ALTERNATIVE PROJECT DELIVERY METHODS
DO THEY SAVE TIME AND MONEY?

Gordon Culp
Smith Culp Consulting
SmithCulp.com

INTRODUCTION

Are there alternative methods for delivering water and wastewater treatment projects that can save time and money without sacrificing project quality? This is an especially relevant question in these difficult economic times. This paper addresses the question by comparing traditional and alternative project delivery methods in terms of their effects on project quality, schedule and costs. Project delivery methods discussed are:

Traditional

- Design Bid Build (DBB)

Alternative Project Delivery Methods

- Construction Manager at Risk (CMAR)
- Design Build (DB)
- Design Build Operate (DBO)
- Design Build Finance Operate (DBFO)

This paper is presented in the following sections:

- Overview of DBB
- CMAR, DB, DBO and DBFO described and compared to DBB
- Factors affecting delivery method efficiencies
- Cost, change order and time efficiencies of alternative delivery methods

OVERVIEW OF DESIGN BID BUILD

Description

In the traditional public sector DBB method, the local government (owner) is responsible for the design, construction and operation of the project. The owner has two contractual relationships: one with the design engineer who designs the facility and one with the construction contractor who builds the facility. The design engineer and the owner collaborate to establish the project framework and develop the design basis. The design engineer prepares the engineering design and assists with the subsequent bidding and construction process. There is no involvement of the construction contractor during the design stage.

Bids are solicited from contractors based on contract documents developed by the owner and the design engineer. A contract is then typically awarded to the responsive bidder who has the lowest bid. Following procurement through the bidding process, a separate contractor constructs the project. The contractor works to a defined scope of work for a fixed price. Once the project's construction phase is complete and the plant has passed an acceptance test, the construction contractor has no remaining connection with the project beyond the warranty period (typically one or two years) and the owner is responsible for the ongoing operation and maintenance.

Advantages

DBB is well understood and is a widely used method for public agency projects. Agencies typically have developed standard contracts and procedures based on experiences from many projects and are comfortable with the DBB approach. The owner maintains a high level of control during the design phase. There is typically a large pool of contractors who are familiar with completing public sector projects using this method. The advantages of this approach include owner and contractor familiarity with the process, ability to attract competition and the ability to spread work among several contractors.

Disadvantages

DBB requires the longest time for design and construction because design and construction are sequential steps with no overlap. There is a lack of emphasis on life cycle costs. Firm construction costs are not known until the design and bidding process is complete. Bids greater than the estimated costs can cause project delays while the construction documents are redone to reduce costs. Design documents often are more detailed and costly than necessary because of concerns that the low-bid contractor may be marginally qualified. The owner retains the risk for design errors.

CONSTRUCTION MANAGER AT RISK

Description

CMAR evolved from traditional DBB as a method to overlap the design and construction phases and to obtain significant constructability input during the design phase. In CMAR, the owner contracts separately with a designer and a construction manager/general contractor (CM/GC). The designer is contracted by the owner using a qualifications based submittal process and is responsible for the design. The CM/GC is also selected using a qualifications based submittal process. The CM/GC provides coordination services in lieu of a general contractor and provides design phase input and assistance. The CM/GC self performs portions of the construction and selects qualified subcontractors for the remaining portions. Although under separate contracts, the designer and CM/GC work together as a team during design through construction. In DBB, the construction contractor is not selected until the design is complete and provides no input to the design. CMAR provides for input from the construction contractor throughout design including involvement of the CM/GC in value engineering during design. The owner, designer and CM/GC are involved during the preparation of project cost estimates based on intermediate design milestones such as the 30% and 60% designs. At some point in the design (often around the 60-75% design point), the CM/GC negotiates a Guaranteed Maximum Price (GMP) for the project. The GMP is not exceeded unless the owner issues a change order. Any savings in costs under the GMP can be shared by the owner and the CM/GC or retained in full by the owner. Following acceptance of the project, the responsibility for project operation and maintenance transfers to the owner subject to the basic warranties of construction.

Competition on Factors Other than Price

The procurement process for CMAR allows the owner to consider the qualifications of the party that will construct the project rather than being required to select the low bidder if DBB were used. This allows the owner to evaluate the CM/GC's personnel to be assigned to the project, previous experience on similar projects, financial resources and the CM/GC's approach to the project. This provides the owner greater control over the quality of the constructor of the project.

Collaboration on Design and Construction

CMAR enables collaboration between the designer and the constructor throughout design and construction. The input from the CM/GC in design can avoid problems when construction begins. In DBB, the construction contractor has no opportunity to identify constructability issues during design.

Reduced Change Orders

The collaboration between the designer and the constructor throughout design and construction reduces the potential for Requests for Information (RFIs) and change orders during construction.

Schedule Compression

CMAR offers potential to compress schedules. Getting the construction contractor involved in the design has the potential to reduce construction time. After the GMP is negotiated and the detailed design is completed for critical elements of the project, selected stand-alone elements of the project can be put on a fast track for construction. The team can selectively complete designs and bid packages to accelerate project completion.

DESIGN BUILD

Because DBO and DBFO add operations or operations and financing to the DB foundation, the principles of DB are discussed most fully.

Description

In DB, the owner contracts with a private entity to design and build the project. The operation of the resulting facility is transferred to the owner after it is completed. Owners execute a single, fixed-fee contract for both engineering services and construction. The DB entity may be a single firm, consortium, joint venture or other organization assembled for the project. The construction member of the team usually leads the DB team with the design engineer as a subcontractor.

In selecting the design-builder, the owner employs a competitive proposal process, which typically consists of the issuance of a request for qualifications followed by a request for proposals. The design-builder is selected based on the overall value of the proposal, considering factors such as qualifications, performance guarantees, the quality of the proposed design, as well as price, rather than price alone.

The typical DB contract requires the design-builder to design and construct a project in accordance with a basic set of design requirements and to demonstrate that the project can achieve a defined set of performance standards through the successful completion of an acceptance test.

Design and construction services are carried out concurrently, saving time. Following acceptance of the project, the responsibility for project operation and maintenance transfers to the owner, subject to basic warranties of construction.

Transfer of Design Liability

A critical function of the DB contract is the transfer of design liability to the design-builder. The design-builder proposes the preliminary design for the project as part of the procurement process and, once the DB contract is signed, develops the detailed plans and specifications for the project in a manner consistent with the contractual design requirements. The design-builder is fully responsible for the design of the project and bears all risk associated with design errors or defects.

The design-builder is responsible under the contract until the project passes the acceptance test, subject to relief only in the event of the occurrence of circumstances beyond the design-builder's control. Problems can arise if the owner is overly prescriptive in developing the project requirements. The transfer of design liability is based upon the premise that the design-builder is responsible for developing the design from the preliminary design level to the detailed plans and

specifications. The owner runs the risk of negating this transfer of design liability if detailed plans and specifications are included in the procurement documents.

The transfer of risk is most clearly accomplished in the water and wastewater field when DB is applied to a new plant or a discrete addition to an existing plant. Complications can arise when attempting to apply DB to an internal modification of an existing plant because of the many factors in an existing plant that can affect performance that are beyond the design-builder's control.

Single Point of Responsibility

A well-drafted DB contract establishes the design-builder as the single point of responsibility for all aspects of design and construction with the sole responsibility for resolving disputes between design subcontractors and construction subcontractors. If the project fails to perform, the owner agency has a contract claim against the design-builder without the need to establish the negligence of the design subcontractor or to become involved in disputes between the design subcontractor and the construction subcontractor.

Risk Transfer

The DB contracting method enables the owner to transfer risks associated with design liability and disputes between design subcontractors and construction subcontractors to the design-builder. This is in contrast to the traditional DBB method of contracting where the owner enters into separate contracts for design and construction.

In general, when an owner furnishes plans and specifications to a construction contractor in the traditional DBB method, there is an implied warranty that the furnished design is capable of construction. The extent of the obligation of a construction contractor in the DBB approach is the construction of the project in accordance with the furnished plans and specifications. The construction contractor bears no liability for the furnished design. In addition, the design engineering contract in a DBB project is generally not a performance-based contract, which means that the owner must establish the negligence of the design engineer in order to prevail in a claim if there are design issues encountered in a project. This negligence standard creates a bar to relief for an owner that is significantly higher than the claim available under a DB contract in the event design issues cause a project to not operate properly or otherwise fail.

It is often unclear if issues that cause a project to fail originate from the design of the project or from its construction. This uncertainty can leave the owner under in the DBB approach forced to pursue claims against both the design engineer and the construction contractor, with each pointing the finger at the other. Under a DB project, one party (the design-builder) is responsible for making the project work. If the project does not work due to a design or construction defect, the design-builder is responsible, regardless of whether the reason for the failure is due to design or construction issues.

Prequalification

The procurement process for a DB project generally enables the owner to pre-qualify potential DB firms through a request for qualifications preceding the request for proposals. The owner is then able to narrow the field of respondents to the request for proposals to those firms possessing the best financial and technical qualifications for the project.

Prequalification is particularly important in water and wastewater treatment projects which involve sophisticated technology and can take a number of years to implement. The prequalification process can provide assurance to the owner that its contracting partner has the technical expertise to address challenges as they arise and the financial strength to sustain a long-term project effort.

Competition on Factors Other than Price

The request for DB proposals process enables competition on factors other than price, which can result in innovative proposals. This enables an owner to tap into private sector ingenuity to solve the particular design challenges of a given project. This is particularly useful in the context of a project involving a water or wastewater treatment facility that involves complex operations as contrasted to an office-building project or road project that does not. Through the request for proposals process, an owner can stipulate a basic set of performance requirements for the completed facility and require the DB firms to compete on proposed design solutions in their proposals. As price is also a factor in the selection process, the DB method generates competition on how to achieve the performance requirements in the most cost-effective manner.

Collaboration on Design and Construction

The DB contracting method enables collaboration between the design engineer and the construction contractor in the development of the proposal. The exchange of ideas between these parties can avoid problems when the construction contractor begins to implement the design. Under the DBB method, the construction contractors have no involvement in the development of the design or in identifying constructability issues that can lead to a greater risk of encountering problems in the implementation of the owner's design.

Earlier Price Certainty

CMAR, DBB and DB contracting offer fixed pricing – CMAR and DBB for the construction work, and DB for both design and construction services. A key difference is that under the DB method the lump sum price for the project will be known by the owner much earlier in the procurement process, and for a much lower transactional cost.

Design-builders will propose a fixed price in response to a request for proposals based on a 20% to 30% complete design. DBB contractors, by virtue of the nature of the procurement method, must await a 100% complete design from the owner in the request for bids. In CMAR, the fixed price is typically not known until the design is 60-75% complete.

DB transaction costs (primarily the owner's procurement and engineering advisors) typically are between 1% to 3% of the project's construction cost. DBB transaction costs can be from 8% to 12% of construction cost (mostly engineering fees for the 100% complete design). Using these

benchmarks for a hypothetical $100 million treatment plant, an owner can determine the actual cost of the project under DB within approximately nine to 12 months (the time for project planning, design to 20% to 30%, and receipt of proposals), with procurement transaction costs of $1 million to $3 million.

Under the DBB method, actual project costs will not be known for 18 to 24 months (the time for project planning, design to 100%, and bidding), with transaction costs of $8 million to $12 million (project design, engineering and procurement costs). Estimated project costs are prepared at the preliminary stage under either method, but under DB the owner is in a much better position to make adjustments to the project in the event the actual cost is unexpectedly higher than the planning estimate.

Schedule Compression

DB contracting is particularly useful for a project where schedule is a key concern. As contrasted with the DBB method where the design must be fully developed under a separate contract prior to the procurement of the construction contract, the DB method involves concurrent design and construction of the project This enables the design-builder to achieve efficiencies in the design and construction schedule. More rapid project delivery is often cited as the key reason for selecting the DB project delivery method. Time is saved by:

- Starting construction concurrently with detailed engineering
- Requiring less detailed documentation
- Eliminating time required to create duplicate and exculpatory information often found in the DBB process where the efforts of the designer, vendors and subcontractors are not coordinated
- Reducing time required for coordination between different entities
- Enabling timely incorporation of construction efficiencies into the design
- Identifying early opportunities to optimize schedule through work sequencing
- Reducing the risk of work interruptions
- Eliminating time lost debating whether a problem is caused by poor construction or poor design

Reduced Change Orders

Unless changes are dictated by the owner, design changes under a DB contract are generally the responsibility of the design-builder. In the event that the design-builder determines that a change to the design is required in order to meet the performance requirements of the DB contract, the design-builder must make such changes at its own expense and without schedule or performance relief. Change orders under a DB contract generally are issued only in the event of uncontrollable circumstance or the owner's project requirements change. Change orders are more common under the DBB method of contracting where the owner retains liability for changes needed to correct the furnished design.

Design Control

Concern is often expressed that the owner under DB has limited control over the development of the final design for a project. In a typical DB transaction, the owner develops only a basic description of the project and its requirements, focusing primarily on the performance standards that the completed project will be required to meet and on construction quality standards. While an owner may include prescribed design elements in a request for DB proposals, an overly prescriptive request for proposals runs the risk of negating the transfer of design liability. Thus, the nature of DB does require an owner to relinquish some control over the final details of design development. This makes the development of the performance requirements and construction quality standards for the completed facility in the request for proposals all the more important because these requirements can serve to dictate the nature of the facility design.

Methods that have been incorporated in the DB approach to see that the project meets the owner's expectations include:

- Use of a bridging engineer as the owner's representative and to develop a 20-30% design that describes the owner's needs and expectations.
- Qualification-based selection that consider overall value, not just cost. For example, in the Seattle Tolt water treatment plant DBO project, only 40 % of the contractor selection criteria were based on price. In the Detroit water treatment plant Design Build Maintain project, only 25% of the contractor selection criteria were based on price. Qualification-related criteria comprised the majority of criteria in both cases.
- Quality assurance plans authored by the owner and design-builder.
- Performance guarantees.
- Detailed acceptance testing requirements.

Lack of Long-Term Vested Interest

A potential disadvantage of implementing a project such as a water or wastewater treatment facility with DB is the lack of a long-term stake on the part of the design-builder in the operation of the facility. Respondents to a request for proposals are motivated by the competitive process to propose the lowest cost facility that will achieve the performance standards. However, the design-builder's responsibility with respect to project performance effectively ends at the completion of the acceptance test and the turnover of operational responsibility to the owner. Accordingly, while the owner can be confident that the DB process will result in a facility that will pass the acceptance test, the owner retains the risks associated with long-term functionality and operations, maintenance and repair and replacement costs.

These long-term risks can be mitigated by carefully developed selection criteria, prescribed design elements and performance standards. However, there are risks associated with these mitigation measures. For example, while the owner can include items such as project operability and life cycle costs as evaluation factors in the selection criteria, there is no way to contractually guarantee such items. The design-builder has no control over project operations following acceptance and will not assume risks associated with long-term operations. The absence of a long-term vested interest in

the project on the part of the contractor is also a fundamental characteristic of the traditional DBB method.

The risks associated with project operations are mitigated through the DBB and CMAR methods of project delivery by developing a project design tailored to the owner's particular operating concerns. However, in DBB and CMAR the owner will ultimately bear the operating risk, as well as the design and construction risks. In determining which method will best serve the owner's needs, the risks associated with project operations in the DB context will need to be weighed, along with the mitigation measures discussed above, against the advantages and benefits of DB. One way to solve the operations risks associated with DB while retaining its advantages and benefits is through the DBO method discussed in the next section.

DESIGN BUILD OPERATE

Because DBO adds operation to the DB foundation, the applicable principles discussed in the preceding section on DB are not repeated. The advantages discussed earlier for the DB method apply equally to the DBO method.

Description

The public sector finances the project and sets performance objectives. A private partner, the DBO contractor, is engaged to design, construct, maintain and operate the facility. The DBO contractor serves as the single point of responsibility for all aspects of design, construction and operation for the term of the service contract that is typically 15 to 20 years following project acceptance. Ownership of the assets remains with the local government. The private partner may be a single firm, consortium, joint venture or other organization assembled for the project. The team is often made up of a design firm, a construction contractor and a firm that specializes in contract operation. The DBO team is typically led by the operations member of the team with the designer and construction contractor in subcontract roles.

The primary purpose for combining design, construction and operations into a single contract is to integrate all three areas of expertise and responsibility during every phase of the project. The aggregation of these services allows for an operator-driven design and permits a full level of cooperation between the designer, builder and operator. Cost savings can result from the reduction of pricing contingencies typically included when they work individually, without the opportunity to collaborate in the typical DBB process.

The DBO Service Contract

A typical service contract incorporates the DB contract provisions discussed earlier and also requires the DBO contractor to operate and maintain the facility for the term in accordance with carefully defined performance guarantees. The service contract provides for the payment of an annual fixed service fee for the performance of the operations and maintenance services, subject to an indexed inflation adjustment factor. In addition to assuming the risks associated with design and construction, the DBO contractor assumes risks associated with project operations, including the risks of project performance and the costs of operations and maintenance. As under the DB

method, the typical service contract provides for price, schedule and performance relief only in the event of carefully defined uncontrollable circumstances.

The Selection Process

An owner typically uses the same competitive proposal procedures in selecting a DBO contractor as are used in selecting a design-builder in the DB method.

Project Description

An owner considers similar factors in developing the project description as considered under the DB method. However, because the DBO contractor will assume long-term operations and maintenance responsibility for the project, prescribed design elements are generally less of a concern. This enables the owner to rely on the performance requirements to generate competition for the most cost-effective design. The DBO method also enables the owner to anticipate changes in future regulatory requirements in developing the operating performance guarantees. Enhanced standards can be included in a DBO contract to capture standards expected to be required in the future.

Risk Transfer

In addition to the transfer of design liability and the risk of disputes between various subcontractors, the DBO method enables the owner to transfer significant operating risks to the DBO contractor. The DBO contractor is obligated to operate and maintain the facility in accordance with all permit requirements and stipulations. The DBO contractor is ordinarily responsible for all fines and penalties assessed by governmental bodies and must indemnify the owner from third-party claims. The DBO contractor bears the risks associated with the operation and maintenance of the facility, including the risk that the facility costs more to operate and maintain than anticipated by the contractor in offering its fixed service fee.

In a typical DBO contract, the DBO contractor's fixed service fee will be subject to adjustment only in accordance with an indexed inflation adjustment factor or in the event of the occurrence of carefully defined uncontrollable circumstances. If, for example, the DBO contractor requires more labor for the operation and maintenance of the facility than originally proposed, the associated costs are the responsibility of the DBO contractor.

Operator Collaboration and Responsibility Affects Project Quality

The DBO method enables the development of an operator-driven design that will involve significant attention to project operability. The fact that the DBO contractor will be responsible for the operation of the facility over a 15-20 year period helps to ensure that the project will be designed and constructed in a manner that will produce a high quality, operable facility.

DBO Companies

There are fewer companies who have the operations capability for a DBO project which results in less competition than if DBB, CMAR or DB were used. However, The companies that compete in the DBO industry are strong companies that specialize in providing the services required for a DBO

project. These companies often have investment grade credit ratings, which enable them to provide the financial security required in connection with major capital improvement projects.

Control of Ongoing Operation

In DBO, owners relinquish direct operating control of a critical public asset to the DBO contractor. While the governmental agency remains the owner of the asset, control of the day-to-day operations is transferred to the DBO contractor. If service issues arise, the owner works within its rights in the DBO contract to address these issues. Thus, it is critical that the DBO contract clearly defines the service responsibilities of the DBO contractor and provides effective enforcement mechanisms for the owner. The owner must understand that it will have a continuing contract administration and monitoring role for the life of the contract.

An important contract element of owner control in a long term DBO contract is the ability to terminate for convenience upon payment of a convenience termination fee without having to prove DBO contractor default. The size of the fee is defined in the service contract and will depend on the project size and remaining term of the operations portion of the contract. The convenience termination fee is typically a fraction of the annual service contract fee.

DESIGN BUILD FINANCE OPERATE

Description

The private sector designs, finances, constructs, maintains and operates the facility. Ownership of the assets remains with the local government. The DBFO team member that provides the financing typically leads the DBFO team with the designer, builder and operator as subcontractors.

DBFO retains the advantages described for DB and DBO plus increased value through transfer of risk to the equity holders in addition to the risk transfer to the designer, builder and operator. The equity holder provides an added level of diligence for effective project execution. However, DBFO involves loss of tax exempt financing for public agencies in the United States, higher interest costs associated with private financing and added procedural and contractual complexities. There are fewer contractors available who have the financial capability or desire for a DBFO project which results in less competition when compared to the other methods. There are only about five major operating services firms with the technical and financial strength and expertise to handle a large DBFO project.

The financing component is a key part of the services provided in DBFO. Most operating services firms are not experienced in being project equity sponsors or arranging private project financing. If they do elect to participate, they are much more likely to team with an investment or development firm to provide the financing component. The typical structure of a DBFO involves a financially led team rather than the operator-driven team found in DBO. Subcontracting to the financial member of the team rather than dealing directly with the owner may be problematic for some operating services firms. These firms are used to leading a DBO team, not subcontracting under a DBFO. While the DBFO model may be familiar to equity sponsors, the unfamiliarity of wastewater operating services firms with this approach can be an issue.

Cash Flow

In DBFO, typically no payments are made to the DBFO contractor until the facility has been completed, has passed the acceptance test and is in full operation. In some circumstances, the owner may find this deferral of cash flow to be a benefit.

Convenience Termination

As in DBO, an important contact element of owner control in a DBFO contract is the ability to terminate for convenience upon payment of a convenience termination fee without having to prove contractor default. However, in DBFO the convenience termination fee must cover equity, equity return and outstanding loan balances. Their payment in effect represents a payment for the purchase of the asset. In the event an unworkable relationship develops, the owner will need to raise or borrow the large amount of money needed to essentially refinance the project and end the relationship. This barrier to convenience termination is not present in the DBO method.

Risk Transfer

The equity sponsor investment and loan repayment will be jeopardized if service is not properly provided. As a result, equity sponsor involvement represents an extra layer of diligence beyond that provided by the operating services firm. It also provides a financial cushion to absorb the risk of collecting damages from the design-builder and operating services subcontractor should they fail to perform. However, this collection risk has rarely occurred on dozens of projects implemented by the major operating service firms. In DBO, because the operating services firm is the single point of accountability and has the resources to absorb any reasonably conceivable damage amount, the presence of the project financing parties to take the collection risk may result in a relatively small incremental increase in risk transfer.

FACTORS AFFECTING DELIVERY METHOD EFFICIENCIES

The DBB approach is a well-proven approach and remains the most widely used delivery method for public agency capital projects. It is well understood by public agencies and their extensive experience with DBB has typically led to well developed procurement and contract documents. DBB achieves open, aggressive competition for construction that is the largest element of project cost. But, the involvement of multiple parties in DBB each having their own interests and liabilities to protect can result in conservative project design and construction that increases project cost. There is normally an efficiency gain from the use of an alternative project delivery method when compared to the traditional DBB approach. Cost savings can result from several factors:

- Not all of the information generated during the DBB process is needed to construct the project. The designer often assumes that the least qualified contractor will build the project and the designer will go to extremes to make certain that the most basic information is available. Protective information is added to limit claims. A maximum amount of detail is provided so that even the least qualified contractor has the detail needed to complete the project in accord with the design intent.
- The designer may have to account for multiple equipment choices and “or equal” considerations instead of designing for a specific piece of equipment.

- Routing of piping, conduits, HVAC is often designed twice – once by the designer and once by the detailers responsible for preparing the fabrication and material ordering documentation.
- Technical specifications are often quite detailed to include protective language and to completely describe material and equipment.
- Redesign often results from changes to selected equipment or details provided during the shop drawing process.

ALTERNATIVE PROJECT DELIVERY METHOD OUTCOMES

Quality

A study(1) of 351 CMAR, DBB and DB projects asked the owner to rate how well the quality met their expectations after project completion. The owner was asked to rank the actual performance of its facility versus expected performance. The authors concluded that DB and CMAR "significantly outperformed" DBB and that DBB, on average, "barely met facility owner/developer expectations" in regard to specific system performance metrics.

The above referenced study of 351 projects examined the factors with the greatest difference between the top and bottom performing projects. The study found the following to be the critical success factors:

- Excellent project team communication
- High ability to prequalify team
- Excellent subcontractor experience with the type of facility being built
- High ability to restrain the contractor pool
- Excellent contractor experience with the type of facility being built

The ability in CMAR and DB to consider contractor qualifications and the quality of the proposed design in the selection of the design-builder is a key to achieving the prequalification and restraint of the contractor pool noted in the second and fourth bullets above. In DBB, the selection of the DBB contractor is driven by the low-bid and there is less control over the quality of the contractor pool.

A study(11) of 147 water and wastewater treatment projects found that owners of DB projects were as satisfied with project quality as were the owners of DBB projects.

Cost Efficiencies

Cost savings associated with alternative delivery methods have been reported in the several sources summarized below.

In a comparison of costs for 351 buildings, Sanvido and Konchar(1) found that CMAR had a unit cost 1.6% less than similar projects delivered with DBB. They found that DB provided an average of 6.1% reduction in unit construction costs with a 99% level of certainty when compared to DBB.

Larger cost savings have often been reported for water and wastewater projects in which DB or DBO has been used.

An analysis of several case studies developed estimates of capital cost savings from five water/wastewater projects that used the DB approach[2]. These savings in capital costs from those estimated for the DBB approach ranged from 14% to 43% with an average of 29.4%.

William Reinhardt, editor of Public Works Financing, surveyed municipal water and wastewater DB projects and reported that the average capital cost-savings of 19 projects was 39%[8]. Public Works Financing, also surveyed municipal water and wastewater projects using the Design Build Operate (DBO) method and reported that the average life cycle cost-savings of 22 projects was 26%[8].

The City of Longmont, Colorado reports construction cost savings of $2.8 million for a DB water treatment plant project with a $43 million budget, a savings of 6.5%[7].

The City of Seattle estimates that it reduced the construction costs of the new 454 ML/day (120 mgd) Tolt water treatment plant by at least 30% by using DBO and reports a net present worth savings of 47% including operating cost savings[4]. The savings at Seattle were based on a comparison of the actual DBO costs with a benchmark cost estimate based on a 30% design of the Tolt plant. The 30% design had been prepared in anticipation of using the DBB delivery method before the City decided to change to the DBO method. The project delivered with the DBO method has the same capacity and meets the same finished water quality and reliability standards as the DBB project that had been planned. The benchmark DBB design had been subjected to two value engineering reviews. A lot of thought and creativity had gone into the DBB design including cost estimates by the VE team and a third independent cost estimate. Although the DBO savings are based on comparing an estimated cost with an actual bid, the benchmark cost estimate had been carefully scrutinized.

Seattle also chose DBO for a second water treatment plant, the Cedar River Project, where life-cycle savings compared to the benchmark project were reported to be 31% ($50 million savings relative to a $159 million benchmark)[8]. The City of Lynn, Massachusetts reported[9] a life cycle savings of 45% for DBO approach for its wastewater treatment plant.

The City of Phoenix used the DBO approach for the 303 ML/day (80 mgd) Lake Pleasant Water Treatment Plant. The plant has been constructed and is in operation. The table below summarizes the three DBO bids and the benchmark project costs of net present value of design, construction and 20-year operating costs. The benchmark costs were based on a 20% design.

Earth Tech was selected but withdrew because of financial problems of its parent company, Tyco. At the completion of construction by the All American team, final costs were 8.1% below the City's benchmark costs.

Table 1
Phoenix, Arizona Lake Pleasant Water Treatment Project Life Cycle Costs
Using DBO Compared to Benchmark Estimate

	All American	*Bradshaw*	*EarthTech*
DBO Price Proposal Net Present Value	$336,701,630	$361,636,969	$286,709,244
City Benchmark	$366,492,876	$366,492,876	$366,492,876
Difference from Benchmark	($29,791,246)	($4,855,907)	($79,783,632)
% Difference from Benchmark	8.1%	1.3%	21.8%

A limitation of extrapolating the savings reported in the above examples is that they compare the actual cost of alternative delivery methods with estimated costs of the project delivered by DBB. The only way to precisely determine the relative capital cost of a project delivered by DBO and traditional DBB is to bid the project using both DBO and DBB. There are very few cases where this has happened. In one case where this occurred (Washington Borough, New Jersey) the savings for the DB approach were 12.1% on a $9.9 million wastewater treatment project[3]. In another case in Lee, Massachusetts involving a 5.6 ML/day (1.5 mgd) sequencing batch reactor wastewater treatment plant, the DBO bid was 35% less than the $21 million DBB bid[10].

Change Order Efficiencies

In the conventional DBB approach, the construction contractor is usually entitled to a change order if the project is disrupted by the owner's actions, if project conditions change or if design problems occur. In the DB approach, the first two occurrences may result in change orders while the third ordinarily does not. Because the design-builder is responsible for the plans and specifications, it cannot use errors in them to expect a change order. Of course, if the owner changes the project criteria, the need to change the design may result in a change order. A study of 104 public sector DB projects found that cost growth during construction was 3% to 4%[5]. A study of 351 projects found that the cost growth for DB projects was 5.2% less than for DBB projects while CMAR had 7.8% more cost growth than DBB projects[1]. A study[11] of 147 water and wastewater projects found 38% of DB projects finished on or under budget versus only 20% for DBB projects.

Time Efficiencies

Methods involving DB have shown greater time savings than CMAR. In their study of 351 projects, Sanvido and Konchar[1] found that CMAR had an overall delivery speed that was 13.3% faster than DBB and construction speed that was 5.8% faster. They found that DB had an overall delivery speed that was 33.5% faster and construction speed that was 12% faster than DBB. They also found that DB had 11.4% less schedule growth than DBB and CMAR had 9.2% less schedule growth than DBB. A study[11] of 147 water and wastewater projects found DB projects to have less overall schedule growth than DBB projects and that more DB projects were completed on time or early. Examples from the water and wastewater treatment field confirm that substantial time savings can be achieved. Seattle completed the 120 mgd Tolt water treatment plant in 30 months after executing the DBO contract. Similarly, San Diego completed the 100 mgd Twin Oaks water

treatment plant within 30 months after executing their DBO contract. Under DBB, one would expect 100-120 mgd plants to require at least 39 months (at least 12 months for design, 3 months for bidding and 24 months for construction). Spokane County had construction underway on a $130 million water reclamation plant 5 months after signing a DBO contract.

CONCLUSION

Alternative project delivery methods can save time and money while delivering equal or superior project quality when appropriately applied to water and wastewater treatment projects. Alternative delivery methods have the greatest potential when applied to projects involving new plants or discrete additions to existing plants, projects that are schedule driven or projects that offer the potential for innovative solutions.

ACKNOWLEDGMENT

This paper is partly based upon the work of a peer panel that evaluated alternative project delivery methods for a new regional wastewater system for the Capital Regional District, Victoria, British Columbia. The members of the panel were: Gordon Culp, Smith Culp Consulting, Las Vegas, NV (chair); Eric Petersen, Hawkins, Delafield and Wood, New York City; George Raftelis, Raftelis Financial Consultants, Inc., Charlotte, NC; Don Lidstone, Lidstone & Company Law Corporation, Vancouver, BC; and Arn van Iersel, independent consulting professional accountant, Saanichton, BC. Tony Brcic was the project manager for the Capital Regional District and was an active participant in the study.

REFERENCES

1. Sanvido, V. and Konchar, M., "Selecting Project Delivery Systems", Project Delivery Institute, State College, PA (1999).
2. "Alternative Delivery Method Investigation for the Lake Pleasant Water Treatment Plant," City of Phoenix, Arizona (1999).
3. "A Growing Trend," Water and Wastes Digest, (March 2006).
4. www.seattle.gov/About/SPU/Water_System_Qualilty/Tolt_Treatment_Facility (2008)
5. Molensar, K.R., Songer, A.D., and Barash, M., "Public-Sector Design/Build Evolution and Performance", ASCE Journal of Management in Engineering, page 54, (March/April 1999).
6. Goddard, M., personal communication (March 2008).
7. "Colorado Water Treatment Plant Earns Design-Build Award", news release, Black and Veatch (October 23, 2006).
8. "Design-Build-Operate Gains Popularity in U.S. Market," Water World (December 2003).
9. "Best Practice: Lynn (MA) Water/Wastewater Innovation Saves Ratepayers Hundreds of Millions," U.S. Mayor Articles (May 28, 2001).
10. Cohen, A. Personal communication (May 2008).
11. "Independent Comparative Evaluation of Design-Build v. Conventional Design-Bid-Build Project Delivery for Municipal Water and Wastewater Facilities," University of Colorado, Iowa State University, University of New Mexico, Water Design-Build Council (August 2009).