Assessing the Performance of Two-Step Design-Build Procurement

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ABSTRACT

Design-Build (DB) is an alternative project delivery system that is distinguished by a DB team acting as the single point of responsibility for a project where the design and construction phases overlap. There are two main methods used to procure DB services: single-step procurement and two-step procurement. This paper focuses on quantifying the resource expenditures of two-step DB projects through investigating both pre-award and post-award metrics. The pre-award metrics include the costs related to the request for qualification (RFQ) and request for proposal (RFP) phases, while the post-award metrics focus specifically on overall project performance (e.g. project cost, delivery schedule, etc.) The authors developed a detailed survey to collect data from public building projects procured using two-step design-build procurement methods. This paper presents preliminary results, specifically the data stemming from six two-step DB projects completed after 2005 and with total project costs ranging from $20.5 million to $299 million. Results of the analysis show the total cost to industry to develop full proposals is about one percent of the total project cost. Additionally, the total proposal cost to DB teams was reduced significantly due to stipend incentives offered by the owners.

BACKGROUND

The design-build (DB) alternative project delivery method has become increasingly common in the architecture, engineering, and construction (AEC) industry. DB is distinguished by a single point of responsibility for the design and construction of a facility. There are two main methods used to procure DB services: single-step procurement and two-step procurement. There is a lack of information comparing the performance of these two main DB procurement methods. Additionally, major stakeholders in the AEC industry are concerned that the single-step DB process might be placing an unfair burden on the industry, particularly because it typically requires a large number of DB teams to develop costly proposals (ECB 2012). As a result, the Design-Build Institute of America (DBIA) and its partner organizations organized a research effort to study and compare the resource expenditures of single-step and two-step DB procurement. This paper focuses specifically on providing a performance analysis of the two-step DB procurement

method in terms of cost and schedule for both the pre-award phase and the post-award phase. The preliminary results of the performance analysis presented here provide an initial benchmark of two-step DB procurement.

Definition of Two-Step DB Procurement

Two-step DB is a procurement method that consists of DB firms first submitting their statements of qualifications (SOQ) in response to an owner's request for qualifications (RFQ). SOQ's are reviewed by the owner in order to shortlist a limited number of firms. The owner then issues a request for proposal (RFP) and the few shortlisted firms are invited to prepare full proposals, typically consisting of technical, managerial and cost considerations. This definition was developed by the research team for this study, which included Arizona State University (ASU) researchers, DBIA and Water Design-Build Council (WDBC) leadership, as well as several industry collaborators.

LITERATURE REVIEW

The first step of this research study consisted of a comprehensive literature review. Previous studies on two-step DB procurement were reviewed and their findings are summarized in this section.

Molenaar et al. (1999) studied the evolution of public-sector DB policies by analyzing data from 104 public building projects. Within the report the authors characterized the differences between one-step and two-step DB by comparing project cost performance and schedule performance. The results showed that two-step DB processes allows for short-listing of qualified offerors, which saves the owner and offerors valuable time and money. Additionally, the two-step process offered a wider range of design solutions and delivered the best cost and schedule performance results as compared to one-step DB projects.

Migliaccio et al. (2009) conducted a research study that utilized two highway construction projects as case studies in outlining two similar two-step DB procurement methods. The first project utilized the two-step method prescribed by the existing Texas Department of Transportation (TxDOT) code, while the second project utilized the two-step method prescribed by the Federal Highway Administration (FHWA). The authors concluded that both two-step processes between were similar. The analysis of the procurement activities suggested that the two-step process was lengthier than the one-step process. Overall, at least for the highway construction sector, the authors have contributed to the literature by detailing the activities performed during the RFQ/RFP process of two-step DB procurement. The detailed steps outlined in this study could help other researchers to quantify procurement schedule duration in relation to the total project delivery time.

Migliaccio et al. (2010) characterized the effects of DB procurement duration on the performance of public transportation projects. The authors studied data from 146 highway and bridge projects. All of the projects in the study were procured using a two-step DB method. The results showed that there is a strong correlation between project schedule growth and procurement duration in transportation projects; notably the longer the procurement duration the lower the schedule growth. The authors

concluded that a procurement duration greater than or equal to 3.4 months will undoubtedly lead to better schedule performance of two-step DB projects.

A number of metrics have been used to illustrate project performance. Konchar and Sanvido (1998) studied unit cost, cost growth, schedule growth, delivery speed, construction speed, systems quality and turnover quality, to compare the performance of DB to that of other delivery systems. Ling et al. (2004) used these same metrics to develop process models in order to predict project performance of DB and design-bid-build (DBB) projects. Gransberg et al. (2003) also compared different project delivery systems in terms of various cost, schedule and quality metrics. El-Wardani et al. (2006) studied the project performance of four different DB selection procedures by quantifying projects in terms of cost growth, schedule growth and quality. Moreover, Bogus et al. (2010) compared water/wastewater project performance using cost growth and schedule growth. More recently, El Asmar et al. (2013) used thirty-two different performance indicators to compare integrated project delivery (IPD) to DB and DBB performance. The aforementioned studies are a small subset of the reviewed body of literature that highlight project performance metrics, and helped identify the key metrics for which data would be collected for this study.

PROBLEM STATEMENT & RESEARCH OBJECTIVES

As stated earlier, little has been published regarding the performance of two-step DB procurement. Therefore, design-builders are not entirely cognizant of the benefits and challenges of this particular procurement method. The goal of this research was to examine the resource expenditure and project performance associated with two-step DB procurement. The larger body of research is meant to contribute knowledge of procurement costs (SOQ and proposal development costs) which has not been exclusively documented in the literature. Both pre-award and post-award performance was quantified in order to present a comprehensive assessment of two-step procurement processes.

RESEARCH METHODOLOGY

The research methodology of this study consisted of four major phases: (1) literature review, (2) survey development, (3) data collection and (4) data analysis. A comprehensive literature review was conducted in order to analyze key DB variables and to understand the major performance metrics typically used to illustrate project performance. DB input variables were gathered from several studies. These input variables along with the experience of seasoned researchers at ASU served as a solid basis for the survey development process. The survey was developed in conjunction with a research steering committee who provided feedback and industry input in the development process. After the survey was completed and thoroughly reviewed, an online version was created and pilot tested with a public DB contractor identified by the steering committee. Further refinement of the survey took place as a result of the pilot study and additional project contacts were identified in order to begin the data collection stage. The survey link was shared with design-builders identified as having completed two-step DB projects between 2005 and 2013. Three categories of data were collected in order to achieve the research objectives:

Procurement schedule duration was quantified by collecting procurement schedule information which included the RFQ issue date, the SOQ due date, the shortlisted firms notification date, the RFP issue date, and the proposal due date. Project schedule performance was quantified by collecting schedule information related to the intended and actual project award and project end date.

Resource expenditure from the design-builder perspective was quantified by detailing the timing of cost expenditures including the proposal development cost for the two-step procurement method. The study also identified cost growth using the contract cost and final cost of the project.

Project quality was documented by collecting data about three quality metrics: project complexity, as-built quality, and overall satisfaction.

Due to the nature of the data collected, a combination of purposive and convenience sampling methodology was employed, e.g. projects from the research steering committee were pursued due to ease of access and the authors also sent the survey to general industry firms, some of which have specific expertise with DB procurement methods. Furthermore, this data was collected from DB contractors who were self-reporting. In order to ensure the data for these projects was accurate, follow-up phone interviews with the respondent for each project were conducted. These follow-up interviews focused on verifying the accuracy of cost and schedule information for the pre-award and post-award phases of each project. Additionally, owners of projects typically have a good understanding of project costs and procurement schedules. Therefore as more projects are received the authors are currently validating these numbers with project owners as a second source of information.

Performance metrics

After collecting the data, the analysis for the study aimed to quantify performance metrics for both the pre-award and post-award phases for each project. These metrics are described below.

Pre-award phase

Four new metrics were calculated for the pre-award phase. First, the combined SOQ development cost for all offerors was calculated as shown below in Equation 1:

$$Combined\ SOQ\ Development\ Cost = Cost\ to\ Develop\ SOQ * Number\ of\ Firms\ that\ Submitted\ SOQs \quad (1)$$

Second, the proposal development cost was calculated as a percentage of total project cost shown in *Equation 2*:

$$Percentage\ Cost\ (\%) = \frac{(Cost\ to\ Develop\ Proposal * Number\ of\ Shortlisted\ Firms)}{Final\ Project\ Cost} * 100\% \quad (2)$$

The aim is to capture the cost to the industry as a whole, first without taking into account any stipend incentives. Equation 3 was then formulated to calculate the percentage cost while taking into account the stipend incentives:

$$Percentage\ Cost\ (\%) = \frac{(Cost\ to\ Develop\ Proposal * Number\ of\ Shortlisted\ Firms) - (Stipend\ Amount * Number\ of\ Unsuccessful\ Offerors)}{Final\ Project\ Cost} * 100\% \quad (3)$$

The terms used in the above equations can be defined as follows: "Cost to Develop SOQ" represents the winning DB team's fully burdened cost to develop their unique SOQ. At the time of the analysis it was assumed that the development cost was around the same range for all competing teams due to a lack of knowledge of the other offerors' cost to develop their individual SOQs. The authors are working on case studies to justify this assumption by collecting procurement costs for all offerors of selected projects.

"Number of firms that submitted SOQs" is the average number of firms to submit SOQs for the project. When respondents are not confident of the exact number of competitors, they were asked to report a range and the average of these values was used. The owners of these projects were also contacted to receive the exact number of respondents, and these exact numbers were used when available.

"Cost to Develop Proposal" is the fully burdened cost by the design-builder to develop the winning proposal for a project. At the time of this writing the authors assumed that the proposal development cost for the winning DB team was approximately the same for the other shortlisted firms, similar to the assumption used for the "Cost to Develop SOQ." The authors are working on case studies to justify this assumption by collecting procurement costs for all offerors of selected projects. The cost to develop a proposal is multiplied by the number of shortlisted firms to obtain an approximate total proposal development cost for all shortlisted firms.

"Fully Burdened Costs" refers to the cost expenditures incurred by all the project team members including but not limited to the prime contractor, the architect, consulting engineers (e.g. mechanical, electrical, plumbing, structural, civil, landscape engineers), and trade contractors (e.g. mechanical, electrical, sheet metal, steel erection, grading contractors), and any other subcontractors that expended time to bid on the work or help prepare concepts for the SOQ or proposal.

"Number of shortlisted firms" is the number of shortlisted firms invited to develop full proposals in response to the RFP.

"Stipend amount" is the whole dollar amount offered by the owner of the project to the unsuccessful offerors who submitted proposals.

"Number of unsuccessful offerors" is the number of offerors who submitted proposals, but did not get awarded the contract.

Another metric presented in the results section below is the "Procurement Duration," which denoted the difference between the RFQ issue date and the proposal due date.

Post-Award phase

For the post award phase, cost growth and schedule growth were calculated as follows:

"Cost Growth" is the increase or decrease in the total project cost with the contracted award value measured in percentage terms. *Equation 4* was used for cost growth:

$$Cost\ Growth\ (\%) = \frac{Total\ Project\ Cost - Contract\ Award}{Contract\ Award} * 100\% \quad (4)$$

"Schedule Growth" is the increase or decrease in the actual delivery time as compared to the contracted delivery time measured in percentage terms. *Equation 5* was used for schedule growth:

$$Schedule\ Growth\ (\%) = \frac{Actual\ Delivery\ Time - Contracted\ Delivery\ Time}{Contracted\ Delivery\ Time} * 100\% \quad (5)$$

The terms used in the above equations can be defined as follows: "Contract Award" is the overall price listed in the final contract; "Total Project Cost" is the final overall payment for the completed project; "Contracted Delivery Time" is the contracted duration for the DB work measured in calendar days; "Actual Delivery Time" is the actual duration in days for the DB work measured in calendar days.

RESULTS

Approximately sixty surveys were recently sent out, and complete data has been received for six projects to date. The current preliminary response rate is only ten percent; however, the authors are aiming for thirty projects, which will raise the response rate to about fifty percent. Responses were received from Virginia, Texas, California and Arizona. Four projects had lump sum contracts, while two were guaranteed maximum price (GMP) contracts; four were federal building projects, while two were state building projects; all were builder-led DB projects; three are rated LEED gold, two are rated LEED silver and one is LEED certified. Both pre-award and post-award performance results are presented below.

Pre-Award findings

Table 1 summarizes the performance results for the pre-award phase. The average durations for each of the two steps are presented, along with a total procurement duration that averaged 107.6 days. The offerors' cost to develop all SOQs averaged around $90,000 with a median of about $60,000, and a maximum and minimum of $250,000 and $10,000 respectively. The offerors' cost to develop proposals decreases by about $110,000 on average (as a group) when the owner uses a stipend to reduce the resource burden on the unsuccessful offerors of the project. Three of the six projects offered a stipend.

Table 1: Pre-Award Performance Metrics

Performance Metric	Average	Std. Dev.
Procurement Duration (calendar days)	107.67	13.71
RFQ Development Duration (calendar days)	26.83	9.20
RFP Development Duration (calendar days)	45.67	9.40
Cost to Develop All SOQs ($ million)	0.09	0.09
Cost to Develop All Proposals without Stipend ($ million)	0.57	0.55
Cost to Develop All Proposals without Stipend (%)	0.99%	0.92%
Cost to Develop All Proposals with Stipend ($ million)	0.46	0.45
Cost to Develop All Proposals with Stipend (%)	0.80%	0.81%

Figure 1 shows the proposal-development cost values in percentage of total project cost. This study's preliminary sample of design-builders shows they are spending on average 0.99 percent with a range of 0.06 percent to 1.95 percent of the total project cost on the two-step DB proposal development process. When the stipend is taken into account this average value decreases to about 0.8 percent of total project cost.

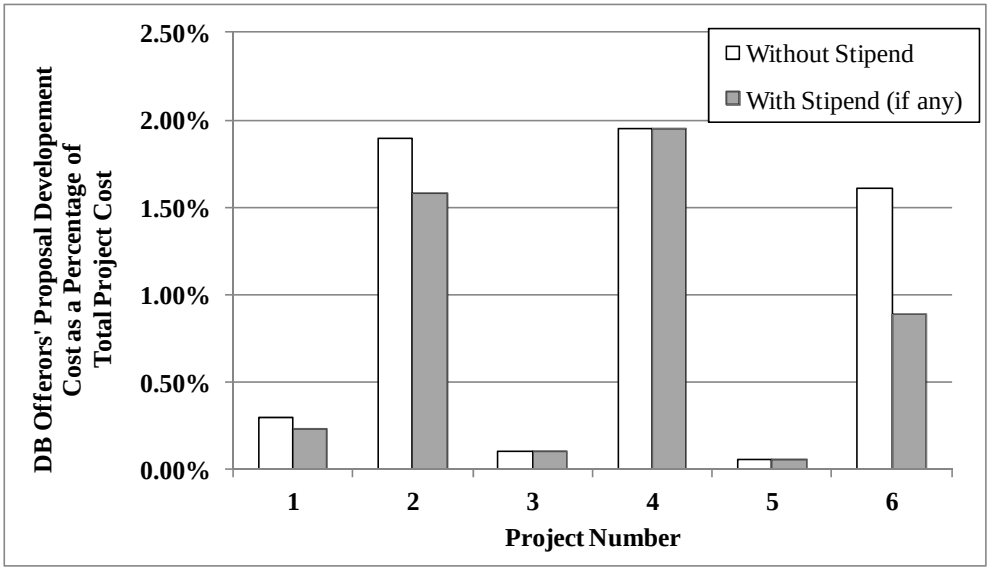

Figure 1. Cost to develop all proposals for each project, in percentage of total project cost

Post-award findings

After the pre-award performance discussion, Table 2 presents a summary of the post-award results, which consist of schedule, cost, and quality metrics. The table shows both the averages and standard deviations for each metric.

Table 2: Post-Award Performance Metrics

Category	Performance Metric	Average	Std. Dev.
Schedule	Schedule Duration (calendar days)	706.50	262.01
	Schedule Growth (%)	-0.85%	1.34%
	Number of Projects with Schedule Growth ≤0	6	--
Cost	Project Cost ($ millions)	104.25	102.60
	Cost Growth (%)	3.15%	5.47%
	Number of Projects with Cost Growth ≤0	4	--
Quality	Project Complexity [1=simple, 5=highly complex]	4.30	0.55
	As-Built Quality [1=economy, 5=premium]	3.80	0.82
	Overall Satisfaction [1=worst, 5=best]	4.50	0.98

Project schedule

Schedule growth is the first post-award performance indicator used in this study. Overall, all six two-step DB projects had a schedule growth of less than or equal to zero indicating that every project was delivered on-time or earlier. Since two-step procurement typically takes longer than single-step procurement, this result is particularly interesting when related back to the findings of Migliaccio et al. (2010) that determined longer procurement durations are associated with lower schedule growth. As shown in the previous section, the sample of projects in this study exhibits an average procurement duration of 107.6 calendar days.

Project cost

Cost growth is the second post-award performance indicator used in this study. The average cost for all six projects was $104.2 million. Overall, four of the six projects had negative or zero cost growth values, meaning the actual project costs were less than originally anticipated. The average cost growth was 3.15 percent; however, the standard deviation was 5.47 percent, indicating that two out of the six projects had relatively large cost growth associated with the final project costs (5.5 percent and 13.6 percent, respectively). It is interesting to note that Molenaar et al. (1999) found that the two-step projects used in their study exhibited a cost growth of 3.0 percent.

Project quality

Quality is the third post-award performance indicator used in this study. Quality data was measured on a Likert scale of 1 to 5. Quality metrics are relatively difficult to collect and by definition provide a qualitative assessment of the project. Average project complexity was 4.3 out of 5 indicating that the projects in the dataset were relatively complex. The average score for as-built quality was 3.8 out of 5 indicating that the as-built quality of the facilities was high. Finally, overall satisfaction scored an average of 4.5 out of 5 indicating that the firms were highly satisfied with the outcome of this sample of projects. Satisfaction results were similar to the results presented by Molenaar et al. (1999).

Overall, the preliminary results presented in this study provide an initial assessment of the two-step DB procurement performance in terms of pre-award and post-award metrics. However, more data will be collected to strengthen the findings.

CONCLUSION

The study investigated both pre-award and post-award performance metrics for two-step DB procurement. The key preliminary result related to the pre-award phase is that the cost to develop all two-step proposals was about one percent of the project cost. The key preliminary result of the post-award phase is that two-step DB projects exhibited a zero or negative schedule growth on average, indicating that the average project was completed early. Two-step projects also exhibited an average cost growth of 3.15 percent.

The main limitation of the study is the small sample size. The authors defined the results as preliminary and these should not be generalized. At the time of this writing, more data is being collected in order to come to a generalization about the current state of procurement costs on two-step DB projects. Another implication of the small sample size is exhibited in the large standard deviations observed for most of the metrics, which are expected to decrease as more projects are included in the database. A second limitation of the study is that the project sample will not necessarily be representative of the whole population of DB projects. For practical purposes, it is impractical to collect data for all of the two-step DB projects delivered in the 2005 to 2013 timeframe. Therefore, a combination of purposive and convenience sampling was used to access project data. Additionally, individual project characteristics, such as LEED certification and commercial contract terms (Lump sum, Guaranteed Maximum Price, etc.), are not accounted for yet. Once the full sample of projects is collected the data will be analyzed under different categories based on project characteristics to determine any categorical effects these attributes may have on procurement cost and schedule as well as project cost and schedule.

The preliminary work presented in this paper is the first step in a benchmarking study that will provide a performance assessment of both single-step and two-step DB procurement. Future work includes increasing the sample size for two-step DB projects, and comparing the results to those of single-step DB projects to provide a benchmark that will help the industry improve DB procurement practices.

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