

Alternative Project Delivery Methods for Water and Wastewater Projects: The Satisfaction Level of Owners

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ABSTRACT

According to the *2013 Report Card for America's Infrastructure*, prepared by American Society of Civil Engineers (ASCE), the drinking water and wastewater infrastructure received grade of 'D'. The American Water Works Association (AWWA) estimated that it would cost about \$1 trillion to replace every drinking water pipe in U.S. Further, it would cost about \$298 billion over the next 20 years to fix the nation's wastewater and storm water systems. Owners, engineers, and contractors are using alternative project delivery (APD) methods, e.g., construction management-at-risk (CMAR), design-build (DB), construction manager/ general contractor to build water and wastewater projects in order to save time and cost as well as to improve the quality of the projects. In this study, a survey was designed to assess the satisfaction levels of policy makers, project staffs and utility managers regarding various benefits related to APD methods. The surveys were emailed to 455 owners using APD methods in their water and wastewater projects. The study results showed that, on average, owners and project staffs were satisfied with most of the issues related to these delivery methods. Particularly, study results elaborate on the differences in satisfaction levels between respondents involved in CMAR and DB projects.

Key words: Alternative Project Delivery Methods, Construction Management at Risk, Design Build, Construction Manager/ General Contractor.

INTRODUCTION

According to the Water Design-Build Council (WDBC 2012), the use of Alternative Project Delivery (APD) methods in water and wastewater projects

significantly increased in recent years. In the U.S., about 30% of the water and wastewater projects were built using APD methods. For these types of projects, generally, Design Build (DB), Construction Management at Risk (CMAR), General Contractor/Construction Manager (GC/CM), and Design Build Operate (DBO) project delivery methods are used in lieu of Design Bid Build (DBB).

In their *2013 Report Card for America's Infrastructure*, the American Society of Civil Engineers (ASCE) states that the condition of drinking water and waste water infrastructures is very poor (ASCE 2013). Further, the American Water Works Association (AWWA) estimated that it will cost about \$1.3 trillion to replace every drinking-water pipe and upgrade the water and wastewater system of U.S. Considering the estimated amount of the work to be done, it is necessary to explore APD methods in order to reduce cost and complete projects on time. A survey conducted by the WDBC in 2010 showed that APD methods save money and time while delivering the water and waste water projects, compared to DBB project delivery methods. In addition, the survey revealed impediments in using APD methods.

As the use of the APD method increases, the satisfaction level of the owners with regard to various issues when using this method should be assessed. Therefore, this study explored the satisfaction level regarding the various advantages of APD methods from owners of utilities agencies that have constructed water and wastewater facilities that provide the services to the public. The main objective of the study was to determine the satisfaction level of owners relating to the use of APD method in their water and wastewater projects. Respondents were asked to rank the advantages of APD method. This study also analyzed the differences in the satisfaction level of owners who worked on projects using the DB and CMAR delivery methods to determine whether there was a difference in satisfaction levels regarding various issues relating to APD methods, based on their experiences on DB and CMAR projects.

LITERATURE REVIEW

A WDBC (2009) survey involving 24 municipal representatives found that the major reasons they used the DB project delivery method were single-point accountability and builder involvement in the design-build process. The study found that the majority of the respondents found both cost and schedule advantage when using APD methods in their water and wastewater projects. The WDBC (2009) also conducted another study to determine whether a significant difference in cost and schedule performance existed for DB and DBB water and wastewater projects. This study found that DB project schedules are significantly shorter than DBB projects. Additionally, they found a significant difference in the cost delivered per unit of time between DB and the DBB methods.

Molenaar et al. (2004) conducted case studies of three projects using APD method in order to prepare guidelines of DB users. The projects studied were Michelson Water Reclamation Plant Upgrades (MWRPU), Tolt Water Treatment Plant (WTO), and Floyds Fork Wastewater Treatment (FFWT). When using DB, it is important that the owner prepares the proper contracting documents, allocates risk among the parties, evaluates the proposals based on the best-value selection process,

identifies key decision makers at the initial phase of the project, establishes the trust among involved parties, and handles permitting.

Beringer et al. (1999) stated that the major advantages of DBO and Design Build Maintain (DBM) project delivery methods were that they had a single point of contact, lower risk among the parties, and schedule advantages. The authors indicated that the decision making to select a DBO or DBM method should be done through an initial workshop, during which the right solution was determined by the design, construction, operation, and maintenance contractors. The authors noted sharing of the profit among the owner, contractor and engineer results in innovations introduced into these types of projects.

Kelly et al. (1998) studied a project in Seattle, Washington that used the APD method to provide a reliable and cost-effective water filtration plant. Seattle used the DBO method with 25 years of operation, which saved the city \$70 million in comparison to using a conventional method. The use of an alternative approach, such as DBO, led to innovation and a well-designed approach for the project. Similarly, a water and wastewater project in the Phoenix, Arizona area saved about \$30 million when using the DBO project delivery method (White et al. 2005). Moreover, this delivery method yielded innovation in the project's design.

In order to determine the suitability of the APD method and develop procedures for a new regional wastewater system to be located in the Capital Regional District of Victoria, British Columbia, Culp (2011) reviewed various studies on buildings as well as water, and wastewater projects that used the APD method. The author found that the DB method reduced the time spent on bidding and the redesign of drawings; these helped to save money and had a schedule advantage. In addition, the author concluded that the APD method saved time and money for many of the projects that were reviewed.

Konchar and Sanvido (1998) compared the performance of DB, DBB and CMAR project delivery methods with respect to cost, schedule, and quality metrics in building projects. The study used 351 projects from the U.S., of which 33% were DBB projects, 44% were DB projects, and 23% were CMAR projects. The multivariate analysis revealed that the unit cost of DB projects were 6.1% less than the DBB projects, and 4.5% less than the CMAR projects. Furthermore, the results showed that the cost growth and schedule growth of DB projects were less than for DBB projects by 5.2% and 11.4%, respectively. Similarly, the cost growth and schedule growth of DB projects were less than the CMAR projects by 12.6% and 21.8%, respectively. The study found that construction speed of DB projects was 12% faster than DBB projects and 7% faster than CMAR projects. Likewise, delivery speed of DB projects was faster than DBB projects by 33.5%, and faster than CMAR projects by 23.5%. The study concluded that the DB method had significant advantages over DBB and CMAR in terms of cost and schedule, and that CMAR had significant advantages over DBB.

Shrestha et al. (2007) statistically compared the project performance of four DB (\$126 million to \$1.4 billion) and 11 DBB highway projects (\$50 - \$100 million) in terms of cost, schedule, and change order. The DBB projects were selected from the database of the Texas Department of Transportation (TxDOT), and the DB projects were selected from a list of projects from the Federal Highway

Administration (FHWA) Special Experimental Projects No. 14 (SEP-14). The DB projects were built in Arizona, New Mexico, Utah, and Virginia; DBB projects were from Texas only. The findings showed that the cost growth of a DB project (5.47%) was lower than that of a DBB project (4.12%). Similarly, the schedule growth of a DB project (7.59%) was lower than that of a DBB project (12.88%). However, the schedule growth was not statistically significant. Likewise, although the cost factor of change orders for a DB project (5.28%) was higher than that for a DBB project (3.94%), there was no significant difference. The study observed that the type of input impacts the performance of the projects. For example, the study found that a delay during project construction directly impacted the cost growth, delivery speed, and schedule growth, consequently affecting the change order.

Rojas and Kell (2008) compared 273 DBB and 24 CMAR projects for public schools in Oregon and Washington. They found that CMAR projects (4.74%) had a lower rate of change orders than DBB projects (6.29%). However, no significant difference was found in change order growth between DBB projects (5.3%) and CMAR projects (6.13%).

Shane & Gransberg (2010) conducted a study to determine the innovations when using the CMAR method in transportation projects. Data from 19 case studies and structured interviews showed that two advantages to using CMAR for highway construction, in terms of quality, were construction design input and owner design control. In terms of scheduling, the accelerated schedule has an advantage; and in terms of cost, top benefits included cost certainty in advance and the use of progressive Guaranteed Maximum Price (GMP).

Shrestha et al. (2012) conducted a performance comparison of 16 DBB and 6 DB large highway projects (greater than \$50 million) with respect to cost, schedule, and change orders; they investigated the project characteristics associated with performance as well. The DB projects were selected from the list of FHWA SEP-14 projects, whereas the DBB projects were selected from Texas only. The study found that the DB projects outperformed DBB projects in terms of delivery speed and construction speed. However, cost-related metrics, schedule growth, and cost per change order were not significantly different between DB and DBB project delivery method. The study found that there was an association among the cost, schedule, and change orders with various input factors, for example, project characteristics and contract clauses.

RESEARCH METHODOLOGY

A questionnaire was prepared to measure owners' satisfaction when using APD methods for water and wastewater projects, in collaboration with members of the Water Design Build Council and a team from the University of Nevada, Las Vegas (UNLV). This survey was emailed to 455 respondents between October 1, 2012 and December 14, 2012. The 'owner' was defined as policy makers, utility managers, and project staffs involved in the construction of water and wastewater projects. Qualtrics Survey Software was used to collect the data from respondents in SPSS format. The questionnaire had two sections. The first section had questions relating to general information about the respondents; the second section covered questions relating to the reason for choosing the APD delivery method and a

satisfaction rating of various advantages of the APD method. About 35% of the total respondents' responded to the survey.

RESULTS

General information about respondents

Project staff constitutes 54% of respondents followed by utility managers (42%) and policy makers (4%). The APD experiences of these respondents are summarized below.

Respondents' alternative project delivery experience

As shown in the Figure 1, out of the total number of respondents involved in APD methods, the respondents involved in DB, CMAR, and GC/ CM were 79%, 56% and 27%, respectively. Some respondents had experience with more than one project delivery method.

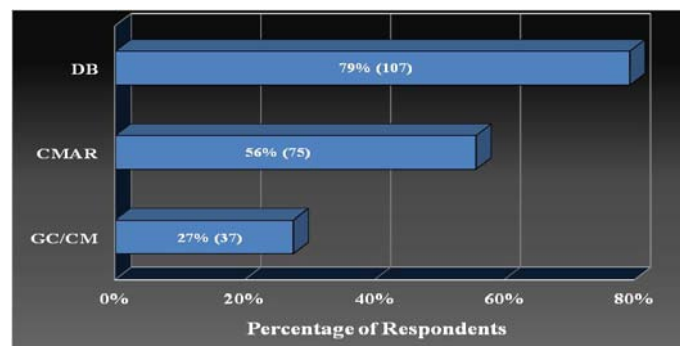


Figure 1. Experience with various APD methods (n =135)

Type of projects involved

Figure 2 shows that the majority of respondents involved in water and wastewater treatment plant were 50% and 47%, respectively. The respondents involved in Conveyance Projects/ Pumping was 44%, Other types (Dam, Irrigation, Intake, Tunnel, Transportation, Buildings, etc.) were 27%, and Storage Projects were 20%.

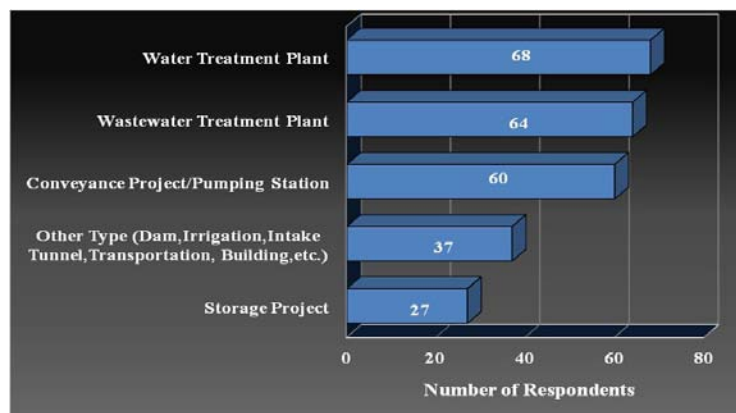


Figure 2. Respondents involved in various types of projects (n = 136)

Respondents' number of projects experience.

The survey results showed that 44%, 39% and 17% of the total respondents were involved in few projects (2-5), many projects (>5) and only one project, respectively, as shown in Figure 4. A higher percentage of respondents were involved with between 2 to 5 projects.

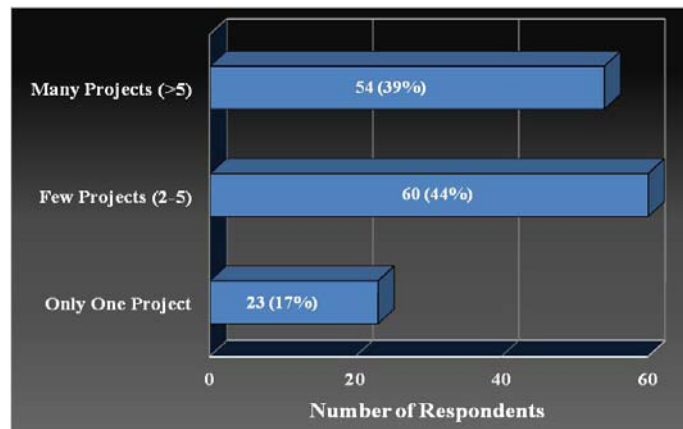


Figure 3. Respondents involved in projects using APD methods (n = 137)

Project size, procurement process, and contractor selection methods

The respondents were asked about the size of the project with which they were involved. The majority of the respondents involved in projects ranging in size from \$10M to \$100M were 60% of the total respondents. The respondents involved in less than \$10M was 25%, and more than \$100M was 15%, as shown in Figure 4.

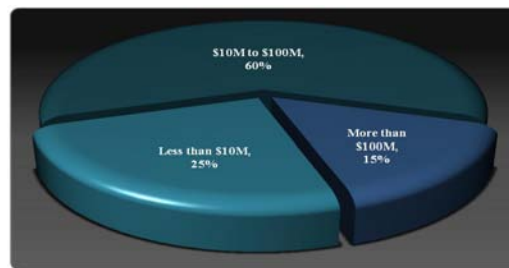


Figure 4. Range of project costs by percentage (n = 132)

About 68% of the respondents were involved in a two-step solicitation process, involving Request for Qualification and Request for Proposal; 32% were involved in one step-solicitation process (Request for Proposal), as shown in Figure 5.

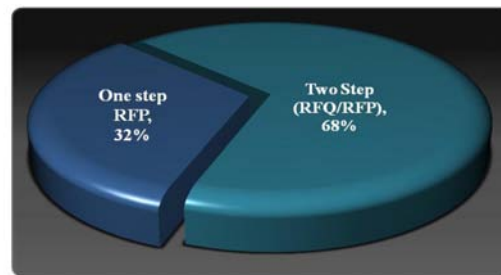


Figure 5. Types of solicitation processes by percentage (n = 132)

The respondents were asked about the contract selection method they used for their projects. The majority of respondents (57%) used best value as their contract selection method. About 31% and 12% of the total respondents used Qualification Only and Price, respectively, as their contract selection criteria (Figure 6).

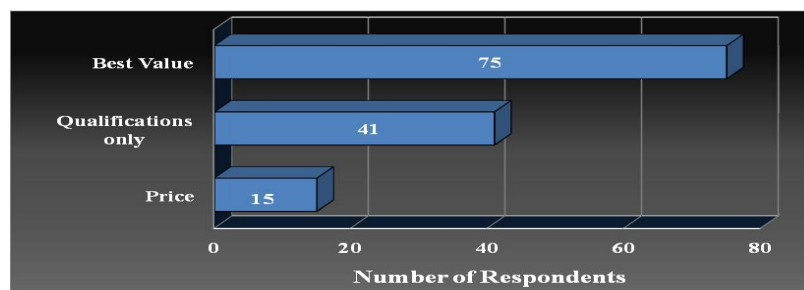


Figure 6. Number of respondents vs. contract selection criteria (n = 131)

Reasons for using APD methods in water and wastewater infrastructure

The schedule advantage and better quality were the major reasons for using APD methods when the respondents were asked to rank the basis of cost advantage, fewer disputes, innovation, risk transfer, and other reasons, as shown in Figure 7. The survey results showed that most of the respondents found the schedule advantage as the primary benefit when using APD methods for their projects.

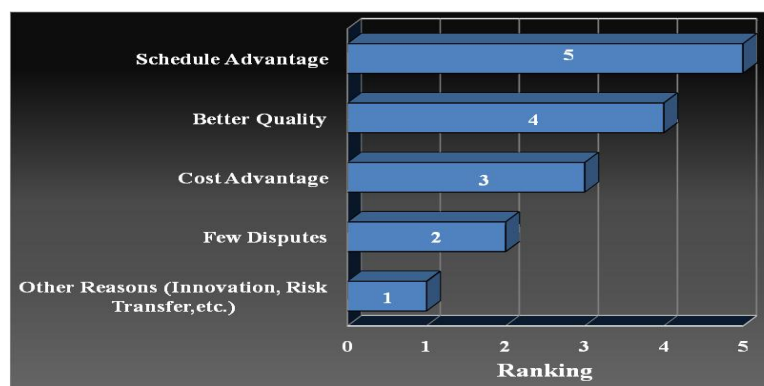


Figure 7. Final ranking of reasons that APD methods were used (n = 128)

Level of satisfaction with APD methods

Satisfaction level of all the respondents

Figure 8 shows the mean satisfaction level of utility managers and project staffs with the issues related to APD. The top four issues the respondents indicated they were satisfied with APD methods were the level of the owner's involvement in the design process, the quality of the completed project, their experience regarding the company's communication process with owner, and their overall experience with the project delivery method.

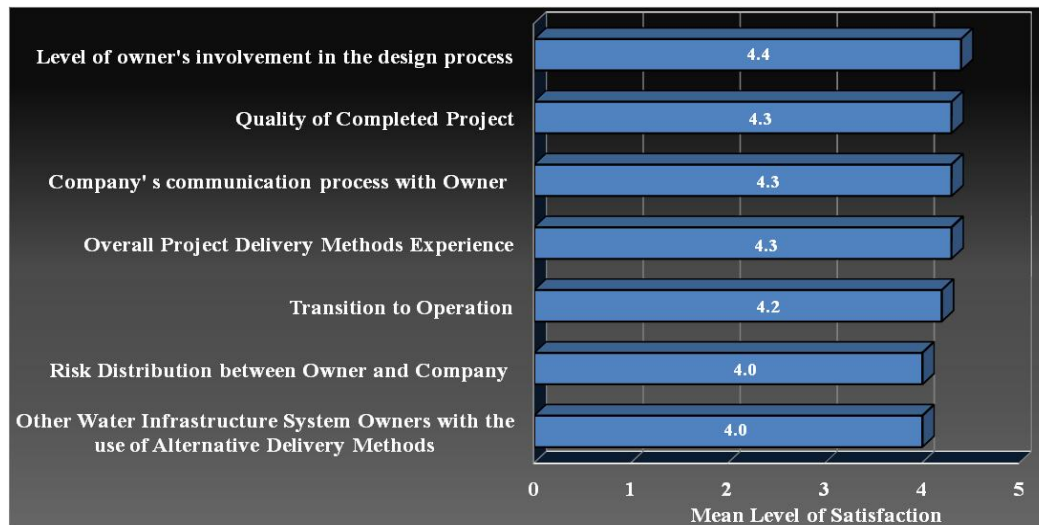


Figure 8. Mean level of satisfaction with various issues related to APD methods.

Satisfaction level comparison of DB and CMAR experience respondents

The results regarding the level of satisfaction of utility managers and project staffs with DB and CMAR methods in their projects are shown in the Figure 9. The results showed that respondents using the DB method were more satisfied than those using CMAR in all the issues except transition to operation. The top three issues that respondents indicated they were satisfied with the DB method were the level of the owner's involvement in the design process, the quality of the completed project, and their overall experience with the project delivery methods. The first top two issues the respondents they were satisfied with the CMAR method were same as for the DB method; however, with CMAR, they were more satisfied with transition to operation than their overall experience of the project delivery method.

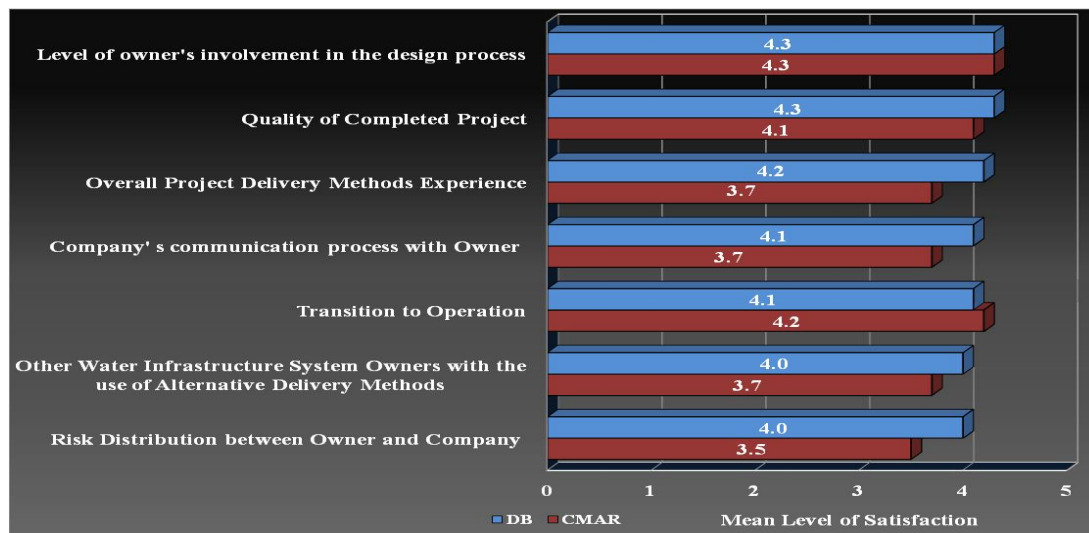


Figure 9. Mean level of satisfaction with DB and CMAR methods.

CONCLUSION AND RECOMMENDATIONS

The majority of the respondents for this survey were utility managers and project staffs who were involved mainly in water and wastewater projects. The survey results showed that the level of owners' satisfaction with water/wastewater projects using APD method was high. The project staffs and utility managers were highly satisfied with level of owner's involvement in the design process, the quality of the completed project, and company's communication process with owner. The majority of respondents were involved in two or three projects.

Furthermore, the most popular contract selection method found from the survey was best value, and the most popular solicitation process was the two-step solicitation process (RFP/RFQ). The common reason for using an APD method was schedule advantage. The top three reasons why respondents were more satisfied with the APD method were level of the owner's involvement in the design process, the quality of the completed project, and the company's communication process with owner. When the data set was subdivided based on DB and CMAR project experience, the majority of DB respondents were more satisfied with various advantages of the APD method than were CMAR respondents.

This survey did not determine the impediments in using APD methods for water and wastewater projects. Therefore, it is recommended that another survey be conducted to determine the impediments as well as possible solutions to overcome these impediments so that the APD delivery method can gain widespread use in water and wastewater projects.

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