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Fixed Budget-Best Value Procurement Method and Case Studies for Transportation Projects

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As the highway construction industry faces significant challenges in rehabilitating aging infrastructure and meeting growing traffic volumes, delivering projects within available funds becomes far more critical. Fixed budget-best value (FB-BV), also known as "design-to-costs", allows state departments of transportation (DOTs) to generate more amount of work while achieving the best value for dollars expended. This paper aims to investigate practices of FB-BV for highway projects in state DOTs and analyze case studies of FB-BV procurement contracting strategies. This study presents practices and case studies related to FB-BV procurement contracting strategies in four state highway agencies including, Idaho, Michigan, Utah, and Colorado. This paper reviewed the current state of practices in the FB-BV procurement method and identified best practices in utilizing this innovative contracting method. The results showed that defining the basic configuration scope, defining additional scope elements, and establishing rigorous evaluation criteria and their weights are critical for successfully delivering projects with the FB-BV contracting strategy. The findings of this study contribute to the state of knowledge and practice of the FB-BV procurement method and help state DOTs establish an effective process for implementing the FB-BV contracting method under a strict budget.

Key Words: Design Build, Fixed Budget-Best Value, Highway Project, Innovative Project Delivery

Introduction

The highway construction industry in the United States faces significant challenges in rehabilitating aging infrastructure and meeting growing traffic volumes with limited funding. Thus, delivering projects within available funds becomes far more critical in the highway construction industry. Amid the increasing complexity of projects and funding constraints, state departments of transportation (state DOTs) have utilized best-value procurement methods, such as fixed budget-best value (FB-BV), to maximize the value of dollars expended for their projects. The best value-procurement methods can be typically applied to design-build (DB) projects. Figure 1 illustrates the project delivery sequences of traditional and DB project delivery methods. The best value procurement methods can include several evaluation criteria, such as price, schedule, and technical factors, in the request for proposals (RFPs).

With best-value procurement methods, state DOTs can select key factors that match or meet the project's specific requirements (Scott et al. 2006). Based on the key evaluation factors, the state DOT selects the proposal that most closely meets or exceeds the owner's expectations and the project's requirements.

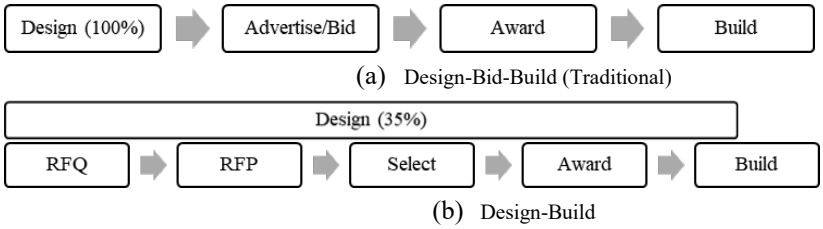

Figure 1. Project Delivery Sequences of Traditional (a) and DB (b) Delivery Methods

Fixed budget-best value, also known as "design-to-costs", allows state DOTs to generate the greatest amount of work while achieving the best value for dollars expended (FHWA 2013). This approach encourages the proposers to submit the proposals with the best value while staying within the defined budget. As a variation of best value procurement methods, a FB-BV approach provides state DOTs a choice for selecting evaluation and selection criteria, such as project scope, qualifications, and schedule that meet or exceed their project requirements. The FB-BV algorithm includes the two major components, technical score and project price (i.e., $Algorithm: Award\ T_{max}, Fixed\ P$). With these two factors, the state DOT selects the proposal that obtains the maximum technical score while fulfilling the premise of the fixed budget. The technical score can be calculated based on several types of parameters (e.g., time, qualifications, and design) that the owner requires for the project goal. As the FB-BV evaluates the proposal by using project scope, qualifications, schedule, and non-cost factors (Scott et al. 2006). Figure 2 depicts the best-value procurement process. For the FB-BV, the budget constraints should be incorporated in the first step, where the agency screens the candidate project and define the project goals/benefits. As many highway construction projects have suffered from significant cost overruns, this approach provides an attractive alternative for procuring a project with a tight budget.

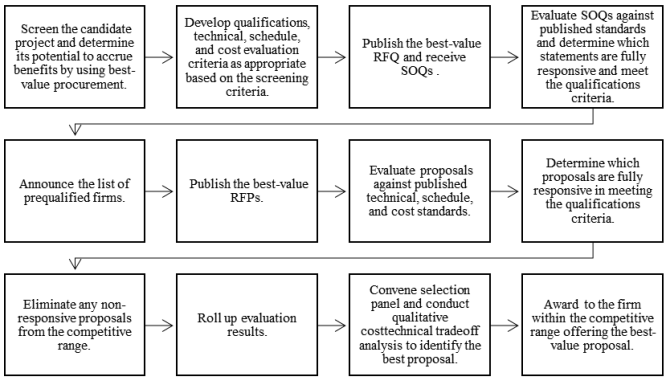

Figure 2. Flow Chart of Best-Value Procurement Process (Scott et al. 2006)

The FB-BV approach maximizes improvements within the defined budget and provides incentives to proposers to utilize the full budget. This approach increases competition and exploits the budget as much as possible, which can result in maximum improvements for the project. The FB-BV has several

advantages and disadvantages. The major advantage of this approach is that it can be a good tool for controlling costs and keeping a project within budget. However, the agencies may get less work done than originally planned if the budget is too tight. In addition, this approach may require more time for evaluating the proposal and have challenges in selecting the contractor if selection criteria are not clearly defined and defendable (Scott et al. 2006; WSDOT 2013). Although the literature has shown that the FB-BV is an effective method for maximizing the value of dollars of projects, few have provided the current state of practices of a FB-BV contracting strategy. Therefore, the objective of this study is to identify and analyze FB-BV practices in state DOTs. This study contributes to the state of knowledge and practice by examining the literature and practice of the FB-BV procurement method, which provide an effective strategy to deliver projects under a strict budget.

Research Methodology

The primary goal of this study is to analyze the FB-BV practices and explain recommendations for enhancing the process of delivering highway projects. To achieve this goal, this study conducted a critical scanning process on the FHWA and state DOTs' websites to determine their execution process and interviews with several state DOTs to identify successful case studies related to a FB-BV contracting strategy. This study presents FB-BV procurement practices and case studies from four state highway agencies in the United States including, Idaho, Michigan, Utah, and Colorado. Table 1 provides the summary of state DOTs' FB-BV contracting strategies and case studies.

Table 1

Summary of State DOTs' FB-BV Contracting Strategies and Case Studies

DOTs	FB-BV Procurement Process	Case Studies
Idaho	Pass/Fail and Scored Criteria (e.g., formatting, executive summary, legal, financial aspects of proposals, organizational structure, project management, maintenance of traffic, and project-specific technical and quality factors)	Bridge deck preservation in 2010 Resurfacing in 2015 Seal coating projects in 2016
Michigan	Three Types of Projects for the FB-BV approach (i.e., Type 1: projects receive bids by the units of work that can be completed for a State fixed price, Type 2: projects receive bids by the units of work that can be completed for a maximum price, and Type 3: projects receive bids through a traditional low-bid process)	Crack sealing work in Hillsdale, Ingham, Jackson, and Lenawee counties in 2012
Utah	The relative significance of UDOT (i.e., High, Medium, and Low)	I-15 Corridor Expansion project in 2008
Colorado	Adjectival rating for each evaluator category	Transportation-Expansion project in 1999

Results and Discussions

Under the provisions of Special Experimental Project No. 14 (SEP 14) (FHWA 2016), several state departments of transportation currently utilize the FB-BV approach to maximize the use of their available funds. To document the state of practice of a FB-BV contracting strategy, a comprehensive review of academic and professional literature was conducted. In addition, a critical scanning process was conducted on the FHWA and state DOTs websites to determine their execution process and case studies related to a FB-BV contracting strategy. The results of scanning indicate that the use of a FB-BV approach was successfully utilized in several state DOTs, including Idaho, Michigan, Utah, and Colorado DOTs.

Utah Department of Transportation (UDOT)

The Utah Department of Transportation (UDOT) defines the FB-BV, also called fixed price-best value, in the context of three objectives, including knowing funding limitations, maximizing scope for the

price, and encouraging innovation (UDOT 2016). With this procurement method, UDOT aims to maximize the amount of work under a single contract while spending all authorized funding for the contract. Besides, UDOT encourages the proposers to develop innovative solutions to achieve the state's goal (UDOT 2013). Since the FB-BV approach provides higher flexibility in design and construction methods and techniques than that in traditional procurement methods, such as low bid, UDOT utilizes this method in DB projects. The selection process of the FB-BV follows a similar process of best value DB procurement (UDOT 2016). First, UDOT develops and approves project goals. In this step, the process begins with an understanding of the major factors impacting the project based on environmental study information or other known issues. The project team and region leadership should clearly define the project goals based on scope, schedule, budget, and impacts on the public. Based on the project goals, the project team and region leadership apply relative weights to goals and develop evaluation criteria for each scored goal. The project goals and evaluation criteria should be refined by the selection committee throughout project development. Finally, the project team and region leadership request approval of the project goals and evaluation criteria from the selection committee.

Next, UDOT receives and evaluates proposals. Once the project goals and evaluation criteria are approved by the selection committee, the proposals will be received and evaluated by the committee. There are three types of committees involved in the evaluation process. The analysis committee identifies the added values, risks, strengths, and weaknesses of proposers. The evaluation committee offers one-one meetings with each proposer. Lastly, the selection committee meets with the evaluation committee early in the process to discuss the project and agrees on the purpose and objective of the project. Next, through the review of blinded technical and blinded price proposals, the selection committee determines the overall best value selection and provides a written and blinded justification of the best value selection. To measure the quantitative and qualitative benefits of proposals, UDOT uses evaluation adjectives, including "HIGH", "MEDIUM", and "LOW", which indicate the relative significance of UDOT. An example of evaluation factors for project definition is shown in Table 2.

Table 2

Example of Evaluation Factors and Category

Evaluation Factor	Evaluation Category
HIGH	The number of I-15 lane and shoulder miles added or improved, by type and level of improvement. The number of interchanges reconstructed or improved and the level of improvement. Operational metrics of mainline, at and between interchanges. Operational metrics of mainline transitions to existing facilities. Level of improvement to regional mobility associated with mainline improvements using the results from the transportation demand management Level of improvement of the interchange operations using the results from the traffic engineering models
MEDIUM	Other operational improvements include the number and nature of decision points, length of weave areas, width and location of shoulders and refuge areas, etc. The number of intersections improved and the level of improvement For areas between American Fork Main Street and Provo Center Street
LOW	Operational metrics in cross-street transitions to existing facilities Extent and functionality of non-motorized improvements

An Example of Fixed Budget-Best Value from UDOT

The first FB-BV project in UDOT was the 24-mile I-15 Corridor Expansion (I-15 CORE) project in 2008. The major challenge of this project was the budget cut from $2.6 billion to $1.7 billion. Using a FB-BV approach and proactive risk management, UDOT was able to deliver all the basic configuration scope with additional elements while spending $1.1 billion which was less than the state legislature-approved budget. The I-15 CORE project is an exceptionally successful example of a FB-BV procurement method. All proposers submitted more scope with innovative solutions for design and construction and did not exceed the approved budget. The winning proposal provided the fastest

schedule, more lane miles, fewer lane closers, and an additional inch of pavement that has a longer life and lower life cycle costs (UDOT 2013; WSDOT 2013). The evaluation criteria for I-15 CORE include technical, must-have requirements, pass/fail elements, and project goals and values. the scores for three categories include 60% project definition, 20% maintenance of traffic, and 20% schedule. Overall, UDOT verified that a FB-BV approach is an effective contracting strategy in maximizing the amount of work while staying within the approved budget.

Colorado Department of Transportation (CDOT)

The Colorado Department of Transportation (CDOT) also utilized a FB-BV, also called, the fixed price-best proposal procurement method, when the agency has a budget constraint and wants to maximize the scope of work. This method provides proposers with flexibility in selecting the technical approach and scope for a project within the defined budget. In addition to the basic configurations, CDOT usually defines additional scope elements, known as "Additional Requested Elements (AREs), so that proposers can have options to select. As more AREs are included in proposals while staying within the budget, the proposers will obtain a higher evaluation score. To achieve the project goal, the agency should carefully define the budget and the AREs for a project. The selection process for a FB-BV approach is completed with two steps (CDOT 2016). First, CDOT develops the evaluation procedure. The process begins with determining the project goals. CDOT determines the project goals by using best-value parameters including cost, time, scope, technical design consideration, and construction operation consideration (such as Maintenance of Traffic (MOT) and Public Involvement parameters). The best value scoring parameters are shown in Table 3:

Table 3

Relating Project Goals and Values to Best Value Scoring Parameters

Project Goals	Possible Best Value Parameters
Maximize operational capacity	Project technical approach and commitments & AREs
Maximize use of available funds	AREs & Additional proposal scope commitments
Manage impacts during construction, minimize inconvenience to the traveling public, or minimize inconvenience to the stakeholders	MOT approach and commitments PI approach and commitments, Time of completion, & Duration of construction impacts
Complete the project on or before a set date	Time of completion & Time to obtain key schedule milestones
Provide a high-quality project	Quality management plan approach and commitments & Technical approach and commitments
Safety of the public and workers	Safety management plan approach and commitments
Maximize project durability or Minimize life cycle costs of a project	Maintenance level of service commitments Low-maintenance structures, Low-maintenance pavement, & Other low-maintenance designs

Next, CDOT receives and evaluates proposals with evaluators. Each evaluator reviews and assesses individual SOQs/Proposals using the overall criteria set and records observations using provided evaluation forms. Each evaluator determines an adjectival rating for each evaluator category using the adjectival evaluation and scoring guide as shown in Table 4. Each evaluator uses a best-value evaluation formula to determine the total score. Each parameter is then assigned specific scoring criteria. The maximum total proposal score is 100 points. Table 5 shows Alternative Algorithms to calculate the total score. Moreover, the evaluation committee and technical advisors meet and discuss the submitted SOQs/Proposals and the evaluation forms. The evaluation committee then determines the final score for each proposal. Lastly, CDOT provides the opportunity for one-one meetings for each proposer that requests a meeting within the allowed time.

Table 4

Adjectival Evaluation and Scoring Guide

Adjective	Description	Percentage of Max. Score
Excellent	SOQ/Proposal supports an extremely strong expectation of successful project performance if ultimately selected as the contractor. SOQ indicates significant strengths and/or some minor strengths and no weaknesses. The submitter provides a consistently outstanding level of quality.	90-100%
Very Good	SOQ/Proposal indicates significant strengths and/or some minor strengths and no significant weaknesses. Minor weaknesses are offset by strengths. There exists a small possibility that if ultimately selected as the contractor, the minor weaknesses could slightly adversely affect successful project performance.	75-89%
Good	SOQ/Proposal indicates significant strengths and/or some minor strengths. Minor and significant weaknesses exist that could detract from strengths. While the weaknesses could be improved, minimized, or corrected, it is possible that if ultimately selected as the contractor, the weaknesses could adversely affect successful project performance.	51-74%
Fair	SOQ/Proposal indicates weaknesses, significant and minor, which are not offset by significant strengths. No significant strengths and few minor strengths exist. It is probable that if ultimately selected as the contractor, the weaknesses would adversely affect successful project performance.	25-50%
Poor	SOQ/Proposal indicates the existence of significant weaknesses and/or minor weaknesses and no strengths. SOQ indicates a strong expectation that successful performance could not be achieved if ultimately selected as the contractor.	0-24%

Table 5

CDOT Design-Build Alternative Algorithms to Determine Total Evaluation Score

Alternative Algorithm	Formula	Result
Technical Score Adjusted by Price	Total Score = Ts x (GMP/Pp)	The highest score determines the apparent best value.
Proposal Price Score Adjusted by Technical Score	Total Score = Pp/Ts	The lowest score determines the apparent best value.
Qualitative Technical Score + Quantitative Price Score	Total Score = Ts + (Pmax x Plow/Pp)	The highest score determines the apparent best value.
Qualitative Technical Score + Quantitative Price Score (based on defined dollars per point)	Total Score = Ts + [Pmax – ((Pp – Plow)/($ per Pt))]	The highest score determines the apparent best value.

Note: Ts = Technical Proposal score: the sum of all other best value scoring elements, including AREs; Pmax = Maximum Proposal price points; Pp = Proposal price; Plow = Lowest Proposal price; $ Per Pt Factor = A defined dollar amount per point value; GMP = Guaranteed Maximum Price

An Example of Fixed Budget-Best Value from CDOT

CDOT utilized a FB-BV approach in the $1.67 billion Transportation-Expansion (T-REX) DB project in 1999. The scope of this project is to add 19 miles of double-track light rail, build 13 stations with park-n-Rides, add 13 light rain vehicles to the Regional Transportation District (RTD)'s fleet, and construct a new light rail maintenance facility in Englewood. The project goals of this project are to minimize inconvenience to the public, meet or beat the total program budget of $1.67 billion, provide a quality project, and meet or beat the schedule to be fully operational by June 30, 2008 (CDOT 2003). CDOT achieved significant schedule and cost savings because of the innovative funding and DB/FB-BV approach. The winning proposal was selected based on a best-value evaluation process by looking at technical and price proposals. The Innovative contracting strategy enabled CDOT to complete the project within schedule and under the approved budget.

Idaho Transportation Department (ITD)

The Idaho Transportation Department (ITD) also started to experiment with a FB-BV, also called the fixed Price-best design approach, under the provisions of SEP 14. ITD uses this contracting strategy in a DB delivery method to yield a greater amount of work than the low-bid method and not an additional element of work. Thus, ITD selects a proposer who submits the maximum scope or quantity of work within the approved budget. The selection process of the ITD's FB-BV approach includes the development of an evaluation procedure and evaluation of proposals (ITD 2014). For instance, the process begins with defining the project goals for the project. Next, the project team needs to develop the project scope, estimated cost, and maximum time allowed for the project. Based on the project goals

and other information, the evaluation criteria and process need to be developed. Next, proposers submit technical and price proposals concurrently. ITD should keep price proposals confidential until technical proposals have been evaluated, scored, and reviewed by higher levels. First, the evaluation committee will evaluate technical and price proposals by using pass/fail and score criteria. Pass/fail criteria include formatting, executive summary, legal, and financial aspects of proposals, as well as participant experience. Next, score criteria consist of organizational structure, project management, maintenance of traffic, and project-specific technical and quality factors (i.e., design and construction qualifications, innovation, design and construction quality, and time of completion). Besides, the selection committee discusses and reviews the evaluation techniques and price proposal with the evaluation committee and documents the results of the evaluation. Lastly, the contracting officer approves the evaluation of the technical and price proposal and summary of scores and feedback from evaluators.

Examples of Fixed Budget-Best Value from ITD

ITD tried FB-BV with several project types (i.e., bridge deck preservation, resurfacing, and seal coating projects). Table 6 provides examples of project types in the state of Idaho that the FB-BV procurement method has been utilized. For example, in 2010, ITD used FB-BV in a bridge deck preservation project. ITD required the bidders to determine the total number of square yards of deck preservation that they could accomplish for the fixed budget of $700,000. ITD selected the bidder who submitted a bid with the largest square yardage of 27,641 squad yards. In 2015, ITD had a fixed budget of $651,500 for the roadway resurfacing projects between MP36.783 and MP48.869 in Idaho. The contractors were required to bid a tonnage of the crushed aggregate base that is excavated or blasted from the source, crushed, placed, and compacted. The range of the tonnage was between 14,115 and 41,448 tons. ITD procured the contract to the bidder who submitted the biggest tonnage, 41,448 tons. In 2016, ITD also used the FB-BV approach for seal coating projects in District 4 of the state of Idaho. The bidders bid how many square yards they could seal coat for the fixed budget of $2,948,000. The range of the square yards is between 1,433,897 and 1,616,228.07 square yards. The winning bid was the bidder who submitted the bid with 1,616,228.07 square yards. Using a FB-BV, ITD achieves equal to or better than the base concept.

Table 6

Example of Fixed Budget-Best Value Projects in the State of Idaho

Construction Year	Budget	Work Type	Winning Bid
2010	$7000,000	Bridge Deck Preservation	The largest square yardage (27,641 sq. yd.)
2015	$651,500	Roadway Resurfacing	the biggest tonnage (41,448 tons)
2016	$2,948,000	Sealcoating	The largest square yardage (1,616,228.07 sq. yd.)

Michigan Department of Transportation (MDOT)

The Michigan Department of Transportation (MDOT) uses a FB-BV, also called fixed price-variable scope, to maximize the amount of work within a maximum budget. Thus, the contractor providing the most scope/work for the established budget is awarded the contract. MDOT classifies projects into three types that can be procured by a FB-BV approach (MDOT 2015). In Type 1 projects, MDOT receives bids by the units of work that can be completed for a fixed price. The selected contractor is the bidder that proposed the most units of work for the given fixed price. Type 1 has been used for HMA crack seal, chip seal, and fog seal projects, bid by the lane mile. Next, in Type 2 projects, bids are received by the units of work that can be completed for a maximum price. Contractors bid units of work and may also bid a price for that work that is below the maximum price. The selected contractor is first determined by the bidder that proposes the most units of work, for their determined maximum price. If two or more contractors propose the same amount of work, then the successful bidder is determined by

which of those contractors proposed the lowest maximum price. Type 2 has been used for bridge deck epoxy overlay work, bid by the square yard. Lastly, for Type 3 projects, bids are received through a traditional low-bid process. The contractor provides unit prices for pay items provided in the schedule of items. The selected contractor is determined by the lowest submitted bid. The project is awarded at a low bid price. With Type 1, the proposal submits the maximum amount of work while spending all authorized funding. On the other hand, the Type 2 projects allow MDOT and proposers to adjust the maximum price depending on the maximum amount of work submitted by proposals. The Type 3 project will go through the normal low-bid process. It allows additional work until final construction costs are equal to the engineer's estimate (Youngs 2013).

MDOT considers a combination of technical and price factors to select the winning bid in a FB-BV approach. The selection process for a FB-BV method also includes two steps. First, MDOT develops and approves project goals. In this process, the project manager prepares a proposal evaluation plan that details the process and criteria to be used during technical proposal evaluation. The selection team develops scoring criteria for the technical portion of the evaluation. Next, MDOT receives and evaluates proposals. In this step, the proposals will be reviewed by a selection team consisting of the project manager, staff from the region/transportation service center, the innovative contracting unit, the central selection review team (CSRT), as well as other technical experts. The project manager and deputy project manager review the technical proposals by using the pass/fail criteria in the RFP and score the proposals. The project manager provides the selection team with the submitted proposals and the results of the technical proposal review. Next, the selection team reviews the technical proposal and determines the score for each proposal with justification. Lastly, the project manager provides CSRT with the information for final review and approval. The results will be posted after approving the scores.

Examples of Fixed Budget-Best Value from MDOT

MDOT also utilized the FB-BV contracting strategy in several projects to achieve the maximum amount of work within the fixed budget for the project. In 2012, MDOT used this innovative approach for crack sealing work in Hillsdale, Ingham, Jackson, and Lenawee counties in the state of Michigan. The scope of this project included a maximum of 103.78 miles of hot mix asphalt crack treatment and overband crack filling on 15 segments of various roadways in Michigan. Three bidders submitted the bids with the maximum number of roadbed miles of work that could be completed for the established project budget of $387,000. To evaluate proposals, MDOT had two evaluation criteria: past performance and maximum amount of work. MDOT awarded the contract to the bidder who submitted the maximum length of 74.43 roadbed miles, which is longer than the Department's estimate of 70.62 miles (MDOT 2012).

Conclusions

State DOTs experience crucial funding limitations for delivering much-needed construction and rehabilitation projects that are necessary for maintaining the quality of transportation infrastructure systems. Innovative contracting strategies, such as a fixed budget-best value procurement method, can help state DOTs complete a project within an established budget. This paper reviewed the current state of practices in the FB-BV procurement method and identified best practices in the utilization of this innovative contracting method.

This study provided important implications of the findings for implementing a FB-BV procurement method in the delivery of successful highway projects. First, it is important to define project goals/benefits based on scope, schedule, budget, and public interest in implementing the FB-BV

procurement method. Next, establishing rigorous evaluation criteria (e.g., cost, time, and design alternatives) and the weights for the criteria to evaluate the proposals based on the project goals is critical to selecting the best proposer for a project while allowing higher flexibility in proposing design and construction solutions. Moreover, including committees for refining project goals, establishing evaluation criteria, and reviewing/selecting the proposals is essential for implementing the FB-BV procurement process and increasing transparency of the contract award. Lastly, this study found that defining the basic configuration scope and allowing the proposers to include the maximum amount of work or additional scope elements in their proposals while staying within the fixed budget are critical to achieving the best values of a project.

Therefore, the findings of this study contribute to the state of knowledge and practice of the FB-BV procurement method and help state DOTs establish an effective process for implementing the FB-BV contracting method under a strict budget.

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