conducted a qualitative content analysis.

3.3. Quantitative content analysis

Using the software *dedoose*, the RFPs were stored, identified, and codified. First, the researchers stored the RFPs in the dedoose's cloud-based environment. Second, the researcher identified each RFP using identification numbers (I.D.s) and information fields such as the year when the RFP was issued and the DOT's state. Finally, the researchers conducted a two-step coding. The research focuses on analyzing the evaluation criteria related to long-term performance. Thus, the first step in the coding process was identifying all the evaluation criteria within each RFP. To this end, the authors used "EVALUATION CRITERIA" and "CRITERIA" as keywords in this stage. In the second step, the focus was to codify those evaluation criteria related to long-term performance. In this case, the keywords used were "LONG-TERM," "MAINTENANCE," and "LIFECYCLE."

The researchers finalized the quantitative content analysis by quantifying the frequency of each of the codes defined.

3.4. Qualitative content analysis

Evaluation criteria with a focus on long-term performance were analyzed using affinity diagrams. According to Holtzblatt & Beyer [22], "An affinity diagram is an inductive process that bubbles structured up out of the details of the user data."

On the other hand, long-term evaluation criteria were categorized based on the focus of the assessment articulated by the evaluation criteria. In this regard, the researcher defined three areas of focus for improving long-term performance: design, materials, and methods.

4. RESULTS

Results from the quantitative content analysis of 100 RFP showed that 42 out of 365 evaluation criteria identified (roughly 11%) related to long-term performance. (Figure 2).
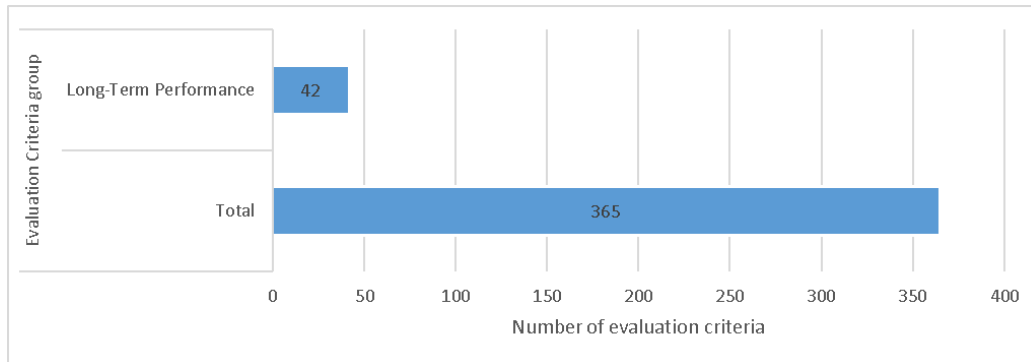
Figure 4. Number of evaluation criteria identified

Further, the analysis showed that 63% of the states analyzed did include long-term performance information evaluation criteria in their RFPs. After identifying the long-term evaluation criteria, the authors categorized them based on the focus of their assessment, considering three categories, design, materials, and methods. Results from this analysis showed that 60% of long-term evaluation criteria focused on the assessment in the design, 15% in materials, 15% in technology, and 10% on other topics (Figure3). Further, the research found that long-term evaluation criteria were found to be secondary criteria included in three primary criteria categories: design, management, and innovation. The weight given to these criteria in the overall technical proposal was lower than 30%.
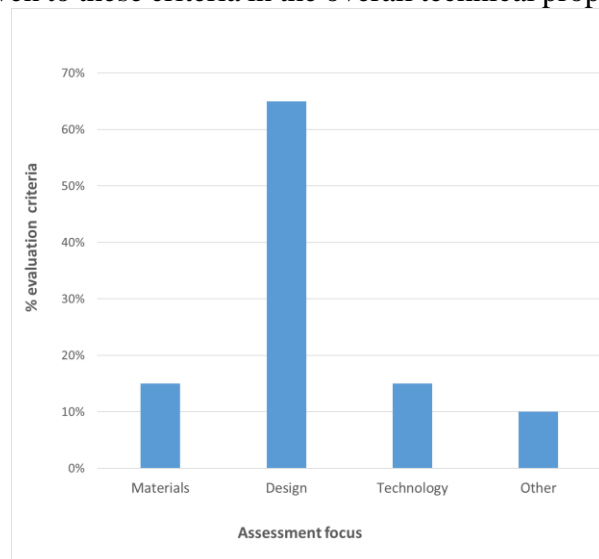
Figure 5. Long-term evaluation criteria per assessment focus

Table 5, Table 6, and Table 7 show examples of how the categories of design, materials, and methods are articulated to assess long-term performance in the evaluation criteria.

Table 5. Long-term evaluation criteria with a focus on design

Design focus	Long-term performance feature under evaluation
Master design	Maximize performance and serviceability, minimize long-term maintenance cost
Design features	Reduce the need for maintenance or would make inspection/maintenance more effective
Design approaches	Minimize periodic and routine maintenance

In these cases, the long-term approach is assessed by asking the proposers to provide a design that reduces maintenance and maintenance costs and increases performance and durability.

Table 6. Long-term evaluation criteria with a focus on materials

Materials focus	Long-term performance feature under evaluation
Exceed minimum material requirements to	Enhance the durability of the project components
Consider the type of materials that	Reduce the need for future inspection and maintenance
Special materials that	Result in a long-term reduction in maintenance.

Long-term evaluation criteria that focus on materials ask proposers to exceed minimum requirements or use special materials that reduce maintenance and increase performance and durability.

Table 7. Long-term evaluation criteria with a focus on technology/methods

Technology/Methods focus	Long-term performance feature under evaluation
Develop and deploy construction techniques that	Enhance project durability, reduce long-term performance and routine maintenance
Consider methods to	Reduce the need for future inspection and maintenance
Construction methods that	Would reduce maintenance costs to the department

In these cases, the long-term approach is assessed by asking the design-builders to propose construction techniques that reduce maintenance and maintenance costs and increase performance and durability.

5. DISCUSSION

Long-term evaluation criteria were found to be secondary criteria included in three primary criteria categories: design, management, and innovation. In these categories, 65% of the evaluation

criteria focused on design solutions to address long-term performance issues, while 15% emphasized materials and methods, respectively. Thus, the main focus of assessment is design, while materials and methods are barely considered. DOTs might evaluate what materials and methods have benefited the long-term performance of their projects and require them in the procurement of future projects. Further, they may use the "value-added" primary criteria to require materials and methods that enhance projects' long-term performance. Van Dam et al. [2] provided examples of these materials, such as WMA that improve compaction: and methods like thermal cameras and transfer vehicles that might prevent segregation.

The results of this study are aligned with previous research, where long-term goals and evaluation criteria were not considered among the primary most commonly used criteria [7], [13], [15]–[17]. Further, this study adds a new line of research to the current studies by Cho, El Asmar, S. Underwood, and Kamarianakis [7], Abkarian, El Asmar, and S. Underwood, [8] on long-term performance and design-build delivery.

Future research needs to explore the relevance and effectiveness in actual project performance of including long-term evaluation criteria in the procurement. To this end, surveys and case studies might be conducted on projects already procured and executed. The results from the analysis of best-value procurement evaluation criteria and long-term performance might establish the foundations to explore the impact that procurement practices might have on the actual performance of highway projects.

6. CONCLUSIONS

Improving long-term performance in highway projects is an imperative goal for DOTs, and procurement might be an opportunity to align the design and construction processes with this goal. This research's findings show that DOTs are not taking full advantage of this opportunity, with only 11% of the evaluation criteria analyzed assessing long-term performance issues.

This study is a first steppingstone to initiate a deep exploration of the relationship between procurement practices and actual project performance.

Currently, with sustainability and life cycle assessments being top concerns in infrastructure projects, this line of research might be of particular interest to DOTs and highway agencies across the U.S. and worldwide.

7. ACKNOWLEDGMENTS

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