WATER DESIGN-BUILD COUNCIL
AN ASSOCIATION OF LEADING DESIGN BUILDERS

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Water and Wastewater Design-Build Handbook

Fourth Edition

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AN ASSOCIATION OF LEADING DESIGN BUILDERS

The Water Design-Build Council's mission is to advance design-build delivery methods to transform the water industry through thought leadership and education, supported by research.

WDBC MEMBER COMPANIES

WDBC is comprised of 11 member firms representing over 60% of the design-build firms on the ENR list top 100 list delivering water infrastructure projects. Membership comprises any private sector company engaged in integrated design and construction services or in construction management at risk (CMAR) as a prime contractor or under a risk sharing arrangement with a partner; and which has in-depth, in-house comprehensive engineering capabilities to design and build public and investor-owned rate regulated utility water or wastewater treatment facilities in North America.

WDBC ADVISOR COMPANIES

WDBC Advisors is a new member category comprised of industry stakeholders and practitioners, who support the mission and vision of WDBC, and engaged with the organization in further recognition of their services in the water design-build industry. The purpose of the Advisors is to advise WDBC with additional industry perspectives in the furtherance of collaborative delivery through communication of industry trends, lessons learned, and advocacy of best practices.

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Acknowledgments

The Water Design-Build Council (WDBC) and the Design-Build Institute of America (DBIA) entered into a Strategic Alliance Agreement in June of 2015 to further our joint efforts in providing industry-leading education for owners and practitioners in the water sector.

This updated and expanded **Fourth Edition of the Water and Wastewater Design-Build Handbook** represents our organizations' continuing commitment to effective collaborative delivery. It provides detailed education and reference resource that integrates WDBC's practical guide to the full spectrum of collaborative delivery methods with DBIA's best practices for design-build. In addition, this edition introduces a discussion of how effective collaborative delivery is essential to the implementation of a public-private partnership (P3) project.

We trust that this Handbook will be of value to all who support the water sector, and that together we can meet the many challenges of procuring and implementing collaborative delivery methods for the water and wastewater infrastructure. This Handbook is a just a starting point. We encourage you to access the many resources available from both WDBC and DBIA.

We wish to acknowledge the valuable contributions of both organizations' members in the production of the technical content and review of this F**ourth Edition**. We especially recognize the work and leadership of Dr. Linda Hanifin Bonner as editor-in-chief — her efforts have kept this effort on schedule and established the foundation for collaboration between the DBIA and WDBC, as well as the chapter contributors.

In the spirit of effective collaborative delivery, we know you will make great use of this resource.

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ISBN 978-0-692-70786-9

Original publishing date 2008

The Water Design-Build Council's 2016 Handbook provides information and advice to guide owners of water and wastewater systems, both municipal and private, in using collaborative delivery methods for capital projects. The Handbook is not intended to substitute for sound advice from owners' legal or other experts, design-builders, CMAR firms, or individuals experienced in collaborative delivery. Each community and each project will have its own needs and requirements, which should be addressed by individuals familiar with those specific circumstances.

Handbook design and graphics by Fishergate, Inc., Chester, Maryland

Introduction

The use of collaborative delivery methods for water and wastewater projects has been steadily increasing over the past decade. Throughout this period, research conducted for the Water Design-Build Council (WDBC) in using these delivery models reports that more and more owners praise them for their ability to achieve quality projects on schedule and within budget. Owners also agree and recommend on the continuing need to educate industry professionals about how to maximize success with these methods.

This Handbook provides comprehensive information and clear direction on best practices on the various collaborative-delivery methods to those responsible for procuring, designing and building public and private water or wastewater capital projects.

Since its first edition in 2008, and through two subsequent updates, the Water Design-Build Council's Water and Wastewater Design-Build Handbook has focused on achieving its education mission by producing guidance documents on the various collaborative delivery methods. Through the 4th Edition of this series, WDBC's is furthering its purpose with expanded and more inclusive information and clear direction on best practices to those responsible for procuring, designing and building public and private water or wastewater capital projects.

This 2016 update is more encompassing and descriptive than previous editions. It now includes a chapter on preparing an owner's organization to pursue a collaborative delivery project, including extensive discussion of the roles and responsibilities of both the owners staff and that of an owner's advisor. The chapter on managing projects is revised to ensure that owners comprehend the essential practices to effectively implement a project from procurement through construction. In addition, a new chapter introducing the topic of public-private partnerships (P3) as it relates to collaborative delivery projects, specifically within the water and wastewater industry has been developed.

The glossary is expanded to facilitate the clarity and consistency of terminology applied throughout the water design-build industry. One specific example is use of the term "collaborative delivery," – which is now used to minimize the confusion previously caused by the occasional and inconsistent use of the terms "alternative delivery"—and, less often, "integrated delivery." Collaborative delivery, which integrates all of the design-build delivery methods is now a more effective, inclusive and applicable approach than the design-bid-build—and is really no longer considered as an "alternative."

The Handbook's chapters are structured to take an organization through the fundamental steps of a collaborative procurement, management and implementation processes. DBIA's Best Practices are also used to reinforce the overall principles and guidance provided within the chapter topics. The 30 case studies following the Handbook chapters provide examples of successful design-build projects of WDBC's members. In addition, other case studies are also included in chapters as they relate to the specific topic.

Since education is WDBC's mission, updates within this Handbook are also reflected in the current educational modules produced by the WDBC and available on our website, waterdesignbuild.com. Highlights of the contents of each of the Handbook chapters follows.

Chapter 1, Preparing to Procure and Manage a Collaborative-Delivery Project, introduces and takes owners through an internal and external decision-making analysis to prepare them to identify the needed resources to achieve successful collaborative-delivery project. This entirely new chapter includes an exercise in determining critical project priorities, an introduction to developing the project-implementation plan, together with a new section describing the procurement, roles and responsibilities of an owner's advisor.

Chapter 2, Principles and Best Practices of Design-Build Delivery, explains the various collaborative delivery methods—defining the differences among them, as well their advantages and distinctions. The specific update in this chapter are the new delivery methods graphics illustrating the relationship of the often concurrent project activities occurring throughout procurement, management and implementation. Also provided is a decision-making model for use in evaluating the various collaborative delivery methods, against project priorities, and selecting the one most in alignment with the owner's goals.

Chapter 3, Apportioning and Managing Project Risk, describes the contents of a systematic risk assessment process, for use in reaching agreement between an owner and collaborative delivery firm in allocating risks to the party best able to manage or finance them.

Chapter 4, Conducting the Procurement Process, expands on the explanation of the collaborative delivery methods in chapter 2 and describes the major steps in the procurement process from preparing the request for qualifications and request for proposals to selecting the design-builder or CMAR firm. While this chapter further incorporates information from the WDBC Procurement Guides on Progressive and Fixed-Price Design-Build and CMAR, users are also encouraged to obtain the actual documents from the WDBC website.

Chapter 5, Managing Collaborative-Delivery Projects, focuses on the management activities that commence once the contract with the collaborative delivery firm is signed. Guidance on furthering the overall collaboration among the respective parties throughout the implementation of the project is based upon successful accomplishments.

Chapter 6, Transition to Owner Operations, addresses the final steps of successfully completing a project, from startup and commissioning, through project acceptance, to transitioning to owner operations. However, it also emphases the importance of beginning the transition process in the planning phase.

Chapter 7, Design-Build-Operate, describes the attributes and characteristics involved in the accepted and well-used, design-build-operate delivery method.

Chapter 8, Public-Private Partnerships, a topic receiving a lot of interest in the water industry, focuses on providing an understanding of the fundamental terms, concepts and applications, as they apply to water and wastewater projects.

A **glossary of terms** used within the Handbook and within the industry has been expanded to facilitate the clarity and consistency of terminology applied throughout the water industry for design-build projects.

A **compendium of more than 30 case studies**, describe some of the more recent and innovated collaborative delivery projects accomplished by WDBC member firms. Additional case studies are also within the chapters themselves as they relate to the chapter topic.

A separate **list of reference documents**, some of which have been cited in the chapters and others included as additional sources, are provided for use by industry members to further their education process.

At the same time, it is important to understand that the contents of this Handbook are not intended to substitute for sound advice from your own legal and other experts, consultants/contractors themselves, or other individuals experienced in collaborative project delivery. Each community and each project will have its own specific needs and requirements, which can best be addressed by professionals familiar with those specific circumstances.

—Linda Hanifin Bonner, PhD, Editor-in-Chief

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CHAPTER

1

Preparing to Procure and Manage a Collaborative-Delivery Project

A successful collaborative-delivery project begins with **education within the owner's organization**. This extensive process ranges from assessing the organization's familiarity with collaborative delivery and readiness to embark on a collaborative-delivery approach, to identifying external factors that may affect the owner's ability to complete the project. As dynamics within organizations and the design-build industry evolve, so does the need for an effective roadmap.

Chapter 1 provides guidance to help owners establish their roadmap by addressing the internal and external factors that affect water and wastewater projects in today's environment. It includes guidance on building internal understanding and consensus about a project's goals and priorities, as well as how to use those findings to make effective decisions. The chapter is intended to help an owner and its staff determine what information it needs for decision-making, as well as what to include in procurement documents to help proposing firms understand the owner's expectations, project priorities, and technical requirements.

The end results are intended to accomplish the owner's goals: an efficient procurement and a successful project— completed on schedule and within budget.

Preparing to procure and manage a collaborative-delivery project requires the owner and its team to compile relevant information about the organization and the project, and then use the information for the components of a project implementation plan. Development of this plan includes the following actions.

1. Conducting an overall **preparedness assessment**, which requires answering and addressing a series of questions about certain factors—both external and internal to the organization—that ultimately affect the success of the project.
2. Using that information to reach agreement on the project's priorities—and translating those priorities into the **project drivers**.
3. Developing the framework for a draft **project implementation plan**, which incorporates the information and agreement described above, and may also include considering the possible need for, and potential use of, an owner's advisor.

An owner should conduct a proactive and objective assessment of the unique characteristics of its project and its organization before deciding to use design-build or CMAR delivery. It is crucial to have an organization that supports the collaborative-delivery project from procurement to completion, with key owner personnel involved in all areas.

Source: DBIA 2015 Design-Build Best Practices for the Water/ Wastewater Sector

Managers look out over the DC Water (Cambi) Energy Recovery System.

Preparedness Assessment

Assessing the owner organization's preparedness to procure and manage a collaborative-delivery project requires identifying various external and internal factors that affect the project, and using the information to determine the owner's project priorities and, ultimately, its drivers. The core questions to begin this process are described below.

Identifying and Evaluating External Factors — concentrates on clearly understanding the situations external to the organization that affect the success of the project.

- Are there any clear or specific drivers as a result of state and local regulations and/or planning requirements or mandates?
  - If so, what are they, and how do they affect schedule and performance standards?
- Is there adequate funding to complete the project, or does it rely on other sources?
- Is it necessary to select the site and/or purchase property prior to procuring the services of a contractor?
- What permits or regulatory approvals will be required for the project, and which party will be responsible for securing them?
- Is there, or will there likely to be, any significant public interest/ outreach requirements affecting the project?
- Are there relevant or important stakeholders that may be affected by the project? How will they be engaged in the process? Are there resources available for this aspect of the project?

State and local regulations. *Are collaborative-delivery methods allowed? If so, which specific collaborative methods, and are there any limitations or restrictions?*

The first step is to determine which, if any, of the collaborative-delivery methods are legally permitted for water and wastewater infrastructure projects in the owner's state, jurisdiction, and organization. Because statutes and regulations vary from state to state, as do local ordinances within different jurisdictions, it is beyond the scope of this Handbook to cover all circumstances. The Water Design-Build Council has completed two surveys of states that are known to allow one specific type of collaborative delivery: progressive design-build. Results of these surveys are available on the WDBC website (waterdesignbuild.org).

For more definitive and current information, it is recommended that owners obtain legal advice on project-delivery laws and regulations in their jurisdictions, as well as how they apply to the specific project. Additional sources are identified in the References section.

Funding. *Are available funds sufficient and allocated to complete the project on schedule and/or are they dependent on other sources?*

There may be questions concerning adequate funding to accomplish the project's goals and priorities. Because owners may have access to a variety of resources and potential funding streams, this Handbook does not make recommendations about project funding. To give owners a clearer understanding of a different financing option, however, Chapter 8 discusses public-private partnerships (also called P3 or PPP).

Developing a current and realistic estimate of the cost of the project is an important part of the planning process. A project estimate typically takes into account both internal and external resource requirements, schedules and contingencies; and, it also facilitates determining whether a project has adequate funding. Preparing procurement documents and evaluating statements of qualifications (SOQs) and proposals requires dedicated time and resource commitments for owners and should be considered as a funding resource need. Likewise, submitting SOQs and proposals requires dedicated time and resource commitments for collaborative-delivery firms. No organization wants to begin a procurement process, only to find that the anticipated project is canceled or indefinitely postponed due to insufficient funding.

Whenever funding is a concern, two collaborative-delivery methods—progressive design-build (PDB), and construction management at-risk (CMAR)—make it possible to determine a project's cost early in the design process. In PDB and CMAR, the owner works collaboratively with either the design-build or CMAR firm to develop the design to a point where project costs can be estimated. Specifically, PDB and CMAR delivery methods provide the flexibility necessary to address any budgetary concerns before an owner agrees on a final price and proceeds to construction. In addition, both PDB and CMAR delivery can be used in a phased process, which may include developing early bid or response packages that can span multiple budgetary cycles to help manage project costs and cash flow.

Site selection and purchase. *Does land need to be purchased prior to procuring design and construction services?*

The project site has significant impact on decisions regarding design, construction, and other associated project costs. Some states have laws requiring that land be acquired in advance of any procurement for capital improvement. In any case, it is best to select the site and acquire the land and any required easements before procuring these services.

This topic is particularly important when procurement documents require that proposals include a fixed price or a guaranteed maximum price (GMP). If the site location has not yet been established, or if there is uncertainty surrounding ownership, initial pricing may prove inaccurate, pending resolution of such matters.

Should an owner want to procure services for a project prior to site selection and property purchase, it may be in the owner's best interest to use progressive design-build or construction management at-risk as the delivery method with deferred pricing (to address permitting, geotechnical, design consideration, and environmental hazards). (See Chapter 4 regarding procurement.)

Permits and regulatory approvals. *Which ones are required for the project, and which party is responsible for obtaining them?*

The permitting process is always a project requirement and often a schedule driver. Securing as many of the required permits and approvals as possible—particularly discretionary ones such as environmental permits—prior to initiating the procurement process works to mitigate any potential impacts on the project's scope and schedule.

Early on, a member of the owner's team should develop a plan for obtaining the required permits to avoid schedule delays. The permitting and approval plan should be written into the contract so all parties clearly understand what they are committed to provide and what they can rely on others to provide.

Obtaining required governmental permits, such as those for construction purposes, is the responsibility of the collaborative-delivery firm. Owners generally undertake acquiring discretionary permits, which typically require significant time to obtain and which may depend on the owner's relationship with the permitting agency.

The ability to expedite the permitting process is a key benefit of collaborative project delivery. Depending on the regulatory agency, design-build and CMAR firms may be able to seek needed approvals and permits before the design is complete.

Leadership plays a critical role in recognizing the importance of involving procurement, legal, operations and maintenance departments in successfully procuring and completing capital projects, as well as in developing processes to educate and seek input from key personnel in those departments. This is particularly important in instances where departments are unfamiliar with design-build and CMAR project delivery.

Source: DBIA 2015 Design-Build Best Practices for the Water/Wastewater Sector

Identifying and Evaluating Internal Factors — devotes attention to evaluating the conditions within the owner's organization that affect its ability to successfully complete the project.

- What is the level of involvement that the owner and staff desire in the project?
- How knowledgeable are the organization's leaders and decision-makers about collaborative-delivery projects?
- How knowledgeable is the organization's staff about collaborative delivery, and what is their level of expertise?

- Does the organization have adequate technical resources?
- Are roles and responsibilities of the owner's team known and clearly defined?

Owner's involvement in the project. *How involved do the owner's management and staff want to be throughout design and construction?*

Owners often want to participate in the design process to ensure that preferred features are included in the constructed project. Some also desire a higher degree of participation in construction—such as approval of subcontractors—than the design-bid-build delivery method allows. For complex projects, examples of this involvement include soliciting input from several departments—including engineering, operations and maintenance, collection and distribution, procurement/purchasing and safety—during the design process.

Knowledge and preparedness of leadership/decision-makers. *What is the level of knowledge within the organization—from its governing leadership (decision-makers) to its managers—about the characteristics, advantages, challenges and applicability of collaborative-delivery methods? Having a clear understanding of their role in the project further empowers the owner's management and staff to achieve a successful project.*

Within every owner organization (utility, agency or municipality), a group of individuals, who serve in governance, leadership and decision-making roles, have final authority to approve and fund capital projects. Examples of these leadership positions include:

- Elected or appointed (city or county) councils, commissions; and
- General manager, chief executive officer.

These individuals need to be knowledgeable about the advantages and benefits of collaborative-delivery methods, as well as how to effectively manage any impediments to a successful project.

Individuals who report to those in the governing structure should also be empowered with decision-making authority and with responsibilities for the overall management of the owner organization. Depending on the owner's overall governance structure, these managing leaders may be a general manager, or a utility, agency, or engineering director. More importantly, they need to be the internal champions for using collaborative delivery and to ensure that decisions on complex issues are resolved in a timely manner.

Organizational leaders are responsible for assessing all project team members' knowledge and understanding of the different collaborative-delivery models, the types of procurement procedures needed to acquire a design-build or CMAR firm and how to implement and manage the contract. WDBC's research among owners has found that this education process is critical to achieving a successful project.

Source: WDBC 2015 Lessons Learned Research Study

Need for an owner's advisor. *Does the owner believe that the organization's internal management, staffing and technical expertise are adequate to plan, procure, and manage the project? Alternatively, are outside support and additional resources needed, in the form of an owner's advisor (or advisory team)?*

Because of the increased interest in this topic, a special section has been produced and is included at the end of this chapter. This section answers the many questions regarding the role and responsibilities of an owner's advisor.

Manager's Recommendations for a Successful Design-Build or CMAR Project

- Emphasize teamwork and conduct partnering sessions early on to promote collaboration.
- Educate all staff members about collaborative-delivery methods.
- Have project managers with an open, collaborative mindset.
- Have well-defined and involved leadership as champions.
- Involve project managers early in the project.
- Facilitate good communication among the owner, designer, and builder.
- Recognize that every project is unique and that the same delivery method will not work for all projects.
- Allow enough time in the project schedule for design reviews.
- Identify project objectives early, including key design requirements.

Source: WDBC 2015 Lessons Learned Research Study

Knowledge and preparedness of the owner's management team. *Have the individuals on the owner's team—including operations and maintenance—been identified? If so, how familiar are they with collaborative-delivery methods, and do they have the requisite technical and commercial knowledge, as well as management skills?*

Ideally, the owner's management team comprises professional individuals with knowledge of the various delivery methods and the technical competencies needed to manage the project to a successful conclusion, as well as skills in collaboration and communication. The owner's project management group typically comprises representatives from key departments such as engineering, operations/maintenance, finance, procurement or contracts, communications and legal—all of whom are either directly or indirectly involved with management aspects of the project on a day-to-day basis. (See Figure 1.1 for a sample organization chart.)

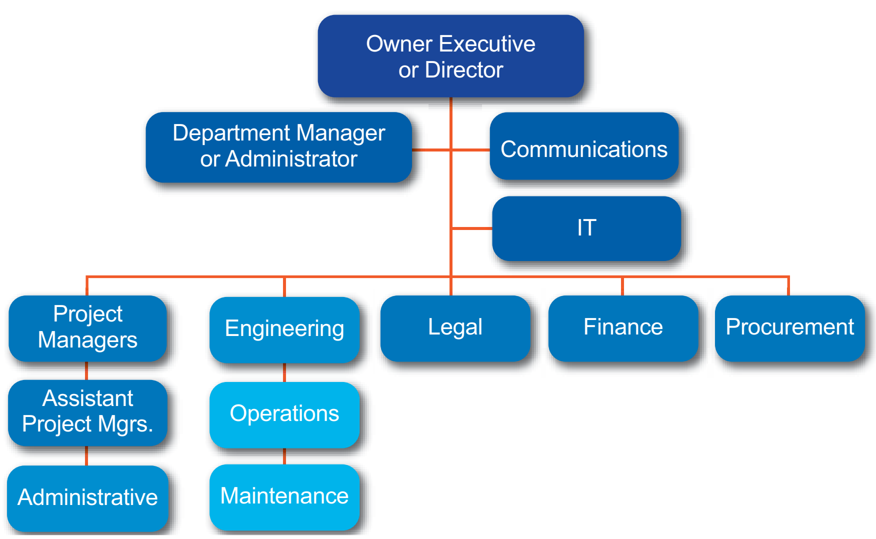


Figure 1.1 — Sample owner organization chart

To effectively manage a collaborative-delivery project, the owner's management team needs to understand the project goals and priorities driving the selection of the specific collaborative-delivery method, as well as their roles in achieving those goals. Individual team members need sufficient knowledge and experience to offer constructive comments, suggestions, and input to the counterparts they will work with on the project team. Additional management direction is provided in Chapter 5.

The owner's project-management group is typically led by an individual who is empowered with appropriate decision-making authority. Ideally, this project manager (PM) possesses effective management and consensus-building skills and can establish and maintain agreement and cooperation among all of the participants within the owner's organization. The PM's primary role is to oversee the work of the collaborative-delivery firm and to administer the terms of the contract. It is also the project manager's responsibility to resolve as many incidents as possible and at the lowest possible level in the organization prior to making a determination that they may need to be resolved by executive leaders.

Education is the foundation for achieving a successful project and must be integrated prior to the planning process.

Source: Owner recommendation from the WDBC 2015 Lessons Learned Research Study

It is important that the organization's leaders assess and understand the project manager's knowledge about collaborative-delivery methods to determine what additional education and training are needed. The WDBC offers a full training course, based on this Handbook.

Table 1.1 provides an example of the various roles/responsibilities within an owner's organization for a collaborative-delivery project.

Table 1.1. *Organization and Project Staffing*

Position Title	Roles/Responsibilities
Executive or Director *with overall responsibility for organization*	• Ensures adequate funding and staffing resources to achieve a successful project • Makes final decisions on project funding and implementation • Supports project champions • Addresses political and complex situations
Director or Administrator *Responsibilities may be combined with those of the executive or director.*	• Oversees project budget and schedule • Reviews and determines project changes affecting scope, cost, or time • Manages PM to ensure all project reports (owner, regulatory) are complete and submitted on time • Makes decisions on project recommendations that could achieve cost & schedule efficiencies • Ensures that staff is adequately educated and has technical resources
Project manager (PM)	• Oversees project implementation including budget and schedule • Reviews and recommends project changes affecting scope, cost, or time • Ensures all project reports (builder, regulatory) are complete and submitted on time • Maintains tracking and provides recommendations on project details • Manages meetings and contract details

continued on next page

Table 1.1. *Organization and Project Staffing (continued)*

Position Title	Roles/Responsibilities
Assistant project managers *(or responsibilities may be entirely placed with the project manager)*	• Participates in meetings and workshops, reviews meeting documents • Participates on related team activities and may chair meetings • Daily interface with collaborative-delivery firm, any subcontractors, testing, etc. • Coordinates financial, public awareness and owner safety officer • Coordinates operations & maintenance • Oversight of administrative support needs
Legal *(Ensures that contractual documents are in compliance with requirements, including project change orders)*	• Ensures that all solicitations are transparent and fair • Provides input to PM on contractual matters during construction, including claims by subcontractors or consultants
Procurement	Assists in preparing RFQs and RFPs, bid-period site visits, and responses to questions; evaluates submittals, and assists as necessary during the award period.
Finance	Ensures that the project is financially supported, progress payments are made on time, and fees are appropriately apportioned.
IT	• Ensures that the project's document-management system is functioning at all times, maintained with latest upgrades and security interfaces—and is hacker-free • Responds to requests for assistance • Ensures system backup exists both on and offsite to prevent loss of data
Communication, public outreach	Provides the project description and updates to media, public, and officials via direct contact, newsletters, website, etc.
Commissioning team *(Program oversight during conceptual and preliminary design, includes manager, operations, and maintenance)*	• Implements the commissioning program and ensures adherence to contract requirements • Ensures that final modifications have been made to O&M manuals and vendor information, based on results of the commissioning
Safety *(on behalf of owner)*	• Ensures that the collaborative-delivery firm is implementing a defined program in its safety plan • As soon as there is a determination of non-compliance, immediately brings non-compliance issues to the firm's project engineer and the owner's PM • Ensures that all owner staff is appropriately trained regarding safety
Administrative support	Attends meetings and prepares meeting notes as requested. Assists with preparation of sign-in sheets, agendas, meeting notes, etc. Receives and distributes incoming mail and handles outgoing mail.

Project Priorities/Drivers

It is well understood that an owner's overall goal is to successfully complete a high-quality project—in a timely manner, and for the lowest lifecycle cost. In practice, however, trade-offs among scope, schedule, risk-allocation and cost—but never safety!—are virtually inevitable. Understanding what these trade-offs mean to the organization requires answering questions that relate to the organization's goals and project priorities and defining its drivers.

Guidance in defining a project's priorities, as they relate to the owner's goals, is illustrated in Table 1.2, with sample questions for clarifying each goal's priority.

Table 1.3 provides a sample format for assigning a weighting factor for each project priority, which defines priorities' relative levels of importance. **The most important influencers become "drivers."** After reaching agreement on the project's drivers, the next step is to use the information to evaluate the various delivery methods and select the best approach. Chapter 2 discusses how to use the project drivers to evaluate the various collaborative-delivery methods for the project.

Table 1.2. *Defining Project Priorities*

Project Goals	Clarifying Questions	On a scale of 1 (low) to 5 (High) Rate Project Priorities
Schedule	How important is the project's current completion date? Is it a defined date? Is there flexibility to accomplish it within a reasonable period?	
Quality: performance, reliability, innovation	How important are technology and operational performance and reliability; are there new features or innovations, e.g., energy recovery, to be considered?	
Regulatory compliance	How important is regulatory compliance; are there ongoing technical mandates — does the project need to comply with a specified deadline that impacts the schedule?	
Budget: project lifecycle costs, asset management	How important is the project budget; does it have specific requirements; is there flexibility for innovative concepts; are maximum capital costs established?	
Risk allocation	How important is the appropriate allocation of project risk between the owner and the collaborative-delivery firm? Has the topic been discussed or examined and/or have determinations been made?	
Collaboration	How important is establishing trust and openness in the relationship between the owner and project delivery firm; are there previous experiences that can be learned from?	
Owner involvement	How important is the owner's role and level of involvement in the project? Is perceived loss of control an issue that needs to be addressed?	

List priorities from the results in Table 1.2 (in order) and assign them a weighting.

Table 1.3. *Translating Priorities to Project Drivers*

Defined Project Priorities	Weighting
Quality: performance, reliability, innovation	
Owner involvement	
Budget — lifecycle costs, asset management	
Schedule	
Regulatory Compliance	
Risk Allocation	
Collaboration	
Weighted Total	100%

Once the assessment is completed and project priorities ranked and weighted as drivers, the next step is drafting the project implementation plan.

Developing the Project Implementation Plan

Developing the owner's project implementation plan is an iterative process requiring collaboration within the owner's organization and, later, with the selected design-build or CMAR firm.

- The owner creates the first draft incorporating the results of the internal and external assessment. This engenders collaborative understanding of these capabilities and consensus within the owner's organization regarding the owner's priorities and the project's drivers.
- The second draft integrates the agreed-to project drivers and describes how the collaborative-delivery method was selected, creating a more comprehensive draft document for use in procurement (further described in Chapter 2).
- The owner's final project implementation plan is completed after selecting the collaborative-delivery firm and signing the contract. The owner and the collaborative-delivery firm then collaborate to fine-tune the final project implementation plan, laying the groundwork for continued collaboration and a successful project (further described in Chapter 5).

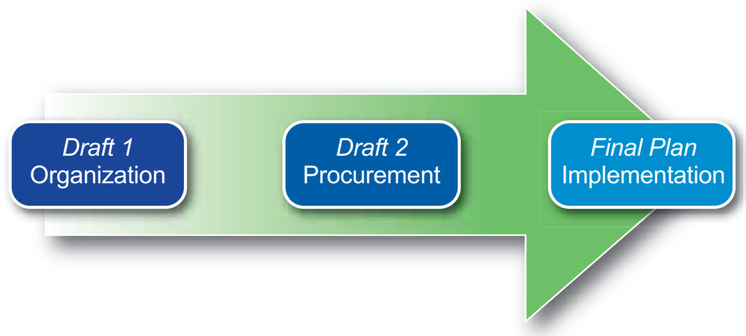


Figure 1.3 — The evolution of the Project Implementation Plan

Draft 1 — Organizational Preparation

The first draft incorporates the project background and results of the comprehensive assessment, including the owner's goals, project priorities, and drivers; the organizational structure; team members' roles and responsibilities—and whether an owner's advisor is involved (and, if so, a description of its role and responsibilities).

Once the owner's organization has developed the draft project implementation plan, the next step is to review the various collaborative-delivery methods, evaluate their attributes against the project drivers, and select the best one for the project. Chapter 2 presents a model evaluation and selection process.

Draft 2 — Procurement Preparation

The second draft of the project implementation plan is expanded to describe how the chosen delivery model was selected. It is used in developing the procurement documents. Contents of this draft, which are included in the RFQ or RFP, gives proposing firms a clear understanding of the owner's expectations and priorities, as well as why the owner selected the specific project-delivery method. This information assists proposing firms in determining the appropriate work plan, as well as the best way to integrate its own team into a collaborative environment with the owner and owner's team.

The owner should consider this version of the project implementation plan a living document, which can be adjusted or amended based on feedback from the proposing firms and changes resulting from any unusual situations. The owner should use the draft plan to solicit input from the proposing firm on certain topics, through informational and confidential one-on-one meetings during the procurement process, thus initiating collaboration.

This second draft of the project implementation plan also initiates the framework for the design criteria package and scope of work. It also defines how the relationship between the owner and the design-build or CMAR firm evolves, as well as the owner's management plan (further described in Chapter 5). This document is later used in the design-build or CMAR contract. These core topics, incorporated into this draft document, should now represent the owner's priorities.

- The selected **collaborative delivery method**.
- A preliminary **scope of work and project schedule** identifying procurement, design, construction, and commissioning activities.
- The level of the **owner's involvement** with the envisioned design and construction work.
- The **owner's financial management** policies and procedures.
- **Decision-making** and dispute-resolution procedures.
- **Existing health and safety** planning and protocols.
- **Communication** procedures, both within and external to the organization.
- A preliminary **risk and responsibilities matrix** (further described in Chapter 3).
- The owner's approach to addressing **unplanned occurrences** or unexpected situations.

Because water and wastewater construction projects are complex undertakings, **unexpected situations** are likely to arise. A well-defined method for managing these unexpected situations helps avoid delays and disappointments.

Change management (further discussed in Chapter 5) generally becomes an issue as a result of three types of incidents.

- Expected—but unquantifiable—changes, such as materials cost escalation, differing site conditions, permitting delays, and labor situations.
- Unexpected changes or unforeseeable circumstances.
- Owner-directed changes.

An effective approach to managing expected and unexpected changes helps preserve the collaborative nature of the project.

Preparing the Final Project Implementation Plan

The second draft document is finalized after the owner has selected the design-build or CMAR firm and signed the contract. The owner and the firm use this document to create the final project implementation plan, laying the groundwork for continued collaboration throughout design and construction to final project transition. Chapter 5 describes the important roles and responsibilities involved in managing a collaborative-delivery project.

Using an Owner's Advisor

For a variety of reasons, an owner may need to consider engaging additional resources to assist the organization's staff in project planning, procurement and implementation. These needs may be the result of budgetary limitations and staffing cutbacks, or owners facing challenges of insufficient technical expertise or other in-house resources to plan, procure, and deliver capital-improvement projects. Even with smaller capital projects, owners must respond to multiple complex demands ranging from complying with regulation changes to meeting increased demand, together with the need to rehabilitate and renew existing assets on an expedited delivery schedule.

Definition

An owner's advisor (OA) is an individual or firm with expertise in planning, procuring, and managing collaborative-delivery projects that can provide essential guidance, direction, and advice to an organization. Depending on the owner's needs and project demands (defined at the organization and planning stage) the OA—and even potentially the OA's team members—can provide a wide range of technical resources and expertise. **It is important to note, however, that an OA never assumes the owner's management role in decision-making.**

In determining whether to use an OA, an owner takes into consideration the project's characteristics, level of complexity and envisioned delivery approach, as well as the owner's own organizational capabilities, and any scheduling concerns or requirements. Based primarily on the specific project and the owner's organizational needs, OA's services often encompass support for project planning, delivery-method analysis, and developing the draft project-implementation plans. Other services may include financial planning and funding support, procurement assistance, contracting and legal support, project controls and reporting, design and construction oversight, regulatory permitting, land acquisition, and public outreach assistance. The OA can also represent the owner's interests with regulatory agencies, designers, contractors, and the public.

Services

An owner's advisor is most effective when involved early at the project's planning stage, following the overall assessment of the organization's staffing and resource needs. Forging early agreement and collaboration between the owner and OA facilitates a collaborative partnership. Below are many of the types of support an OA can provide throughout a

WDBC owner education program —preparing to pursue a collaborative project delivery.

collaborative-delivery project. In addition, Table 1.4 provides examples of the division of responsibilities among the owner, owner's advisor, and selected collaborative-delivery firm.

Planning services may include assisting the owner with the following tasks.

- Acquiring land or necessary easements or right-of-way.
- Conducting site investigations and collecting data—for example preparing geotechnical data report, wetlands delineation.
- Developing project cash-flow projections to match availability of funding.
- Developing initial budgeting and cost estimating.
- Internal and external stakeholder coordination.
- Developing a clear decision-making matrix and ensuring full understanding of decision-making process and levels of authority.
- Developing project risk-responsibility matrix.
- Obtaining permits.
- Leading public outreach meetings.
- Facilitating pre-proposal conferences and controlling the flow of confidential information.

Procurement may include assisting the owner with the following services.

- Determining the most appropriate collaborative-delivery method for the project.
- Developing/preparing procurement documents (RFQ and/or RFP).
- Soliciting and evaluating responses.
- Meeting and interviewing participants.
- Preparing contract documents for negotiating with selected design-build or CMAR firm.

Design services may include assisting owners with the following tasks.

- Either developing or evaluating conceptual design, basis-of-design, and design criteria requirements.
- Providing periodic design reviews.
- Reviewing owner-selected shop drawings.
- Performing constructability reviews (this is less important with fixed-price design-build than with progressive or open-book design-build —and is described in greater detail in chapter 2).
- Participating in a value-engineering analysis (important with fixed-price DB than with progressive or open-book DB).
- Responding to requests for information and interpreting conceptual design, basis-of-design, design criteria requirements.
- Monitoring design development for compliance with contract.
- Reviewing and analyzing value-added change orders, which could be based on lifecycle cost analysis of future or new equipment.
- Reviewing payment requests and contract modifications and making recommendations.

Because all water and wastewater projects, no matter their size, are complex undertakings, it is critical that owners involve operations and maintenance team members early in the planning for later commissioning and acceptance activities.

Construction management may include assisting the owner with the following services.

- Identifying appropriate changes in scope; reviewing change orders; validating the impact of changes, and managing the documentation process.
- Resolving disputes and escalating issues, if necessary.
- Reviewing and monitoring the construction schedule and budget.
- Coordinating and attending project meetings.
- Monitoring the submittal log of the construction firm's job progress.
- Maintaining owner's project records and preparing owner's monthly progress reports.
- Reviewing the construction firm's payment requests.
- Monitoring compliance with the construction firm's and owner's QA/QC plans.
- Responding to the construction firm's information requests.
- Monitoring and reviewing as-built documents and record drawings.
- Interfacing with the community and affected residents on behalf of the owner and coordinating with owner's staff.
- Reviewing monthly reports for contract compliance with approved designs and shop drawings.
- Monitoring the construction firm's compliance with safety plan.
- Overseeing performance-testing and confirming compliance with performance guarantees.
- Monitoring compliance with the startup and testing plan; and warranty services.

Selecting an Owner's Advisor

To determine the services that an OA will provide, the owner identifies the resources needed to support its staff, given the staff's time and availability. To procure these services, the owner often follows a typical one-step procurement process, issuing a combined request for qualifications and proposals (RFQ/RFP). To facilitate a solid understanding of the required level of services and technical expertise, the RFQ/RFP needs to include the following information about the owner's and project's needs.

Although most of this information may be derived from the draft project implementation plan, it is also possible that an owner may need to consider obtaining services to draft the plan, and should ensure that the procurement documents specify the following information.

- Owner's organization details and existing staff resources.
- Project characteristics and priorities.
- Identified services desired of the owner's advisor, the OA's role and responsibilities and interaction with the owner's staff.
- Projected budget, if known.
- Request for relevant experience in collaborative project delivery as designer, builder, or owner's advisor.
- Qualifications/resumes of key members proposed for OA's team
- Availability time of OA's team.
- OA's approach and preliminary fee (e.g., for initial tasks or activities).

The owner then reviews and evaluates responses, conducts interviews, and contracts with the selected OA.

Table 1.4. *Examples of Responsibilities of the Owner, the Owner's Advisor and the Collaborative-Delivery Firm*

Legend: P = Primary Role/Decision Maker S= Secondary Role/Advisor

	Owner	Owner's Advisor	Firm
Pre-selection/Project Development			
Sourcing and obtaining funding	P	S	n/a
Schematic design development, technology screening, pilot testing	S	P	n/a
Site investigation (e.g. geotech)	S	P	n/a
Public outreach	P	S	n/a
Developing and reviewing master project schedule	P	S	n/a
Developing procurement documents: contract template, general-conditions statement, RFQ, RFP	P	S	n/a
Developing scoring criteria and matrix for selecting contractor	P	S	n/a
Selecting contractor	P	S	n/a
Budgeting	P	S	n/a
Project risk assessment	S	P	n/a
Project permitting	P	S	n/a
Developing design and construction procurement plan	S	P	n/a
Collaborative-delivery team approval process	P	S	n/a
Preparing notice of award, notice to proceed	S	P	n/a
Design-build contract negotiations	P	S	P
Design			
Design development	n/a	n/a	P
30%, 60%, 90% design reviews for compliance with contract	S	P	S
Construction documents, specifications and drawings index	S	S	P
Design and construction cost estimating	S	S	P
Procurement of Subcontractors and Vendors			
Verifying that subs/vendors pre-qualification process complies with contract docs	S	P	S
Conducting pre-bid meetings	S	S	P
Developing and issuing bid documents, technical and commercial addenda	S	S	P
Receiving and evaluating construction package and equipment bids	S	S	P
Issuing purchase orders and subcontracts, reviewing for compliance with contract documents	S	S	P
Construction Oversight			
Conducting construction kickoff meeting	S	S	P
Chairing weekly/monthly project meetings	S	P	S
Preparing project meeting minutes	S	P	S
Preparing the submittal list	S	S	P
Preparing/maintaining project submittal log	S	P	S
Review/approval of collaborative-delivery firm's commercial submittals	S	P	S
Review/approval of collaborative-delivery firm's technical submittals	S	P	S
Request for information (RFI) log and tracking	S	P	S
Developing and updating critical-path method (CPM) schedule	S	S	P
CPM schedule monitoring	S	P	S
Handling construction change directives or bulletins	S	P	S
Review/approval of proposed change orders (PCOs)	S	P	S
Change order preparation and negotiation	S	P	S
Change order approval	P	S	S
Progress payment review	S	P	S
Progress payment signoff	P	S	S
Cost commitment monitoring	S	P	S
Monitoring compliance with collaborative-delivery firm's QA/QC plan	S	P	S
Punch list preparation	S	P	S
Construction-phase inspections	S	S	P
Field measuring or otherwise confirming any quantities for which owner is paying on a unit-price basis	n/a	P	S
Field inspections of critical components prior to covering/burying them	S	S	P
Interfacing with the community and affected residents	S	P	S
Managing startup and testing	S	S	P
Performance testing to confirm compliance with performance guarantees	S	S	P
Certification of substantial completion	S	P	S
Time extension review	S	P	S
Time extension approval	P	S	S
Dispute resolution	S	P	S
Warranty services	S	S	P

Roles and Responsibilities

Because the owner's advisor is an extension of the owner's staff, it is important that the relationship be collaborative. Once the OA is selected, the owner and advisor collaborate to define the services that the OA will provide and to create a draft task schedule with milestones.

An owner and its advisor should determine the corresponding roles and responsibilities for the management and oversight of the project. An integrated, collaborative, project-specific organizational structure is often developed to delineate these roles and responsibilities, as well as the level of support the OA is providing (e.g., specific individuals, specific tasks). As part of the initial project planning, the owner and its OA also develop or agree on selected management processes, procedures, and systems. The overall goal of the owner's planning process is to have a well coordinated management and project plan prior to procuring and selecting a collaborative-delivery firm.

The initial collaborative role for the OA starts during contract negotiations. It is important to work closely with the owner's staff to reach a mutually acceptable scope of services that complements the capabilities and availability of the owner's internal staff, and to determine a specific list of, and schedule for, completing all deliverables.

Early Integration of Suppliers Adds Value to a Successful Collaborative-Delivery Project

When it comes to design-build for water and wastewater facilities, collaborating with a reliable supply partner in the early stages can help to optimize cost, maximize reliability and provide schedule certainty of jobsite logistics.

Often, one advantage of design-build project delivery is an accelerated schedule. If schedule is a primary driver for a project, the selection of the right components, the logistics for on-time delivery, and field support for installation can make or break the job.

A more collaborative and proactive approach for the design-build of water and wastewater facilities with complex treatment processes – those which may require specialty, non-standard materials – could better serve the project than a traditional method of delivery where materials supply is based on already set specifications and quantities.

Integrating a full-service supplier, one with solid knowledge on product selection and an efficient online project management system, into the collaborative design and build process early on, can help to ensure successful delivery. Incorporating a supplier onto the team in the beginning means leveraging their insight to estimate quantities and scope based on a preliminary design, and still ensure that the right material is selected to support the project's objectives. Also, in building an early partnership with a nationwide supplier – one that offers local support – the resource remains in place, long after the design-builder moves on to their next project.

In the right circumstances, a full-service supplier with a national footprint will provide the best value in successfully supporting the collaborative design-build delivery model, and will bring efficiency and flexibility in delivery and operation of a project.

— Andy Santi, *HD Supply Waterworks (WDBC Advisor Member)*

Owner's Advisor

Wastewater-Treatment Plant

East Providence, Rhode Island

Challenge

The City of East Providence, Rhode Island, needed to upgrade its 10.4-mgd wastewater-treatment plant (WWTP) and collection system to comply with a consent order to implement nitrogen removal and reduce sewage overflows. With limited staff resources to address the complexities of a procurement process involving an operations component, the City determined the best approach was to secure the services of an owner's advisor (OA).

Wastewater system improvements to the East Providence Water Pollution Control Facility included replacement of the existing traveling bridge sludge collectors with longitudinal sludge collector flights on the four Primary Settling Tanks.

Approach

As the City's OA, Arcadis led the procurement process to secure a DBO firm to provide design-build and long-term operation, management and maintenance (OMM) services. Working with the City and its legal advisors to develop the RFP, Arcadis then helped the City evaluate the proposals and negotiate a contract with the selected DBO team. The selected DBO contractor team was AECOM with United Water, with a contract value at $51.59 million.

As the OA for both the design-build and OMM services, Arcadis also monitored the contract operator's progress in transitioning to full service. For design-build services, the OA reviewed the design and construction submissions for compliance with contract documents, monitored construction, participated in monthly progress meetings, and assisted the City in negotiating change orders. For OMM services, the OA developed and reviewed monthly operating reports and maintenance documents, and reviewed the contract operator's baseline-asset-condition report to evaluate the condition of the equipment and structures and determine the equipment's weighted-average useful life.

To support the City with its wastewater rate planning study, Arcadis developed a City-specific rate model—which incorporates OMM services, capital improvements work, and different financing sources—all of which enabled the development of a five-year projection of wastewater rates. This rate model helped City leaders quickly and efficiently run alternative rate scenarios for future years based on actual revenue collection changes. The OA also performed a cost-of-service rate study to assess the viability of incorporating different wastewater rates for residential and non-residential customers. This helped City leaders implement rate increases for the project more gradually, which made the increases more affordable for the rate payers.

Results

Using an owner's advisor helped East Providence establish strong relationships and alignment with all of the parties. Alignment and strong relationships were key factors in the successful, high-quality, on-time and on-budget delivery of a capital project.

Owner's Advisor

L-8 Reservoir Modifications, Pump Station, and Inflow Structure

South Florida Water Management District (SFWMD)

Challenge

The L-8 Reservoir, Pump Station, and Inflow Structure project is one component of the overall restoration strategies for the Everglades, located in Palm Beach County, FL. The ability to use the existing reservoir as a flow equalization basin (FEB) would allow more efficient metering of stormwater flows into the nearby treatment areas, with the goal to improve the quality and performance prior to discharging into the sensitive Everglades Protection Area. This unique project encompasses nearly 45,000 acre-feet of storage covering approximately 1,000 acres. Costing $63.9 million, the project includes the design and construction of reservoir modifications and revetment, a 3,000 cfs inflow conveyance structure from the L-8 canal to the L-8 reservoir, and a 450 cfs pump station to pump water from the L-8 reservoir to the L-8 canal.

Approach

Realizing that this project was unique due to an extensive project scope coupled with an expedited schedule, SFWMD officials determined that the use of design-build delivery was the right approach to meet these challenges. In addition, Florida state statutes require a designated "design criteria professional" for design-build projects. SFWDM procured an owner's advisor (OA) to assist with the following:

- Selecting the appropriate collaborative delivery method to meet SFWMD and project objectives,
- Developing design criteria, including performance requirements and guarantees,
- Preparing procurement documents, including the request for qualifications, request for proposals, and a design-build agreement, and
- Design and construction oversight.

As the OA, Carollo Engineers presented a comprehensive review of a range of alternative delivery methods, and SFWMD selected a fixed-price design-build approach. Proposers were asked to submit a proposal with a technical approach and guaranteed maximum price. Scoring and selection were based on best-value consideration that included both project approach and price.

Results

Using an owner's advisor to navigate the design-build procurement, along with both design and construction oversight, enabled SFWMD, a "first time" user of design-build, to readily understand and manage the process. The OA assisted SFWMD in understanding and allocating the project risks between contracting parties, while implementing necessary management strategies.

CHAPTER

2

Principles and Best Practices of Collaborative Delivery

For decades, water and wastewater agencies and utilities have used design-bid-build (DBB) as the primary approach to delivering capital projects. However, it is well documented that, in the past several years, the water and wastewater industry has turned increasingly to pursuing collaborative approaches. ***Today, the water design-build industry defines collaborative-delivery methods as construction management at-risk (CMAR), design-build (DB) (both progressive and fixed price), design-build-operate (DBO), and public-private partnerships (P3)***

Collaborative-delivery methods differ from the traditional DBB method in two important ways.

First, construction personnel become involved early in the design process.

- In DB delivery, the design-builder's design engineers and construction team work hand-in-hand with the owner's team during the design process to proactively identify and resolve potential constructability, schedule, and other issues. Working collaboratively as a single contractual team minimizes the likelihood of constructability problems or design disputes; it also establishes a foundation for maximizing the benefits of collaboration from project award through closeout.
- Although CMAR delivery involves two separate contracts, one for design and one for construction, the CMAR firm—sometimes referred to as the construction manager/general contractor (CM/GC)—provides substantial input into the engineer's design process and early cost estimates that aids owners in understanding a project's cost and its specific features.

Second, the collaborative-delivery firm is generally selected based on best value—rather than on just the lowest bid, as with DBB delivery. In both DB and CMAR delivery, the owner specifies a range of criteria, in addition to price, in its procurement documents. While many criteria may relate to an owner's specific goals, priorities, and project drivers, the most frequently cited include the following:

- Key personnel experienced with similar projects;
- The proposed project approach;
- Innovative design suggestions and construction ideas for meeting project objectives;
- An effective schedule and commissioning plan; and
- The collaborative-delivery firm's ability and willingness to work as a team with the owner's staff.

Although the benefits of using collaborative delivery are substantial, the transition process for an organization that has relied on the DBB method for many years presents challenges—especially if this is the owner's first experience with collaborative delivery. A discussion of those challenges

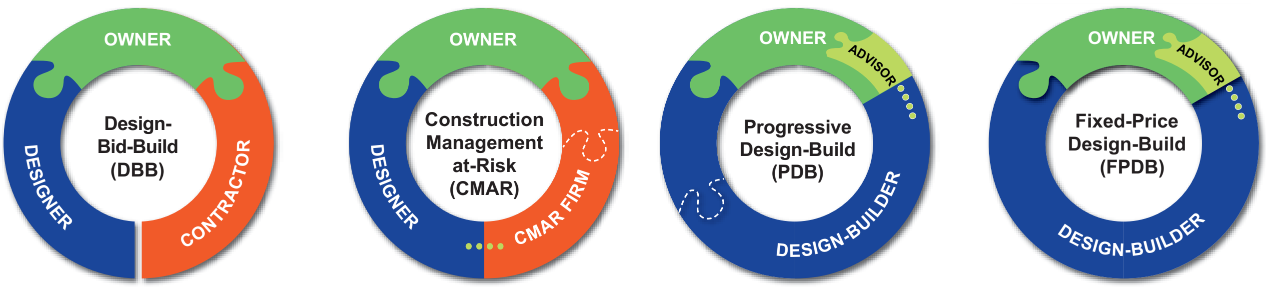


Figure 2.1 — Project delivery methods currently available for water and wastewater projects

can be found in WDBC's 2013 research report on *Impediments to Using Design-Build Delivery*. To address those challenges and establish a stronger knowledge foundation for owners, this chapter describes the distinguishing features of each collaborative-delivery method and compares them with each other, as well as with DBB delivery.

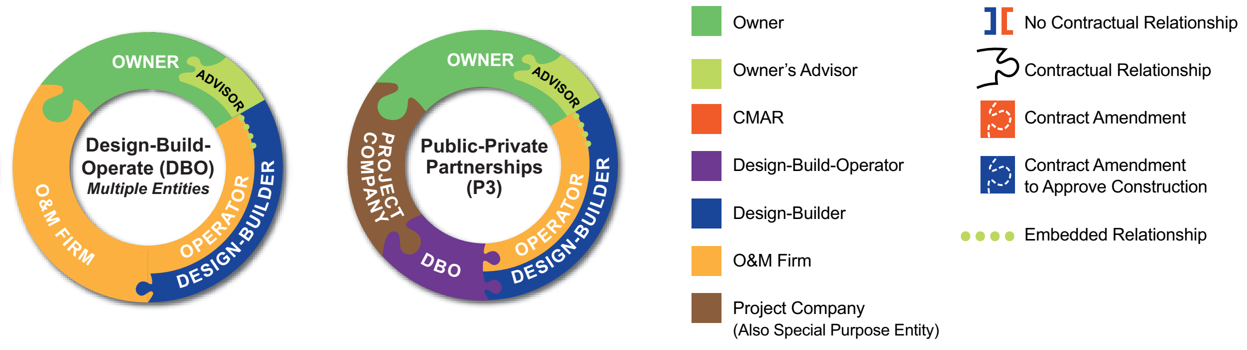
Figure 2.1 illustrates the delivery methods currently available for water and wastewater projects—including DBB— and provides a graphic representation of the contractual arrangements and working relationships between the owner and service providers in each method. In addition, the optional role of the owner's advisor is shown as an embedded relationship: a contractual role inserted (or procured) within the collaborative delivery process to provide specific services for the owner.

Design-Bid-Build (DBB)

In DBB, an owner first procures and contracts with an engineer to prepare detailed design plans and specifications for a project. The owner then conducts a second procurement process and contracts with a separate firm to construct the project, based on the design plans and specifications completed by the engineer (Figure 2.2).

DBB Distinguishing Features

- DBB delivery has been widely used and legally tested in the public water and wastewater sector.
- DBB delivery entails two sequential contracts.
    - The designer is selected first, usually based on qualifications, and completes the project design.
    - The contractor is then selected, usually on a low-bid basis, to construct the project design.
- The construction contractor is responsible solely for constructing the completed design through mechanical completion—not for the overall performance of the plant or project.
- The owner has the responsibility to compensate the construction firm for extra costs related to design errors and omissions or scope revisions.
- The owner is both buyer and project integrator.



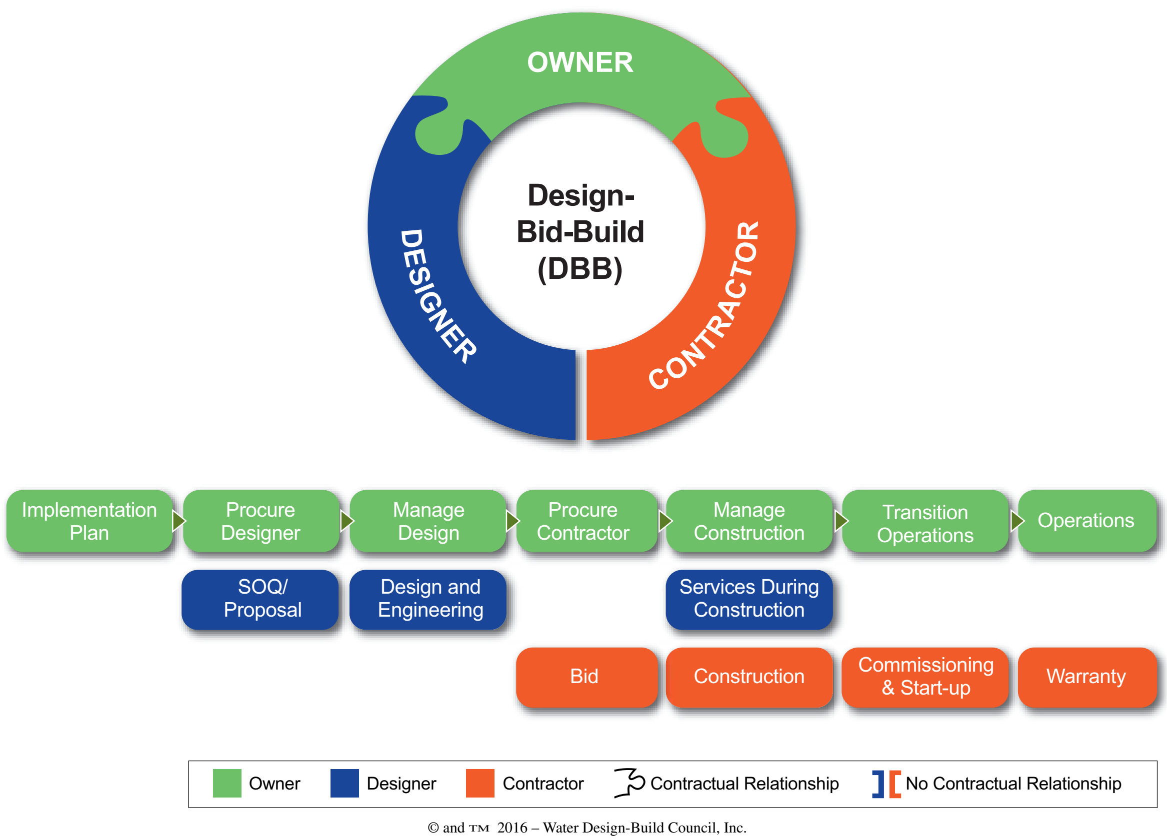


Figure 2.2 — Design-Bid-Build

Construction Management at-Risk (CMAR)

Construction management at-risk (CMAR) is a collaborative-delivery method in which the owner retains an engineering firm and a CMAR firm under two separate contracts, one for design and one for construction (Figure 2.3). CMAR project delivery is most often chosen when the owner wants to capture some of the benefits of design-build delivery, while maintaining direct control of project definition and design. The primary disadvantage of CMAR, compared with design-build, is the lack of single-point accountability; CMAR requires the owner to be more proactive in promoting collaboration between the designer and the builder.

CMAR project delivery is contractually similar to DBB delivery in two regards.

1. In both DBB and CMAR delivery, design is the responsibility of an engineering firm, and construction is the responsibility of a separate contractor. Unlike DBB, however, the contractor in a CMAR project is selected early in the design process and functions both as the owner's construction manager (CM) during design and also as the general contractor (GC) during construction. The CMAR firm is typically selected based on qualifications—rather than on price, which is the standard selection criterion for a contractor in DBB delivery.
2. In both DBB and CMAR delivery, the owner retains design risk subject to limitations in its designer's contract. Unlike DBB, however, the CMAR firm's early involvement in the design process increases budget certainty and decreases risks associated with constructability of the completed design. *NOTE: The CMAR firm does not have any contractual risk related to the project design firm's responsibility.*

The decision to use CMAR project delivery should be made—and the CMAR firm selected—as early as possible, but no later than when the design is 30% complete. In the early stages of design development, the CMAR firm contributes invaluable input to the site work, site layout, constructability, and general arrangements regarding structure and process. Much beyond the 30% design level, opportunities for major constructability impacts may be reduced or lost.

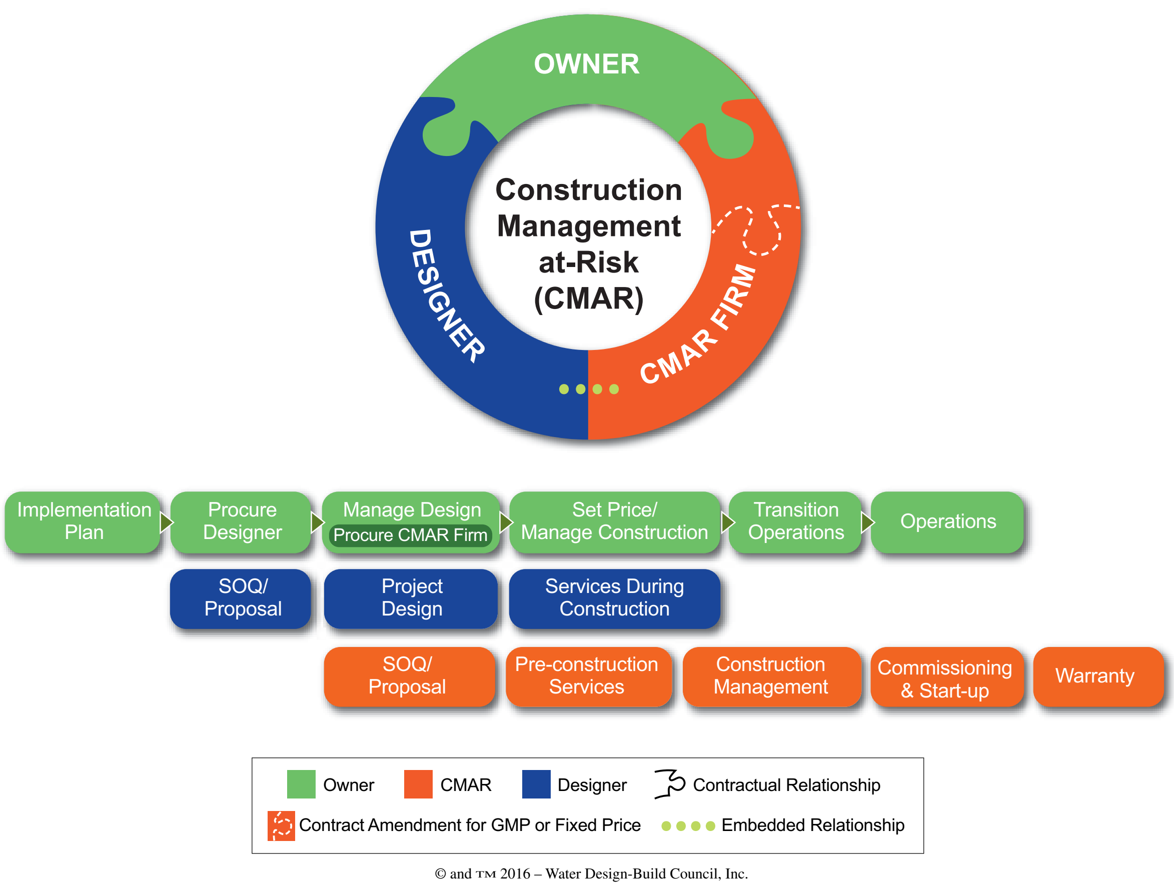


Figure 2.3 — Construction Management at-Risk

Using CMAR delivery, upgrades to the Weslaco Water Treatment Plant's existing processes focused on its raw water pump station, rapid mix basin, biosolids collection, filters and chemical facilities, which increased its overall capabilities to supply quality water to area customers.

CMAR Distinguishing Features

- CMAR project delivery involves two independent contracts with two separate firms:
  - o The owner selects the design/engineering firm first, usually based on qualifications.
  - o The owner then selects the CMAR firm, usually based solely on qualifications. When the design is no more than 30% complete, the CMAR firm becomes actively involved in the design process, and provides preconstruction services.
- There are two phases to the CMAR contract:
  - o Phase one encompasses all activities related to preconstruction through the preparation of the construction schedule and the project price—whether it be a guaranteed maximum price (GMP) or a fixed price—when the design is approximately 60% to 90% complete.
  - o Phase two, in which the CMAR firm assumes the role of general contractor, encompasses the completed preconstruction design review, procurement of subcontractors and vendors, and full construction and commissioning.
- In the event the owner and the CMAR firm cannot reach agreement on a GMP or fixed price, the owner has the option either to negotiate with another CMAR firm to reach agreement on a price, or to have the design completed and proceed with a DBB procurement.
- The CMAR firm provides design input for constructability improvement purposes—not for design or process effectiveness—and is therefore responsible only for following the completed design in the construction process.
- The primary risk/responsibility for plant process performance is allocated between the owner and the designer.
- The owner is both buyer and project integrator.

The selected CMAR firm works in tandem with the owner's engineer and performs preconstruction services at specific milestones in the design process. Preconstruction services may vary, but traditionally include constructability reviews, value-engineering, estimating, and scheduling.

Although an owner may consider price in selecting the CMAR firm, a typical RFP would not require a formal cost proposal to construct the project, as the CMAR firm is traditionally selected during the design phase, well before final construction pricing documents are available. If price is one of the selection criteria, however, the RFP may require proposing firms to provide preliminary target pricing information in one or more of the following ways.

- Preconstruction services expressed as a fixed-price value.
- A project personnel rate schedule in the proposal.
- A general-conditions statement expressed as a fixed price or a maximum value, or as a percentage of construction cost is included in the proposal.
- Overhead and profit expressed as a fixed price or a percentage of cost.

The CMAR firm may either subcontract out all the construction work or self-perform portions of it, depending on the requirements defined in the owner's procurement documents. The amount of self-performance allowed in CMAR contracts may also be dictated by state law or funding agencies. In any case, it is in the owner's best interest to ascertain the extent of the CMAR firm's proposed self-performance. Unlike sub-contractors and equipment, which the CMAR firm will procure by seeking multiple bids, self-performance costs may not be competitively procured.

As CMAR delivery becomes more widely used, owners' familiarity with it is growing—and more states are allowing it.

Using Local Businesses in Collaborative-Delivery Projects

In working on collaborative-delivery water infrastructure projects, it is important to understand the value of involving local businesses. When a collaborative-delivery firm ventures outside its geographic area of influence and into a new municipality, it can often create plenty of challenges. Meeting with local businesses and engaging them early on provides tremendous benefits toward building a successful, collaborative project team.

Local firms add value to the collaborative-delivery process in multiple ways. Their knowledge of the owner's expectations, values and ways of conducting business—as well as the expectations of the organization—provides valuable insight into developing a winning proposal.

Including local businesses in your proposal strengthens your firm's appeal, as every owner has relationships with preferred companies for various materials, supplies and related projects. Including these local businesses in your proposal builds an owner's trust and confidence in your team's ability.

Using local businesses, which employ local residents, also generates a positive economic impact within the area. This practice ensures that some portion of the money spent by the owner for those particular trades or materials will be circulated back into the local economy.

Using local businesses in your collaborative-delivery project can have a multitude of benefits for your team, the owner, and the surrounding community.

—Kevin Waddell, *Foley Company (WDBC Advisor Member)*

Design-Build (DB)

What distinguishes design-build delivery methods from both DBB and CMAR is single-point accountability for both design and construction. Rather than requiring two separate contracts—one for design and one for construction—DB delivery entails only one contract between the owner and the design-builder.

Within the overall category of design-build project delivery, there are two basic variations: progressive design-build and fixed-price design-build.

- **In progressive design-build delivery**, the owner works with the design-builder to develop the project's design to an approximate 60% to 90% level of completion **(phase one)**. The design-builder provides an open-book cost-estimating process as the design progresses, and a GMP or fixed price when design development is complete. If the owner accepts the price proposal, it authorizes the design-builder to complete the design and to perform construction, commissioning and acceptance testing **(phase two)**.
- **In fixed-price design-build delivery**, the design-builder agrees to design and construct the project for a fixed price—based on either the owner's description of the project requirements or a conceptual design provided in the procurement documents, or both.

Progressive Design-Build (PDB)

PDB is a two-phase delivery method in which the project's design, cost-estimating, construction schedule and final GMP or fixed price are developed during phase one. If the owner and design-builder agree on the schedule and the GMP or fixed price, the final design, construction, and commissioning are completed during phase two.

Through a highly collaborative relationship between the owner and design-builder, the owner is able to evaluate a broad spectrum of project solutions. Specifically, due to the straightforward and less time-consuming procurement process that can be completed in a relatively short period of time, PDB procurement follows the customary two-step RFQ and RFP process. Once a short list of RFP proposing firms is established, the RFP requires proposing firms to further address their qualifications, approach to reaching an agreed-on scope/design, construction schedule and final price. At this point in the process, neither the completed design nor final pricing is required.

PDB delivery is frequently preferred when a project lacks definition, when an owner prefers to remain directly involved in the design process while enjoying the schedule and collaboration advantages provided by the approach, or when an owner wants to minimize the time and cost of the procurement. This delivery method is most valuable when owners believe they can lower a project's overall cost, while improving the outcome by participating directly in design decisions, in addition to having a single point of accountability for the entire project.

Once selected, the design-builder and owner work collaboratively to advance the design and incorporate innovative details desired by the owner, as well as enabling the owner to have input regarding available

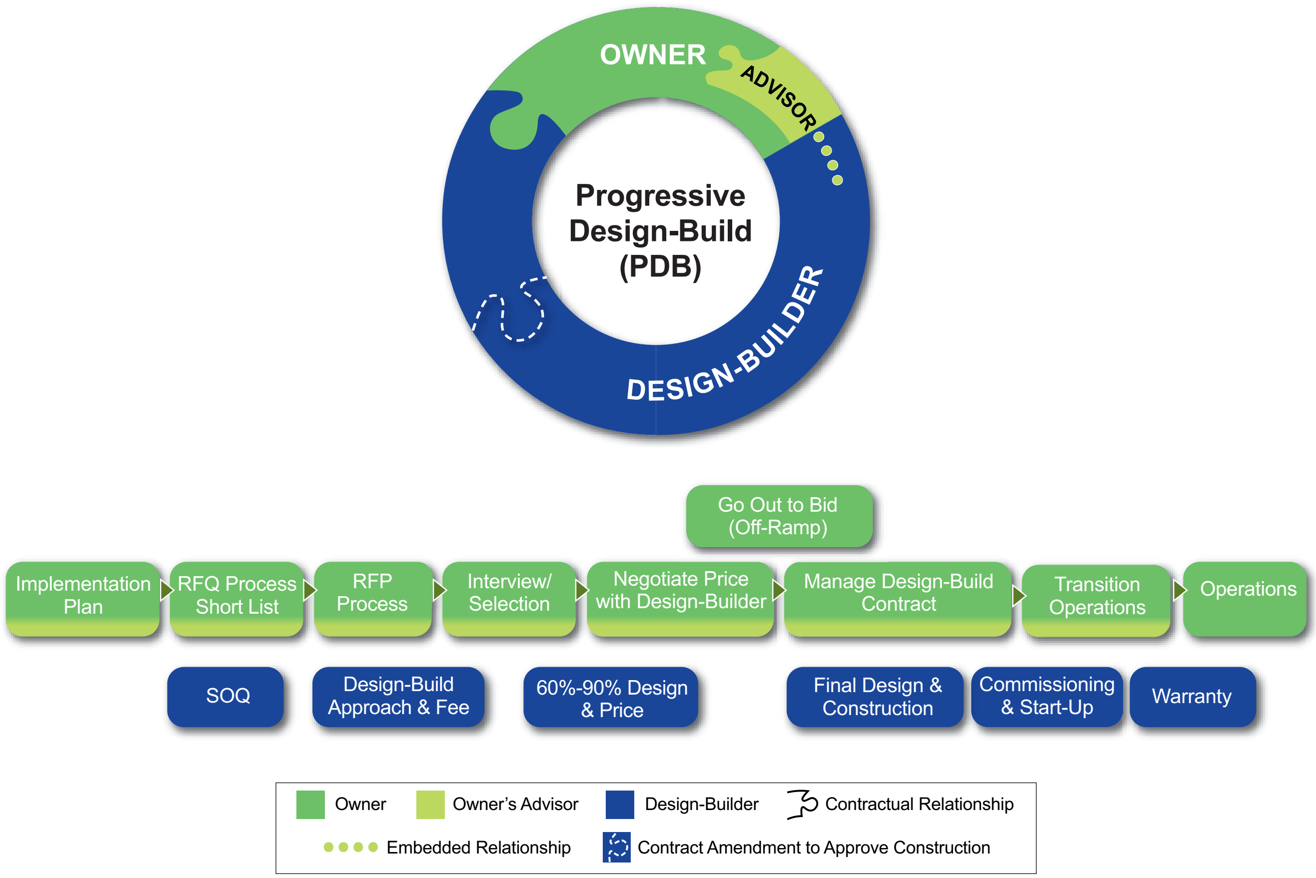


Figure 2.4 — Progressive Design-Build

options. More importantly, an open-book[1] estimating approach enables an owner to make well informed decisions on the overall cost, schedule, and quality of the project. (A separate section on open book is included in Chapter 4.)

The selected design-builder completes the design to the point agreed to by the owner—generally ranging from 60% to 90% complete—and submits a fixed or guaranteed maximum price (GMP) for the total project. At this point, the owner may participate in selecting key subcontractors and equipment suppliers that the design-builder proposed and used in developing the price. Together the owner and design-builder establish a team that will deliver the best value.

An Off-Ramp: However, if the design-builder and owner cannot agree on price or other matters during the design phase, the owner has the option to terminate the existing contract, and either negotiate with another design-builder, or take the partially completed design and proceed with a DBB procurement.

[1] Open-book is a process in which the development of the price (labor, material, equipment, and subcontract costs) is transparent to the owner. In an open-book process, the owner is also party to agreements on contingencies, allowances, overhead, and profit. Once the owner and the DB or CMAR firm agree on the price, the project can be implemented using the open-book approach, or the book can be closed and the project administered as a fixed-price contract with all financial risk for overruns, as well as benefits for under-runs, going to the design-builder.

In addition to offering the owner a high degree of involvement in the project's design, the design-builder provides cost estimates throughout design development to confirm that the owner's budget is not being exceeded.

PDB Distinguishing Features

- Selection is based largely on qualifications and limited pricing information.
- One contract with two phases:
  - Phase one—The design-builder works with the owner to develop project scope, design, initial permits, schedule, and a price for owner approval; and
  - Phase two—After agreement on price, the design-builder completes the design, obtains permits, and performs construction, testing and acceptance, and close-out.
- Owner involvement is typically higher in PDB than in other collaborative-delivery methods.

The owner's team members should be educated and knowledgeable about the differences between design-build and other delivery methods; and understand that the project's success depends on the ability of the owner's and design-builder's team members to work collaboratively and trust that each member is committed to working in the best interests of the project.

Fixed-Price Design-Build (FPDB)

Fixed-price design-build (FPDB) is a delivery method in which a single fixed price, which encompasses both designing and constructing the project, is established when the contract is signed. As illustrated in Figure 2.5. FPDB is used when the owner has defined the project requirements and scope of work sufficiently for proposing firms to accurately predict the project cost early in the procurement process.

Due to the complexity of many water and wastewater projects, owners using FPDB procurement will often incorporate a conceptual design (design criteria document) and detailed project requirements into the RFQ

The PDB approach used by the Town of Davie, Florida, incorporated reverse osmosis in its groundwater plant to treat brackish water from the Floridan aquifer as an alternate source of potable water for customers.

and RFP. Procurement for a FPDB project can therefore be more costly to an owner when compared to other collaborative-delivery methods, due to the cost of preparing the more detailed procurement documents. In addition, FPDB is also often more costly for proposing firms, as they may expend significant effort and money during the procurement stage to prepare and offer an accurate fixed price.

Requirements in FPDB procurement documents may be either prescriptive or performance-based.

- **Prescriptive requirements.** The RFP for a prescriptive FPDB procurement typically includes preliminary design drawings, as well as a description of specific design approaches, and requires proposing firms to submit their own designs that are approximately 10% to 30% complete. Owners often prefer prescriptive FPDB procurement when they already have a clear sense of their design preferences and want to select the design-builder based on a combination of qualifications, schedule, and cost. Procurement for a prescriptive FPDB project delivery can limit proposing firms' innovation and creativity, and therefore may not necessarily result in the optimal solution.
- **Performance-based requirements.** The RFP for a performance-based FPDB procurement may or may not include preliminary design drawings. The RFP sets forth technical criteria and standard construction specifications, establishes minimum quality standards, and focuses on measurable plant-performance criteria or operational objectives. The RFP will not include specific design approaches to achieve those objectives. Owners often prefer performance-based FPDB procurements when they are open to considering various design approaches and the application of innovative technology to

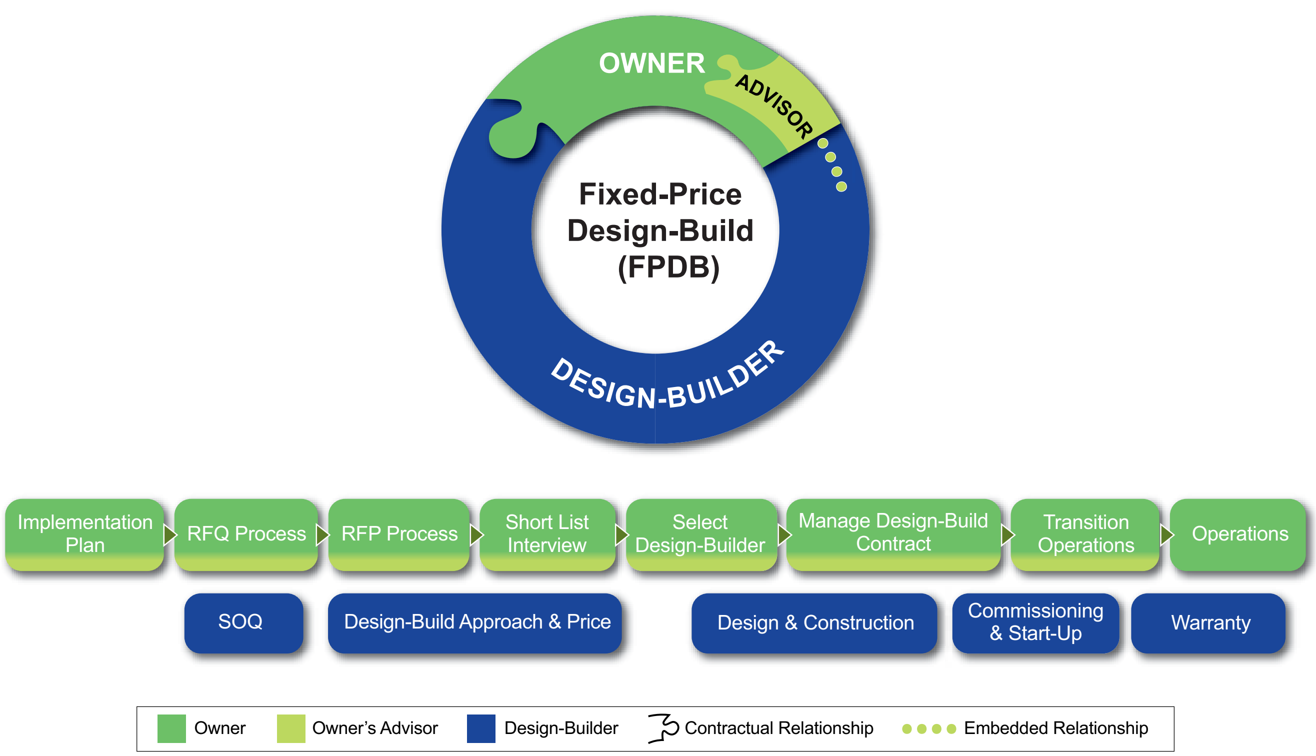


Figure 2.5 — Fixed-Price Design-Build

achieve required performance. Performance-based requirements give proposing firms flexibility and can result in innovative and cost-effective proposals.

Deciding between prescriptive and performance-based requirements means striking the appropriate balance between certainty and innovation; and it is possible for an RFP to effectively blend the two. Owners that have a preferred process technology, equipment manufacturer, or approach for a portion of the project may state those as requirements, while expressing other aspects purely in terms of performance criteria.

Both prescriptive and performance-based FPDB procurements require design-builders' proposals to include a fixed price. If the owner and the highest-rated design-builder cannot reach agreement on an acceptable price and scope of work, the owner can negotiate with another design-builder.

FPDB Distinguishing Features

- More often than not, FPDB is procured through a two-step process involving a request for qualifications (RFQ) to develop a short list of proposing firms, who then participate in the technical proposal process.
- The request for proposal (RFP) provides a detailed technical package—including project scope, construction requirements and any design requirements—and also describes evaluation criteria and selection method.
- The design-builder is typically selected based on the owner's concept of best value—a combination of the design-builder's qualifications, technical approach, and price. The selected design-builder is awarded the contract and proceeds with design, permitting, construction, testing and acceptance, close-out and warranty services.

Fixed-Price Design-Build Selection

The fixed-price design-build delivery method allows an owner to select a design-builder that best fits the project's budget, scope and schedule requirements. A good understanding of their overall project objectives, budget, and schedule requirements enables owners to use FPDB successfully.

The first step in ensuring success is to foster competition among the selected short list of proposing firms, not only for each proposed design's technical merits, but also for its scope, schedule and cost. Although the parameters for scope, schedule and cost are important components, design-builders should be encouraged to also incorporate innovation into their proposals. Using more performance-based requirements encourages greater innovation, which results in more diverse solutions to better distinguish among proposing firms.

Once a selection is made, the design-builder and owner can truly collaborate through an open dialog to affirm the treatment processes, design, scope, cost and schedule priorities, resulting in accelerated schedule milestones and a finished project that best meets the owner's long-term needs. The design presented in a proposal often turns out not to be the most cost- and schedule-efficient solution; many times the finished project bears little or no resemblance to the proposal's design, costs and schedule. As flexibility is a major differential advantage of design-build delivery, owners should incorporate it into their procurement processes at every step.

—Doug Wachsnicht, *Goodwin Bros (WDBC Advisor Member)*

Table 2.1. *Collaborative Delivery Method Attributes and Considerations*

DELIVERY METHOD	BENEFITS TO OWNER	OTHER CONSIDERATIONS
CMAR	• Allows direct owner input into the scope, features, and operational aspects of the design. • Simple and inexpensive procurement process can be completed in short timeframe. • Potential for increased participation due to relatively low proposal preparation costs. • Owner can choose to move to another CMAR firm if unable to reach a consensus with initial CMAR firm. • Better chance of designing to budget because cost estimates are developed at several stages during the design.	• Lack of single-point accountability. • Owner remains responsible for design errors and omissions. • Cost for construction is not known at the time of initial contract signing. • Owner may need to facilitate collaboration between designer and CMAR firm. • Owner still responsible for plant process guarantees. • Can require significantly more owner involvement. • Owner subject to significantly greater risk of change orders.
Progressive Design-Build	• Allows more effective owner input into the scope, features, and operational aspects of the design because input is stimulated and facilitated by the design-build team. • Simple and inexpensive procurement process can be completed in short timeframe. • Potential for increased participation due to relatively low proposal preparation costs. • Flexibility to complete work based on available funding. • Cost is determined through combination of negotiated and competitive processes, using transparent open-book principles. • Owner can reject fixed price or GMP without causing significant delays in project. • Better chance of designing to budget because cost estimates are developed at several stages during the design.	• Cost and schedule for construction are not known at the time of initial contract signing. • An effective public education program may be needed to overcome concerns with construction price negotiation. • Procurement of long-lead equipment will be delayed until GMP agreement.
Fixed-Price Design-Build	• In the case of performance-based procurement, the owner may not receive an innovative concept to be considered. • Cost is determined through a competitive process. • Cost of design and construction is known at contract signing. • Schedule is fixed at contract signing. • Performance criteria and requirements are known when contract is signed. • Public acceptance tends to be high with fixed-price contract award. • Well suited for owners who are most interested in the performance of the plant with limited involvement in the design and construction process.	• Procurement costs are high to both parties because substantial design often needs to be completed prior to proposals. • Procurement process takes substantially more time. • Inefficient use of municipal funds and staff time because design solutions developed and evaluated in procurement phase by unsuccessful proposing firms are not applied during implementation. • Potential for reduced participation due to relatively high proposal preparation costs. • Difficult to price, and inflation can be a major risk because designing and building a major facility can take several years. • Price may be significantly higher when design is complete.

Design-Build-Operate (DBO)

Whether an owner chooses fixed-price or progressive design-build delivery, the arrangement may be extended to encompass long-term operation and maintenance of the completed project.

Design-build-operate (DBO) comprises all the components of DB—including design, permitting, procurement, construction, and testing—as well as operation and maintenance (O&M) services (Figure 2.6). The owner's role and final acceptance of the project do not conclude with delivery, but continue through to a defined operational term. For this reason, owners generally use the best-value selection approach, emphasizing the project's entire lifecycle cost. (Discussed in more detail in chapters 4 and 7.)

Not every design-builder will have all the necessary qualifications to integrate the O&M function into the proposal team. DBO delivery teams may be led either by a single firm that has all such functions within its organization, or by a team consisting of a design-builder and a separate O&M firm.

The DBO team functions as if it is the owner's team throughout the term of its agreement. Moreover, the DBO team—not the owner—assumes the risk for cost, performance, commissioning and acceptance testing, regulatory permit compliance, treatment capacity, repair and replacement, and handover condition at conclusion of the O&M contract.

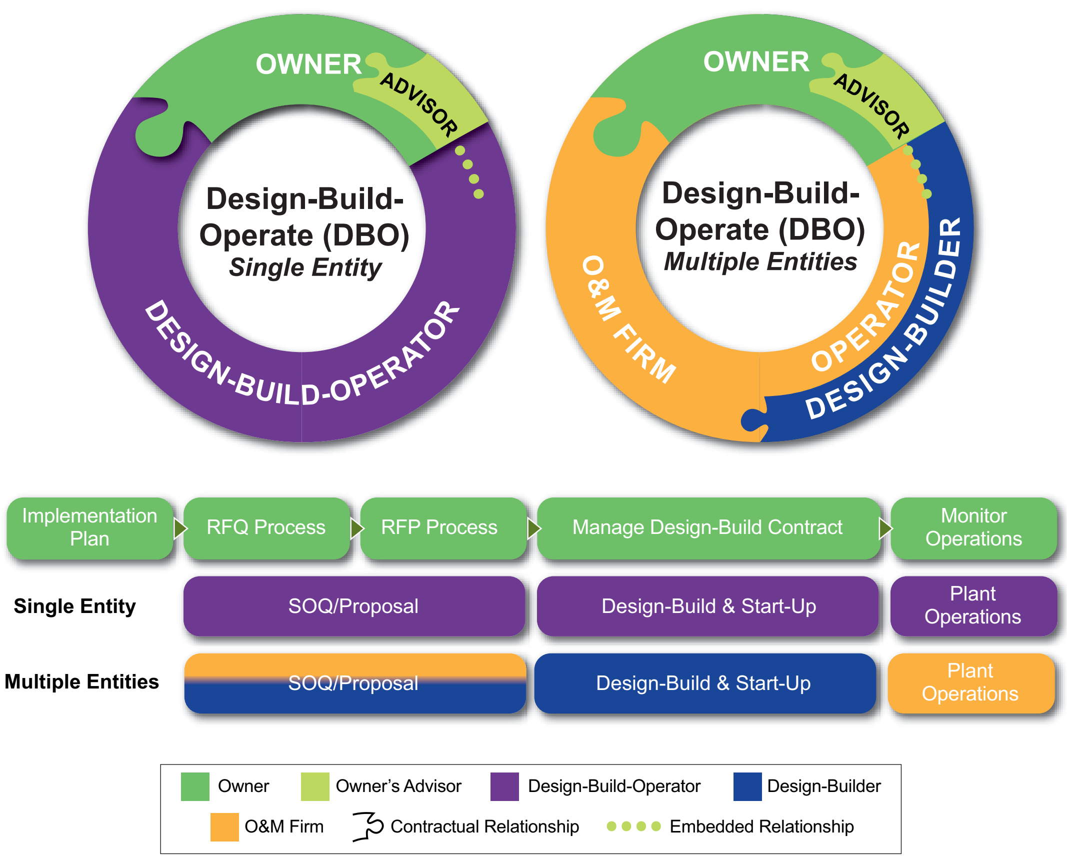


Figure 2.6 — Design-Build-Operate

The DC Water combined heat and power project was a DBO project and a major component of its energy recovery program.

DBO is particularly suited for use in specific circumstances:

- When a project will incorporate new or emerging water or wastewater technology;
- When an owner's staff resources are limited;
- When an owner seeks to transfer operational performance risk to a third party;
- When an owner seeks an efficient delivery method that encompasses both the capital and O&M components of a new project; and
- When an owner is particularly focused on achieving the lowest lifecycle cost through a competitive procurement.

When considering DBO project delivery, owners need to consider the following:

- Legislation, regulations or other procurement policies, including labor considerations, may govern whether a public water or wastewater-treatment facility in a particular jurisdiction can be operated by an outside contractor.
- There may be public resistance to a private firm operating a publicly owned asset.
- Not all design-builders have the qualifications required to operate the facility.
- The contract structure will be more complex when a design-build firm partners with a separate O&M firm.

A further extension of DBO—design-build-operate-finance (DBOF)—is also available. Because DBOF is not widely used for municipal water or wastewater projects in the United States, it is not described here in detail. It is, however, defined in the Glossary on page 123.

Public-Private Partnerships (P3)

Public-private partnerships, often referred to as P3, almost always involve a collaborative-delivery method. P3s integrate private financing support into the collaboration, and often include long-term O&M as well (Figure 2.7). As P3s are gaining significant market attention, Chapter 8 presents the fundamental best practices for adapting existing P3 approaches to the unique needs of the water and wastewater infrastructure.

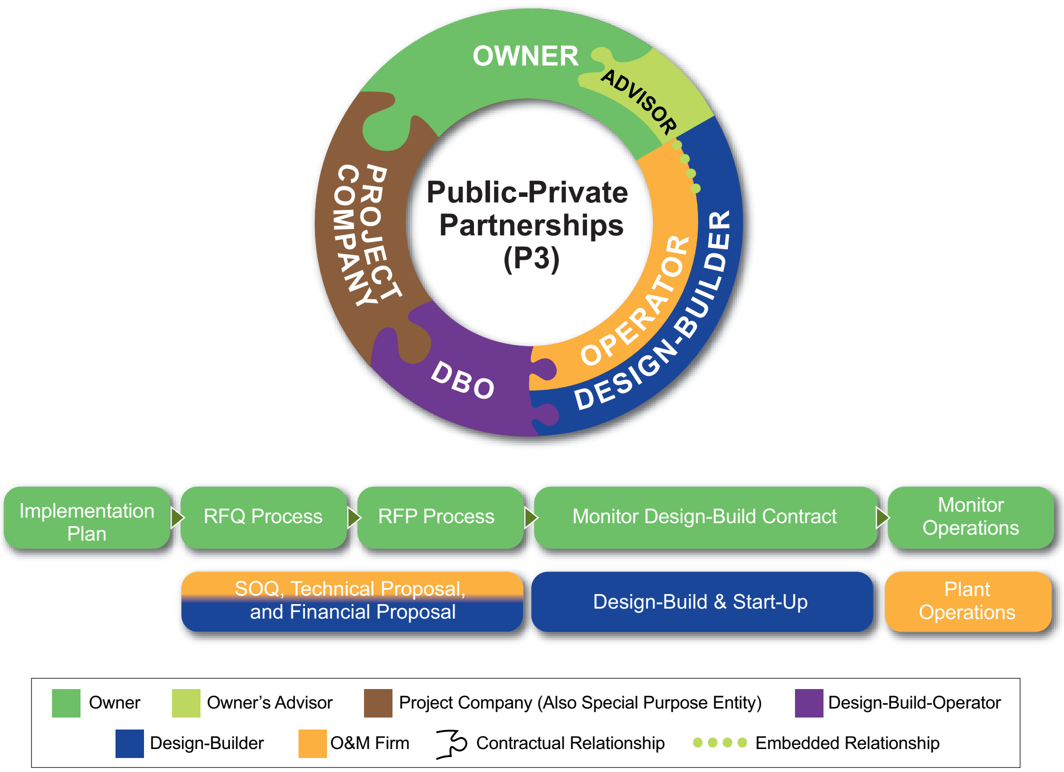


Figure 2.7 — Public-Private Partnerships

Advantages of Collaborative-Delivery Methods

Owners using collaborative-delivery methods consistently report an overall positive project experience. When properly planned and executed, CMAR, DB, and DBO delivery offer numerous advantages over DBB, most of which owners cite as resulting from the involvement of construction and operational personnel in the design phase.[2]

Collaboration

Because the design engineer and the design-build or CMAR firm work closely together beginning early in the design phase, they are able to identify and resolve potential constructability, schedule, and quality issues prior to beginning fieldwork. With DBB, in contrast, the general contractor typically has no involvement in developing the design, and consequently the owner may face costly schedule, quality, or constructability issues during construction.

[2] *WDBC 2012 Customer Satisfaction Survey and 2015 Lesson's Learned Research Report.*

Responsibility

Because the collaborative-delivery firm is involved in the design process, it is often possible to begin early procurement of major equipment and proceed to some construction components before the design is completed. These actions increase opportunities to compress the project schedule and potentially take advantage of lower costs; the shorter schedule generally reduces overhead and lowers project cost. With DBB, in contrast, the owner must review and adopt a fully completed design before entering into a contract with a general contractor for construction. Because there is no overlap or collaboration between design and construction with DBB, there is also no opportunity to realize the time and cost efficiencies that are possible with DB and CMAR.

Collaborative-delivery methods also offer a high degree of flexibility—in risk allocation, in the level of information to include in procurement documents, and in determining at what stage to require a fixed price or GMP. DB and DBO delivery methods make it possible to allocate each risk to the respective party best equipped to manage it. Both methods enable owners to determine at which point in the design process they should require the DB or CMAR firm to provide a GMP or fixed price. DB also enables owners to decide on the appropriate level of design and permit development to include in the RFP. Chapter 3 discusses the topic of appropriating and managing risk in greater detail.

Time and Cost Savings

Because construction often can begin before the design is complete, both DB and CMAR delivery have proven to be particularly effective for water and wastewater projects with tight schedule constraints. With DB, it is the use of a single procurement that helps save time. With CMAR, selecting the general contractor—who also serves as the owner's construction manager during design—early in the design phase saves time. The end result is the potential to reduce project costs through an efficient procurement, a compressed schedule, and the early integration of design and construction—all of which translates into constructability.

Early Knowledge of Total Costs

Although cost is generally not the main selection factor in collaborative-delivery procurement, water and wastewater projects are typically delivered for a more competitive price than DBB projects.

- For DB projects, the price includes both design and construction
- For CMAR projects, the fixed price or GMP is for construction only.
- In CMAR delivery, the CMAR firm has responsibility only for construction, not for design.

In both DB and CMAR projects, the contract price can be agreed on at an early or intermediate phase of the design effort (often when the design is 60% or more complete), avoiding the potential pitfall of DBB projects, in which a design that is 100% complete can be constructed only at an unexpectedly high cost.

Single Point of Accountability/Team Responsibility

Should a problem or dispute arise on a design-build project, having a single point of accountability enables the owner to hold the design-builder responsible to resolve it effectively. And, although CMAR delivery does not provide single-point accountability, it does facilitate collaboration between the design engineer and the CMAR firm early in the design process, which helps mitigate potential constructability issues, guide design decisions and reduce scope creep. In contrast, the separate sequential contracts within DBB create an arms-length, sometimes adversarial, relationship between designer and builder, placing ultimate responsibility on the owner to resolve any requests for additional compensation by the construction firm due to changes.

Differences between Collaborative and Design-Bid-Build Delivery

Success with a collaborative method depends on the owner's preparedness and determination to approach the project differently right from the outset, particularly in terms of attitude toward service providers and an openness to using a different procurement method.

Owners' and collaborative-delivery firms' attitudes—towards the project and each other—are central to the success of collaborative delivery. For example, realizing the benefits of a compressed schedule requires that owners—as well as design-builders and CMAR firms—respect the importance of timeliness of deliverables during various aspects of the project. These include schedule updating, detailed planning, prompt review of work products, and an efficient decision-making process during both design and construction. Teamwork, collaboration, integrity, mutual trust, and respect—rather than control issues or adversarial relations that can hamper DBB projects—are the roadmap to success throughout a collaborative project.

The procurement processes for design-build and CMAR delivery methods also differ from those for DBB. In DBB procurements, the designer is typically selected based mainly on qualifications; because of procurement laws in many states, however, the construction contract must often be awarded to the lowest-cost, responsible and responsive bidder. Although selection based simply on the lowest bid can be appropriate in the procurement of facilities with standard designs, most water and wastewater projects are not standard. Each component is a process unit—unique and inherently complex in terms of design, construction, and performance.

Procurement for collaborative projects requires that owners clearly define the project's technical needs prior to and during procurement. These are usually presented as project criteria in the owner's draft project implementation plan—but without being so prescriptive that they preclude the proposing firms from offering innovative, value-added solutions.

As previously addressed, in large or complex DB projects, or when additional technical resources are needed, some owners retain an owner's advisor (OA) to assist in preparing the RFQ and RFP packages and developing the owner's criteria statement. An OA is skilled at understanding both the chosen collaborative-delivery method and project requirements, as well as translating performance requirements into measurable performance objectives, while giving the design-builder or CMAR firm the appropriate flexibility and creative opportunity to meet them.

Reasons Agencies/ Utilities Switch to Design-Build Delivery from Design-Bid-Build

- Schedule and/or cost benefits.
- Ability to select a design-build or CMAR firm based on qualifications and experience.
- Increasing use of design-build delivery in other sectors.
- Changes in state legislation allowing the use of design-build for water and wastewater projects.
- Allows performance guarantees to help owners manage risk for complex projects using advanced or innovative technology.
- Negative experience with design-bid-build project delivery.

Source: WDBC 2015 Lessons Learned Research Study

The Role of Cost in Procurement for Collaborative-Delivery Methods

Collaborative project delivery generally enables owners to define specific selection criteria in terms other than simply construction costs, enabling them to select the collaborative-delivery firm on a best-value basis—which may include quality, schedule, risk, cost factors, and the design-build or CMAR firm's qualifications, as well as plant operability and lifecycle cost.

Although construction costs are never unimportant, realizing best value generally involves balancing capital cost, lifecycle costs, risk, schedule, sustainability, quality, ease of commissioning, plant-performance requirements, and the design-build or CMAR firm's qualifications.

Some owners might expect that the administrative time and cost required for procuring a collaborative-delivery method would be less than for DBB. Others may be concerned that, with CMAR delivery, having both a general contractor/construction manager and a design engineer with additional project oversight—in the form of value engineering or constructability reviews—will increase the scope of work and overall costs. Either of these may, or may not, be the case. Regardless of the delivery approach—DB, DBO, CMAR, or DBB—owners need to allocate sufficient resources to provide effective management, participation, and oversight of the project.

Selecting the Desired Delivery Method

Choosing the best collaborative-delivery method is a big decision that can be as crucial to success as choosing the best design-build or CMAR firm.

The final step in deciding on the preferred delivery method is evaluating each possible delivery method against the weighted project priorities identified in Chapter 1. This requires the owner's team to understand the benefits and considerations of each delivery method using the information provided in this chapter. Determining the collaborative-delivery method for a project requires a rigorous evaluation of the features, benefits, and risk associated with each, and how they achieve the weighted project drivers. Other methods include qualitative means instead of points. Table 2.2 provides an example of the evaluation process.

Table 2.2. *Model Decision-Making Chart to Select a Delivery Method with Numerical Rankings*

Project Priorities and Goals	Weighting	Design-Bid-Build	Fixed-Price Design-Build	Progressive Design-Build	CMAR
Reliability & operational flexibility	15%	3	2	5	5
Single point of accountability	15%	5	5	3	2
Budget certainty and life-cycle costs	10%	1	3	3	3
Treatment processes—innovation	10%	1	3	3	2
Owner involvement	10%	2	2	4	2
Schedule compliance and regulatory issues	10%	2	2	4	2
Risk allocation	15%	5	3	5	2
Owner–DB firm relationship	15%	3	2	5	5
Total		22	22	32	23
Weighted Total	100%	23%	22%	32%	23%

Bedford Regional Water Authority/ Western Virginia Water Authority

Bedford and Franklin Counties, Virginia

Challenge

In the urban area of western Virginia, customers in the counties of Franklin and Bedford are provided water by two sources: Franklin County is served by the Western Virginia Water Authority (WVWA), and Bedford County is served by the Bedford Regional Water Authority (BRWA). As these areas continue to experience ongoing economic growth, new treatment facilities, as well as a new and upgraded conveyance infrastructure, were needed to support growing water demand.

At the same time, the water distribution systems of Bedford County and the Town of Bedford were combined as part of a 2013 agreement, which also required the Town of Bedford to have a backup water source by the end of 2016. The existing water treatment plant for both these areas, which is located in Moneta, is only able to draw a maximum of 1 mgd from Smith Mountain Lake and is operating near peak capacity – with water demands required at a minimum of 3 mgd.

A new intake from Smith Mountain Lake and 22 miles of water lines, as well as a new membrane filtration water treatment plant, are being constructed to support growing water demand in Bedford and Franklin counties.

Approach

Using a two-step progressive design-build procurement, WVWA selected Black & Veatch, together with its self-perform construction group Overland Contracting, Inc. (OCI), to construct a new water treatment plant and install 22 miles of water lines from the existing Smith Mountain Lake water treatment plant through Bedford County. Black & Veatch/OCI is also constructing a new membrane-filtration water-treatment plant, jointly owned and operated by BRWA and WVWA, that will provide greater capacity—initially 3 mgd and eventually increasing to 12 mgd—to support growing water demand in the region. Construction on this fast-track project began in November 2015. Water lines must be installed by the end of 2016, so the new water-treatment facility is operational in spring 2017. Achieving these milestones enables the jurisdictions to meet growing water demand and provides a backup water supply for the region.

"Good project, good scope, design-build works, our team designed to budget."

—Brian Key, Executive Director, Bedford Regional Water Authority, Virginia May 12, 2015

Results

This critical project provides the area with high-quality water supply facilities and an infrastructure that is expandable and maximizes BRWA's investment. This is being accomplished in a tight time-frame, while keeping residents engaged through proactive communication about the construction, which involves pipelines going through their communities. When completed, the $35 million project will have immediate treatment capabilities of 6 mgd, with the ability to expand to 12 mgd in the future.

The Black & Veatch team is working with local communities to keep the public engaged by communicating about the project to minimize disruption and inconvenience.

CHAPTER

3

Apportioning and Managing Project Risk

When using a collaborative-delivery method—whether design-build or construction management at-risk (CMAR)—for a water or wastewater project, both the owner and the collaborative-delivery firm need to understand the risks inherent to the specific approach being used. In this context, risk is defined as recognizing and understanding what potentially could go wrong (or right) throughout a project. Effective risk management addresses who is responsible for owning, mitigating, or managing the risk. Getting to this understanding is often based on a thorough evaluation of the project in conjunction with what each party has experienced in previous projects, lessons-learned, and ability to mitigate a given risk.

As early as possible when planning the project and preparing procurement documents, an owner needs to address the following questions.

- What **undesirable events** might occur?
- How **likely** is each event to occur?
- For each undesirable event that might occur, how **severe** would the adverse impact be?
- How should each situation be **managed** and/or mitigated?
- **Which party** is best able to mitigate or absorb the responsibilities associated with the resulting impacts?

A prospective design-build or CMAR firm will also need to address similar, and some different, questions. Although neither the owner nor the firm can or should accept all of the project risks, each party must be willing to accept appropriate and reasonable risks to realize the benefits of collaborative delivery.

Using a systematic process to assess risks and identifying procedures to manage them can yield significant cost and schedule benefits to both the owner and the design-build or CMAR firm. Early implementation of risk-reduction strategies by the owner (such as site investigations, pilot studies, means and methods evaluation and permit planning) can prove particularly beneficial. Collaborative-delivery firms experienced with complex water and wastewater projects tend to apply prudent and systematic risk-management analysis when developing proposals.

Risk Allocation Principles

Risk allocation in a collaborative-delivery contract follows the principle that risks should be allocated to the party best positioned to manage them. Whether it is the owner or the firm that prepares the contract, a **risk-allocation matrix** understood and agreed to by both parties provides an essential starting point. Such a matrix identifies potential project risks and allocates responsibility between the owner and the firm, with the objective of reducing the project's risk-related costs by addressing the following questions.

- **Loss prevention—**What measures can be taken to prevent or reduce the likelihood of adverse occurrences, and which party can most efficiently be responsible for taking these measures?
- **Loss control—**What measures can be taken to minimize the extent of damage caused by an undesirable event, and which party can most efficiently take responsibility for these measures?
- **Third-party coverage—**What forms of insurance are available to reimburse some or all of the losses incurred for specific risks, and how cost-effective are these insurance policies compared with other risk-management alternatives?
- **Absorption of risk—**Which party is best able to absorb and manage—and therefore be responsible for—each risk?

The use of a rigorous and equitably balanced risk assessment process begins early in the procurement and is updated/refined as the project proceeds from procurement through execution.

Source: DBIA 2015 Design-Build Best Practices for the Water/Wastewater Sector

In collaborative-delivery projects, contract terms should **balance the allocation of risks** to foster a successful project by encouraging collaborative relationships and establishing an understanding of what project success means to both parties.

For example, it is rarely in an owner's best interest to impose project risks on the collaborative-delivery firm that are not truly within the firm's control. Such **risk shifting** can reduce the number of firms responding to an RFQ/RFP, result in excessive cost contingencies or risk premiums paid by the owner, and make it more difficult for the design-build or CMAR firm to obtain required bonding and insurance cost-effectively. It is neither reasonable, nor even feasible, to shift all risks to the collaborative-delivery firm, as the owner's risk does not drop to zero under any circumstances, and it is not possible to reduce, transfer or mitigate every conceivable risk. Examples of risk best left with owners include hazardous materials, differing site conditions, and *force majeure*. Further, the success of a project can be jeopardized by forcing the collaborative-delivery firm to accept risks that are not within its control.

When deciding whether to respond to a request for proposal (RFP) for a particular project, a collaborative-delivery firm also considers the following questions.

- Is the risk profile acceptable?
- If the risk profile is not acceptable, can it be changed or adjusted during the proposal and negotiation process?
- If the risk profile is not acceptable and cannot be changed, is pursuing the project worth investing business-development funds?

Apportioning Risks/Responsibilities

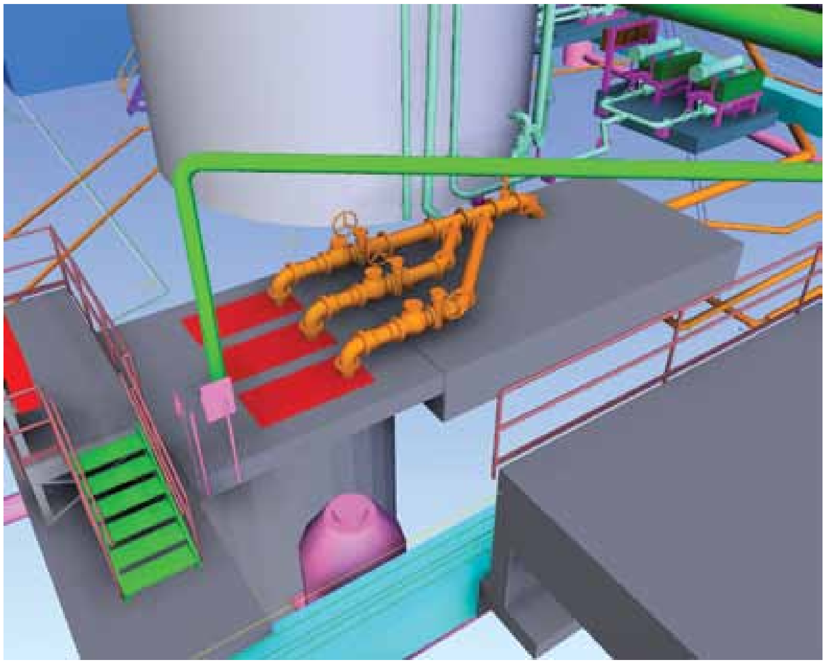
This chapter presents and discusses the various situations that are typical with water and wastewater projects. Also included are recommended best practices for apportioning and managing risk. These practices are based on experiences with successful projects, in terms of likely risks and how best to allocate responsibility for managing them among owners and collaborative-delivery firms. At the conclusion of this chapter, Table 3.4 illustrates the allocation of various risk components among owners and collaborative delivery firms.

Retained by Owners in any Collaborative-Delivery Contract

Certain risks that the collaborative-delivery firm cannot control—and cannot anticipate with reasonable cost contingencies—are typically retained by the owner.

- **Acquiring Land/Easements.** Legal ownership and availability of the project site, as well as possession of executed and recorded easements, are critical to the success of most water and wastewater projects. Although this seems obvious, some projects encounter significant delays or require major design revisions due to difficulties with acquiring land or easements. The owner retains the risk associated with acquiring land and easements, including temporary easements for construction or laydown areas, as well as permanent easements for installed utilities.

  Managing local traffic during construction may also require special permits or traffic-control systems under an agreement with the local municipality. The owner may want to retain responsibility for this function, since it is closely tied to community relations. Impacts of the traffic-management plan on construction costs or schedule may require a change order. For example, any railroad crossings need to be negotiated with the railroad, and railroad protective liability insurance may be required. *NOTE: Temporary road crossings and related liability insurance are normally the responsibility of the collaborative-delivery firm.*
- **Site Conditions.** The owner is responsible for providing complete, accurate, and reliable site plans, survey data and subsurface investigations for the collaborative-delivery firm to incorporate in the planning and design of a project. In most situations, the owner retains the risk associated with site conditions that deviate materially from those described in the RFP and contract. Some owners require the collaborative-delivery firm to conduct its own site investigations during the procurement process. Differing site conditions can affect both cost and schedule and may require a change order. A



The use of Building Information Modeling (BIM) is gaining wide acceptance. The power of BIM to detect and provide a visual model for field installation of equipment results in cost and schedule savings for owners.

well defined approach to addressing such conditions is especially important if the project involves the rehabilitation or expansion of an existing facility where as-built drawings and information may be incomplete or inaccurate.

- **Environmental Approvals and Permits, as Well as Any Related Delays.** Although an owner may engage the collaborative-delivery firm to assist in preparing and obtaining environmental permits and approvals, the owner typically assumes the risks associated with issuance of such permits by a licensing or permitting agency, particularly environmental. Since these are based on the owner's relationship with the permitting agency, delays or additional costs in obtaining such permits or approvals would not be the collaborative-delivery firm's responsibility, unless the permit preparation work performed by the firm failed to meet the standard of care for this activity.
- **Technical Requirements.** The owner should provide a detailed, complete, and accurate site description, together with project performance and other technical requirements, in order to ensure that all potential risk elements are apparent.
- **Quantity and Quality of Influent.** The quantity and quality of untreated water or wastewater entering a facility affects its ability to perform as required. Performance and cost guarantees proposed by collaborative-delivery firms assume that the raw water input to a water-treatment plant, the raw sewage entering a wastewater-treatment plant, or the water and/or sewage flowing into a pipeline and/or pumping station will fall within the range of quality and quantity parameters, including seasonal variations, specified in the RFP and contract. If the untreated water or wastewater entering the plant or pipeline is out of specification at the time of performance testing, the owner and the collaborative-delivery firm will negotiate an equitable adjustment to the plant-performance criteria. The contract would normally address such situations and specify schedule and cost relief to the firm.

Methane gas produced by the Opequon Water Reclamation Facility in Winchester, VA, meets more than 50% of the treatment plant's needs.

- **Materials Cost Escalation.** Contracts that span several years typically include a comprehensive escalation clause to address inflation or unforeseen increases in cost of materials. This clause might be premised on agreed cost components in the fixed price or GMP. *NOTE: Although the owner retains all risk/responsibility for materials cost escalation in a PDB and CMAR contract, the relative allocation can also be negotiated as part of a GMP in the design-build contract.*
- **Owner-directed Changes.** Contractually, an owner is entitled to require changes within the scope of work, and may request extra work from the collaborative-delivery firm. When considering any such change or addition, the owner works collaboratively with the firm, recognizing that early changes on a project can be accommodated more easily, and at less cost, than late or delayed changes. The owner requests a change order proposal from the firm for the change under consideration. The change order proposal details the proposed change in cost and schedule, including recognition of impacts, for the owner's decision.
- **Damage to Owner's Other Property, Including the Facility after Transition.** The risk of damage to the owner's property—other than the facility during construction (which is covered by the collaborative-delivery firm's insurance)—or to the facility after transition, remains the responsibility of the owner, since the owner has permanent insurance in place covering such property. N*OTE: If contractually required, the firm might assume liability for such damage due to its fault or negligence, up to the amount of the owner's insurance deductible.*
- **Payment Responsibility.** Making payments when due is a fundamental obligation of the owner. The collaborative-delivery firm is usually paid monthly, in arrears. The project agreement may specify a mobilization payment due with the notice to proceed with construction.

Shared by the Owner and any Collaborative-Delivery Firm

- **Uncontrollable Circumstances.** Some risks that affect the project cost or schedule, or the ability of the design-builder to perform its contractual responsibilities, fall into the category of uncontrollable circumstances, meaning they are not under the control of either party and are not insurable. Examples include loss of power, floods, unforeseen changes in law or regulatory requirements, differing conditions, storm damage, and earthquakes. Such uncontrollable circumstances might lead the collaborative-delivery firm to seek a change order under the contract. In the spirit of collaboration, the design-build or CMAR firm will typically discuss in advance with the owner the rationale for any changes, as well as the cost and schedule implications, and it may be able to suggest design or construction adjustments and other less expensive approaches to accomplish the changed objectives.
- **Proprietary Processes or Equipment.** The party that purchases a process or equipment, or specifies a supplier, is normally responsible for its performance. However, the performance guarantee given by a supplier to a collaborative-delivery firm flows through the firm as part

of the firm's plant performance guarantee. If the owner pre-purchases the process or equipment from the supplier, and the collaborative-delivery firm does not directly guarantee it, the performance guarantee may flow directly from the supplier to the owner.

- **Coordination with Existing Facilities.** This is a particularly important topic when a project is an addition to an existing water or wastewater treatment facility that must remain in service. The owner provides the collaborative-delivery firm with full detail on the existing facility, including description, location, and condition of physical tie-in points. The firm and the owner develop a mutually agreed-on coordination, shut-down and tie-in protocol to ensure that the firm's work does not interfere with existing plant operations, and that the tie-in itself is completed without disruption.

Retained by Owners Specifically in a CMAR Contract

- **Design.** Unlike design-build, where the design-builder assumes the design risk, in a CMAR project the responsibility remains with the owner, as the owner has retained the design engineer under a separate agreement. The owner supplies the design to the CMAR firm, who expects to rely on its technical accuracy. If the design proves to be defective, the owner may find it difficult to pass responsibility to the designer. (CMAR project delivery has some similarity to DBB delivery, in that the owner's designer is typically held responsible for failing to exercise a negligence-based professional standard of care, but not for failing to produce a design that is free from defects.)

  To prevent these situations from occurring, the CMAR contract requires collaboration between the CMAR firm and the design engineer throughout design and construction, thus reducing design risk. With CMAR delivery, the owner's design risk associated with constructability incidents is significantly reduced through a range of pre-construction services, such as constructability reviews, value engineering, and cost estimating during the design-development process.
- **Cost of Constructed Project (only up to the fixed price or GMP).** As noted above in discussing a CMAR firm's risk, it is important to emphasize that both the owner and the firm shoulder responsibility for cost risk up to the agreed-on construction price. The owner and CMAR firm consult on their choices of subcontractors, which can affect price. Once the GMP is reached, the CMAR firm bears sole responsibility for any further costs. In addition, depending on the details of the contract language, the owner may have sole or partial responsibility for use of contingency funds.
- **Quantity and Quality of Project Output.** Quantity, as well as quality, of treated water or wastewater is a subject that must be defined in the project agreement.

Shared by the Owner and CMAR Firm

- **Cost of Constructed Project.** Upon completion of the pre-construction phase and before starting construction, the CMAR firm typically guarantees an upper limit to the total cost of meeting its contractual obligations to construct the project. The point in the design development process when the owner and the CMAR firm negotiate the fixed price or GMP can vary depending on factors unique to the project, such as the need for schedule acceleration or early cost determination.

It is important to emphasize that both the owner and the CMAR firm shoulder responsibility for cost risk up to the fixed price or GMP. The owner and CMAR firm consult on their choices of subcontractors, which can affect price. Once the project's costs have reached the GMP or fixed price, however, the CMAR firm bears sole responsibility for any further costs. Apart from adjustments for price escalation of materials beyond an agreed limit or changed conditions as specified in the contract, the CMAR firm accepts the risk that such costs may exceed the fixed price or GMP. It should be noted that the amount of cost contingency in the fixed price or GMP is directly affected by the level of design completion, as well as by the availability of fixed subcontractor pricing. Table 3.1 provides examples of these allocated risk responsibilities.

- **Construction Schedule.** If design documents and other owner responsibilities are completed on time, the CMAR firm assumes the risk for constructing the project on time. Failure to construct the project on time may trigger liquidated damages (LDs), since the actual damages might be difficult to calculate. However, LDs usually have a reasonable cap and do not exceed actual costs to the owner. Damages would not be assessed if late delivery is due to circumstances beyond the CMAR firm's control. Consideration must be made for equitable schedule adjustments due to delays beyond the firm's reasonable control, such as impacts from extreme or unusual weather conditions, unforeseen site or subsurface conditions, owner changes, permit or license changes, changes in law, and uncontrollable circumstances.
- **Project/Plant Performance and Acceptance Testing.** The CMAR firm may be responsible for conducting performance testing when construction is complete, but it is not held accountable for the results of testing, which are the responsibility of the designer-of-record.

  The owner and CMAR firm share responsibility for ensuring that the completed project is designed and constructed to meet performance requirements outlined by the owner and explicitly included in the contract.

  A **plant-performance warranty** may include plant-performance liquidated damages set at commercially reasonable levels, which will apply if the performance guarantees are not met within a specified time. They may be graduated for the degree by which the plant fails to meet the performance guarantees, up to a reasonable limit.

  The project is considered complete when the CMAR firm demonstrates the facility's performance through an agreed-on acceptance-testing procedure up to and including mechanical completion—but the CMAR firm is not subsequently responsible for ensuring that full plant performance meets specific criteria. *NOTE: The owner remains responsible for the within-specifications delivery of both quantity and quality of untreated water or wastewater, as well as timely delivery of conforming untreated water or wastewater for testing and commissioning.*

Table 3.1. *Examples of Allocated Responsibilities in CMAR Delivery*

Risk	Primary Responsibility: CMAR Firm	Primary Responsibility: Owner
Land and Easement Acquisition		X
Technical Requirements		X
Project Design		X
Building and Administrative Permits	X	
Environmental Approvals and Permits		X
Quality and Quantity of Influent (raw water)		X
Quality and Quantity of Effluent (finished water)		X
Project Performance/Acceptance	Shared	Shared
Site Conditions		X
Schedule	Shared	Shared
Cost of Constructed Project to GMP		X
Uncontrollable Circumstances	Shared	Shared
Materials Cost Escalation		X

Shared by the Owner and Design-Builder in a PDB Contract

- **Project Design.** In a progressive design-build contract, the owner provides input into the design at specified milestones. This collaborative process minimizes risk stemming from design decisions or details related to constructability, coordination, and similar problems. If such problems do arise, the owner will hold the design-builder responsible for addressing many of the resulting problems and may also assume responsibility for problems stemming from its own role in the design collaboration.

  By contrast, in the design-bid-build and CMAR delivery methods, the owner supplies the design to the builder, and the builder expects to rely on it without modification. If the design proves to be defective, in terms of constructability or otherwise, the owner cannot hold the builder responsible, and will likely find it difficult to pass responsibility back to the designer. Table 3.2 provides examples of these allocated risk responsibilities.
- **Schedule.** In a PDB contract, if design reviews and other owner responsibilities are completed on time, the design-builder assumes the risk for constructing the project on time. Failure to construct the project on time may trigger liquidated damages (LDs), since the actual damages might be difficult to calculate. However, LDs usually have a reasonable cap and do not exceed actual costs to the owner. Damages would not be assessed if late delivery is due to circumstances beyond the design-builder's control. Consideration must be made for equitable schedule adjustments due to delays beyond the firm's control, such as the effects of extreme or unusual weather conditions, unforeseen site or subsurface conditions, owner changes, permit or license changes, changes in law, and uncontrollable circumstances.

Table 3.2. *Examples of Allocated Responsibilities in PDB Delivery*

Risk	Primary Responsibility: Design-Builder	Primary Responsibility: Owner
Land and Easement Acquisition		X
Technical Requirements		X
Project Design	Shared	Shared
Building and Administrative Permits	X	
Environmental Approvals and Permits		X
Quality and Quantity of Influent (raw water)		X
Quality and Quantity of Effluent (finished water)	X	
Project Performance/Acceptance	X	
Site Conditions		X
Schedule	Shared	Shared
Cost of Constructed Project to GMP	X	
Uncontrollable Circumstances	Shared	Shared

Assumed by Any Collaborative-Delivery Firm

- **Building and Administrative Permits.** The collaborative-delivery firm typically accepts the risk and responsibility for obtaining certain permits and governmental approvals, such as building and construction permits that are specifically tied to the project scope and design. The owner, however, retains responsibility for discretionary permits, such as environmental and siting. *NOTE: A CMAR firm would not be responsible for delays or any other problems related to building and administrative permits, if those problems are caused by the design of the facility, as the designer-of-record has ultimate responsibility for the design.*
- **Fines and Penalties.** The collaborative-delivery firm can be held responsible for fines and penalties assessed with respect to its work, to the extent that it had the ability to control the work beginning on the date of the proposal. Such liability would be subject to the change-in-law article of the contract. *NOTE: The owner becomes responsible for any fines and penalties after the transition period is complete and final acceptance is achieved.*
- **Construction Warranty.** As the collaborative-delivery firm controls the procurement of materials, administration of construction and subcontractors, and supervision and inspection of installation, it provides a normal construction warranty (or one-year correction period) on the project. *NOTE: Although a CMAR firm gives a normal construction warranty on the project, it is not responsible for performance guarantees tied to the project's design, as the designer-of-record has ultimate responsibility for the design.*
- **Third-party Liability.** Since the collaborative-delivery team has the care, custody, and control of the project worksite, it also assumes liability for third-party bodily injury or property damage. It will indemnify the owner from and against such liability, and provides

Early site investigations during the preconstruction phase are key to obtaining an accurate GMP and providing cost certainty during construction.

workers' compensation/employer's liability and commercial general liability insurance to cover such risks, along with automobile liability insurance.

- **Damage to Facility.** The collaborative-delivery firm assumes liability for damage to the facility under construction until transition to the owner, and provides builder's risk insurance to cover such risks. Following transition, the owner assumes the care, custody, and control of the facility and provides its own property-damage insurance coverage, with a waiver of subrogation.
- **Professional Liability.** The collaborative-delivery firm will assume responsibility for any professional liability arising out of its professional services. Professional liability insurance (to reasonable limits) provides evidence of the firm's responsibility in this area. *NOTE: A CMAR firm will not provide professional liability insurance, since professional liability on a CMAR project lies with the design engineer under contract directly with the owner.*
- **Other Insurable Risks.** The collaborative-delivery firm will provide appropriate and available special insurance as required for transit, marine cargo, harbor workers and longshoremen, watercraft, and aircraft risks.

- **Uninsurable Risks.** *NOTE: A collaborative-delivery firm should not assume any liability for owner's consequential damages, since it is not possible to predict them or assess their likelihood, and therefore it is not possible to insure against them.*

Assumed by the Design-Builder (not CMAR Firm)

- **Quantity and Quality of Facility Output.** The quantity and quality of the treated water or wastewater is a major subject, with the risk borne by the design-builder.
- **Cost of Constructed Project.** The design-builder guarantees the cost of meeting its contractual obligations. Apart from certain adjustments—for changes in scope directed or requested by the owner, price escalation of materials not addressed in the contract, changed conditions and uncontrollable circumstances as specified in the contract—the design-builder accepts the risk that its cost may exceed the fixed priced or guaranteed maximum price (GMP). *NOTE: Provision should be made for the positive incentive of sharing cost savings when actual costs are lower than the GMP.*
- **Plant Performance and Acceptance Testing.** The design-builder is responsible for ensuring that the completed project is designed and constructed to meet performance requirements outlined by the owner and explicitly included in the contract.

  A **plant-performance warranty** may include plant-performance liquidated damages set at commercially-reasonable levels, which will apply if the performance guarantees are not met within a specified time. They may be graduated for the degree by which the plant fails to meet the performance guarantees, to a reasonable limit. For more on liquidated damages, refer to Addressing Liability in the Contract on page 55.

  The project is not considered complete until the design-builder demonstrates the facility's performance through an agreed-on **acceptance-testing procedure.** The firm typically retains this performance risk until the project is accepted, at which point the owner assumes responsibility for the facility's operation, maintenance and performance. *NOTE: The owner remains responsible for the within-specifications delivery of both quantity and quality of untreated water or wastewater to the project, as well as timely delivery of conforming untreated water or wastewater for testing and commissioning.*

Assumed by the Design-Builder in an FPDB Contract

- **Design.** In a design-build contract with a single point of accountability for engineering and construction, the design and construction teams work together throughout design and delivery of the project. This minimizes risk stemming from design decisions related to constructability, coordination, or similar problems. If such problems do arise, the owner can hold the design-builder responsible for addressing the resulting problems, including any required rework. *NOTE: This is also the case in a PDB project—if the design-builder that provided the design in phase one is retained to construct the project in phase two. If, on the other hand, the owner and the original* *design-builder cannot agree on a GMP and the owner chooses another design-builder to construct the project, the second design-builder is not responsible for any problem arising from the design.*

By contrast, in the design-bid-build delivery method, the owner supplies the design to the builder, and the builder expects to rely on it without modification. If the design proves to be defective in terms of constructability or otherwise, the owner cannot hold the builder responsible, and may find it difficult to pass responsibility back to the designer. Table 3.3 provides examples of allocated responsibilities.

- **Schedule.** The design-builder has the project-planning tools and schedule-management capability to meet expected schedule requirements and therefore usually assumes the risk for completing the project on time in accordance with contract requirements. Failure to complete the project on time may trigger liquidated damages, if so stated in the contract, since the actual damages might be difficult to calculate. For more on liquidated damages, refer to Addressing Liability in the Contract, which begins on page 55. *NOTE: This is also the case in a PDB project—if the design-builder that provided the design in phase 1 is retained to construct the project in phase 2. If, on the other hand, the owner and the original design-builder cannot agree on a GMP, and the owner chooses another design-builder to construct the project, the second design-builder is not responsible for any delays arising from the design.*

Table 3.3. *Examples of Allocated Responsibilities in FPDB Delivery*

	Primary Responsibility	
Risk	**Design-Builder**	**Owner**
Land and Easement Acquisition		X
Technical Requirements		X
Project Design	X	
Building and Administrative Permits	X	
Environmental Approvals and Permits		X
Quality and Quantity of Influent (raw water)		X
Quality and Quantity of Effluent (finished water)	X	
Project Performance/Acceptance	X	
Site Conditions		X
Schedule	X	
Cost of Constructed Project to GMP	X	
Uncontrollable Circumstances	Shared	Shared

Managing Risks and Liabilities

Many tools exist to manage risks and liabilities for collaborative delivery. Basic risk-management guidelines suggest that risks can be:

- Accepted and managed through collaborative efforts and contingencies;
- Mitigated; or
- Transferred, fully or partially.

A useful approach to risk management is for the owner and the collaborative-delivery firm to develop a risk and responsibilities matrix that identifies foreseeable risks, the probability that each risk will occur, the potential impact of each risk, which party is responsible for the risk, and

Mitigating Risks through Collaborative Delivery

During the preliminary design or preconstruction stage of a project, developing a risk and responsibilities matrix—in parallel with design, scope development and costing—gives the owner and the collaborative-delivery firm a clear understanding of the risks and their potential effects on delivering the final project. If the owner and the firm practice true collaboration at this stage, they can discover risks early and have them addressed by whichever party is best suited to resolve them.

Examples of risks to owners and collaborative-delivery firms may include:

- Unforeseen conditions,
- Delivery delays,
- Weather,
- Schedule,
- Process performance,
- Warranty,
- Service disruptions, and
- Safety of the public and operating staff.

Many new water-infrastructure projects, particularly those with expansions or enhancements of currently operating facilities, include a number of these risks. In the case of unforeseen service disruptions, owners should consider retaining this risk, in order to ensure that they are in control of maintaining essential operational services. In situations where an owner has shifted this risk to the design-build or CMAR firm, service outages are more likely to occur.

Another area—preliminary investigations of existing process and piping, including underground—is key to successful design, constructability reviews, and costing. "As-builts" or previous final plans are often used as starting points (e.g., examples or templates) for establishing design and level of work on projects. In these situations, the design-build or CMAR firm must physically verify the site conditions, types of materials and locations of the facilities to be included in the new work. Hydro excavations and internal cameras can be used to discover the locations, sizes and materials of existing pipelines and structures, without the risk of disrupting service.

Involving the owner's operations staff throughout the preliminary investigation process is vital, as they need to know when, and for how long, key processes may be off-line for tie-ins. Identifying and resolving a roadblock early can lessen costs and disruptions.

More often than not, design can help resolve each construction challenge, and construction help resolve each design challenge. We know from experience that when complex problems arise on existing sites, collaboration diminishes the risks

—David B. Odell, *OUI (WDBC Advisor Member)* how each risk will be managed. The risk and responsibilities matrix can also be used to establish the project contingency on a line-item basis, an aggregate basis, or a combination of the two. If the responsibilities matrix is regularly updated and reviewed as part of the monthly project-review process, it can also be a useful project-management tool for both the owner and the collaborative-delivery firm. As the project proceeds and certain anticipated risks don't occur, the project contingency budgets can be adjusted.

Financial Security

Sureties and Bonding

The most common type of security to protect the owner against bankruptcy or nonperformance is a performance bond. A third-party, the surety, guarantees that the design-builder will perform its contractual obligations in designing and constructing the project or that the CMAR firm will perform its obligations in constructing the project. Sureties are increasingly requiring a detailed review of a project's scope of work and contract conditions prior to issuing performance bonds or a payment for nonperformance. Sureties may be unwilling to bond a project that has what they consider to be unreasonable terms.

In addition, bonds may be more economically available if they cover only the construction portion of a collaborative-delivery project, and not the whole design-build scope. Owners need to understand that bonds are not insurance and shouldn't be looked at as such.

Insurance

Similar to the surety industry, the design-and-construction insurance industry is continually adapting to the single-source accountability of design-build delivery and the cooperative integration of design and construction in CMAR delivery. Premium costs and coverage can vary widely based on the particular risks and challenges of a project, as well as the condition of the insurance industry when insurance policies are procured. The insurance requirements included in a project agreement should be based on how risk is to be allocated between the parties.

Most owners require a design-build firm (and its sub-consultants)—or, in the case of CMAR, the design engineer—to carry professional liability insurance to cover liabilities that arise out of design negligence. This requirement is in addition to industry-standard worker's compensation, commercial general liability (CGL), and automobile liability insurance.

Builder's risk insurance is commonly required on a collaborative-delivery project to cover replacement or repair of materials or structures damaged during construction. Although the policy may be procured by the collaborative-delivery team, the cost of the policy is typically passed on to the owner.

In some cases, it may be appropriate to consider project-specific insurance policies or products that provide coverage otherwise excluded from CGL policies. For example, pollution-liability policies can insure against the costs associated with addressing environmental issues, such as contaminated soils. Efficacy insurance, though expensive, may protect against some losses associated with economic liabilities, such as liquidated damages or performance guarantees. Although insurance products are available for a wide variety of risks, the project-specific policies and coverage for certain project risks can be very expensive and contain numerous exclusions. Owners should be cautious about specifying overly protective or cumbersome insurance policies unless they have evaluated their cost and benefits and included such costs in the project budget.

Owner-controlled and contractor-controlled insurance programs (OCIP and CCIP, respectively) are sometimes referred to as wrap-up insurance programs. These types of programs provide centralized insurance coverage for a project and eliminate some of the inefficiency and redundant costs associated with multiple policies and insurers. However, these types of programs can also be costly and require a great deal of oversight, making them often more appropriate for only large and complex projects.

Owners should also carefully evaluate the types of sureties and bonds required, as they are often "belts-and-suspenders" approaches that add cost without providing additional benefits.

Addressing Liability in the Contract

It is important to establish parameters for holding each party accountable for both foreseeable and unforeseeable risks. To ensure mutual understanding and minimize subsequent disputes, the contract usually provides definitions of crucial legal and technical terms. Some of the terms that can

The newly renovated and upgraded reverse osmosis system at the Venice, FL, 4.5 mgd water treatment plant enables the system to meet the existing TDS and flow conditions.

lead to confusion if not defined explicitly include "unsatisfactory performance," "uncontrollable circumstance," "*force majeure*," "consequential damages," "equivalent compensation," and "indemnification."

Limits of Liability

Many contracts include a clause that limits the collaborative-delivery firm's overall liability to the owner. This limitation reflects the characteristically high-risk profile of water and wastewater projects. Without limiting liability, some contracts could expose a firm to the risk of bankruptcy on a single project.

Many experienced firms will avoid contracts that do not contain an overall limitation of liability. **Recently, the surety industry has issued guidance that it will be less inclined to provide coverage to projects that do not have a limitation-of-liability provision.** The specific extent of these limitations and their enforceability are best addressed between the owner and the collaborative-delivery firm in the context of the project's specific risks and challenges. For example, it is relatively common for design-build and CMAR contracts in the power-generation industry to include limitation-of-liability amounts significantly less than 50% of the contract amount. The References section also includes information relative to the Spearin Doctrine, which addresses additional liability topics.

Liquidated Damages

As mentioned earlier, liquidated damages are included in collaborative-delivery contracts. The intent of liquidated damages (LDs) is to hold the design-build or CMAR firm accountable for schedule nonperformance (especially inexcusable schedule delays) by compensating the owner for losses suffered. Although LDs can be appropriate under some circumstances, the owner should recognize that the firm already has a strong interest in finishing the project according to contracted obligations and schedules. Onerous terms and excessive LDs will increase contingency costs and reduce the number of teams interested in the project.

If liquidated damages are set, their amount should reasonably approximate what is necessary to compensate the owner for actual losses, rather than be set at a level that simply serves to penalize the firm. In addition, the aggregate amount of LDs is capped, and also may be tiered or include a grace period for the early days of a delay. Provisions that set unrealistic LDs, provide for payments when the owner has suffered no actual financial loss, or transfer the risk of financing costs, may raise costs to the owner, increase the likelihood that an adversarial relationship between the owner and firm will develop, or impose risks that such payments may not be enforceable as a matter of state law. A more collaborative and positive approach to LDs would balance any potential delay damages with comparable early-completion incentives.

Consequential Damages

Collaborative-delivery contracts hold neither the owner nor the design-build or CMAR firm responsible for the indirect results of alleged failures. These might include damages to the firm, such as loss of market position, harm to reputation, or economic losses, or damages to the owner, such as loss of customers, loss of use of a facility, or debt-service costs. However, due to the subjective nature and varying scope of state laws, it may be desirable to include in the agreement a definition of what is intentionally excluded by a consequential damages waiver.

NOTE: Owners need to be aware that the surety industry currently limits issuance of surety bonds if contracts do not exclude consequential damages.

For example, if a collaborative-delivery firm must take a water-treatment plant off-line for two months to address a warranty obligation, the firm typically would not be required to pay the owner's costs for debt service or for having to purchase water from another utility to cover the lost capacity. Attempting to apply consequential damages in such a situation can result in excessive project costs paid by the owner in the form of risk contingencies, or lack of competitive interest in the project.

Indemnification

Neither party should be expected to indemnify the other party for the other party's negligence. Indemnification often is proportionately shared based on the negligence of each party in a given situation. Typically, the collaborative-delivery firm would be indemnified from third-party claims beyond their control, such as claims filed against the project by outside organizations, and the owner would be indemnified from third-party claims based on the negligence or failure of the firm to perform its contractual obligations. In any event, the scope of available insurance coverage should be taken into account in finalizing the indemnification language.

Where the collaborative-delivery firm has care, custody, and control of the construction worksite, it will usually provide an indemnification to the owner for bodily injury or property damage to third parties incurred at the site, and such indemnification will be covered by the workers' compensation/employers' liability insurance and/or the commercial general liability insurance provided for the project.

Warranties

As stated above, collaborative-delivery contracts typically contain construction-warranty obligations—similar to design-bid-build contracts—such as covering construction defects, materials and equipment defects—items that can be passed along to suppliers and equipment vendors and that have a specified warranty term (e.g., one year from substantial completion). Other warranties in collaborative-delivery contracts often address defects in design or performance, and their terms will vary based on the agreements reached between the owner and the collaborative-delivery firm.

As with any warranty, the terms should be clearly defined in the contract. Overly protective or unreasonably extended warranty terms may require a design-build or CMAR firm to incorporate expensive or cumbersome contingencies into its price, and in some cases may reduce firms' interest in competing for the project, if warranty terms would place a firm at too great a risk. (See risk items at the conclusion of this chapter.)

In addition, design-build contracts may also contain a performance warranty, which guarantees to the owner that if the plant receives the necessary untreated wastewater or water within a defined specification, the plant will meet its specified requirements for energy and chemical consumption, emissions, and effluent quality. Performance warranties are usually satisfied by performance tests on an agreed basis.

Equitable assignment of risks facilitates a productive, collaborative relationship between the owner and the collaborative-delivery firm and helps the owner realize all the benefits of design-build or CMAR project delivery. Both the Water Design-Build Council and the Design-Build Institute of America (DBIA) have developed guidelines to help share risks equitably. These documents, which offer a good starting point for contract development, can be obtained at waterdesignbuild.org and dbia.org.

Industry-Shared Forms

A number of industry service organizations have developed standard forms of contracts that balance risk management between the owner and the collaborative-delivery firm. These forms, including the Consensus DOCS developed by the Associated General Contractors, as well as contract forms developed by the DBIA, have gained wide acceptance in the collaborative-delivery world. Such industry-standard forms are accepted by design-build and CMAR firms with a minimum of negotiation. (Examples are in the References section.) Contracts prepared by outside advisors may not necessarily be consistent with these principles and may require extended negotiation to reach an acceptable agreement. The owner should be careful not to mix and match agreements, as the terminology may differ among various documents, leading to confusion and possible legal implications over contract terms.

In conclusion, a principal advantage of collaborative-delivery methods is that they foster a highly collaborative relationship between the owner and the design-build or CMAR firm. This relationship is established at the very beginning of the delivery process and promotes mutual trust from the start. It is reinforced by agreements that reflect collaborative principles and the equitable sharing of risk and reward for a successful project. All parties work for their mutual benefit and for the success of the project itself. Table 3.4 summarizes examples of the majority of the assigned risk responsibilities in collaborative-delivery contracts.

Cautions

Owners should know that indiscriminately shifting risk to the collaborative-delivery firm can result in lack of interest in competing for a project, or in a firm's transferring the increased costs back to the owner. Listed below are some specific cautions to consider when writing RFPs or contract terms.

- Owners should carefully evaluate the types of sureties and bonds required, to avoid a "belts and suspenders" approach that adds cost without providing additional benefits.
- Recently, the surety industry has issued guidance that it will be less inclined to provide surety coverage to projects that do not have a limitation-of-liability provision.
- Onerous terms and excessive or punitive LDs will increase contingency costs and reduce the number of firms interested in the project.

Table 3.4. *Examples of Allocated Risks/Responsibilities in Key Collaborative Delivery Projects*

RISK	Progressive Design-Build: Design-Builder	Progressive Design-Build: Owner	Fixed-Price Design-Build: Design-Builder	Fixed-Price Design-Build: Owner	CMAR: CMAR Firm	CMAR: Owner
	PRIMARY RESPONSIBILITY					
Land and Easement Acquisition		X		X		X
Technical Requirements		X		X		X
Project Design	Shared	Shared	X			X
Building and Administrative Permits	X		X		X	
Coordination with Existing Facilities	Shared	Shared	Shared	Shared	Shared	Shared
Environmental Approvals and Permits		X		X		X
Fines and Penalties	X		X		X	
Proprietary Processes or Equipment	Shared	Shared	Shared	Shared	Shared	Shared
Quality and Quantity of Influent (raw water)		X		X		X
Quality and Quantity of Effluent (finished water)	X		X			X
Project Performance/ Acceptance	X		X		Shared	Shared
Site Conditions		X		X		X
Schedule	Shared	Shared	X		Shared	Shared
Cost of Constructed Project to GMP	X		X			X
Construction Warranty	X		X		X	
Third-Party and Professional Liability	X		X		X	
Uncontrollable Circumstances	Shared	Shared	Shared	Shared	Shared	Shared
Materials Cost Escalation	TBD	TBD	TBD	TBD		X

- Making the collaborative-delivery firm responsible for consequential damages can result in increased cost being transferred back to the owner. Moreover, owners need to be aware that the surety industry currently limits issuance of surety bonds if contracts do not exclude consequential damages.
- Neither party should be expected to indemnify the other party for the other party's negligence.
- As with any warranty, the terms should be clearly defined in the contract. Overly protective or unreasonably extended warranty terms may require a design-build or CMAR firm to incorporate expensive or cumbersome contingencies into its price, and in some cases may reduce participation in the procurement, if warranty terms would place firms at too great a risk.

CHAPTER

4

Conducting the Procurement Process

As discussed in Chapter 1, a successful design-build (DB) and construction management at-risk (CMAR) project begins with a well planned and organized procurement process, based on the owner's goals and priorities established early in the planning process. Individually or together, these factors drive the type, duration and complexity of the procurement process, as well as its cost.

In addition to being familiar with existing state and local regulations governing which procurement methods are allowed, an owner needs to develop a clear definition of the project's requirements, choose the procurement process and selection priorities, and develop a draft contract that includes terms, schedule, and scope of services. Conveying this information clearly and in a transparent process to potential proposing firms will minimize unnecessary expenditures of time, money and resources for both the owner and proposing firms.

This chapter expands on the information on the various delivery methods presented in Chapter 2. It summarizes the major steps involved in procuring the technical and construction expertise needed for a collaborative-delivery project. It also defines how owners use the information compiled during the planning process to prepare the request for qualifications (RFQ) and request for proposals (RFP) documents. Users are also encouraged to go to the WDBC websites to obtain and use the Progressive Design-Build, CMAR and Fixed-Price Procurement Guide documents; with additional information also available on the DBIA website on contractual documents. (See Reference Section.)

Well-thought-out procurement documents are vital to successful design-build and CMAR projects. They establish and convey the type of relationship the owner wishes to form with the selected firm.

This chapter first describes the process for developing a basic RFQ and RFP with details on how to adapt them specifically for CMAR, PDB and FPDB delivery methods; and concludes with contract award specifics.

NOTE: The procurement process for a collaborative-delivery project may entail either two steps—RFQ and RFP—or a single step, which may be either an RFQ or an RFP. These options are discussed later in this chapter, with additional guidance available at waterdesignbuild.org.

Utility/agency executives' recommendations for achieving a successful collaborative-delivery project.

- Determine the delivery method that best suits the project.
- Network and consult with other owners who have used collaborative delivery for water/wastewater project.
- Secure support from an independent consultant with experience in collaborative delivery.
- Educate staff members about how to manage collaborative-delivery projects effectively.
- Choose project team members who are fully engaged and committed to the project's success.
- Select a collaborative-delivery firm based on the specific qualifications required for the project.
- Clearly define the project's goals and priorities before beginning the procurement process.
- Conduct regularly scheduled planning meetings to evaluate project cost, schedule, and risks and devise ways to manage emerging challenges.

Source: WDBC 2015 Lessons Learned Research Report

Request for Qualification (RFQ) Basics

An owner may use an RFQ to establish a short list of collaborative-delivery firms, who are then invited to respond to an RFP. Occasionally, an owner may decide to use an RFQ in a single-step process, to select the design-build or CMAR firm based primarily on qualifications—although limited cost criteria are sometimes included in the RFQ.

An RFQ generally includes the scope of work and information about the overall procurement process, such as submittal requirements and the owner's evaluation criteria. It also includes key elements of the subsequent RFP, so short-listed proposing firms know what to expect in the next round.

Criteria for evaluating proposing firms may include some or all of the following topics.

- Understanding the project's goals, priorities, and approach
- History of working collaboratively with owners and other partners
- History of meeting budget, deadlines and overall schedule
- Specialized knowledge and experience with projects of similar size, complexity and features
- Experience with design-build or CMAR delivery, particularly on similar projects
- Self-performance capabilities
- Client references
- Team members' experience in working together
- Key personnel's applicable experience and commitment to the project
- Sustainable design expertise and experience in LEED certification, if applicable
- Financial stability
- Demonstrated commitment to quality
- Safety record
- Bonding capacity, appropriate licenses, and ability to meet insurance requirements

Some of these, such as financial stability, safety record and bonding capacity are yes/no or pass/fail factors. Others may be weighted and scored.

In general, owners should ask proposing firms to present only relevant qualifications and other information that will be important for evaluating them. Some owners issue a request for expressions of interest (RFEI) prior to the RFQ. The purpose of an RFEI is to solicit guidance and suggestions from interested proposing firms regarding approaches to the project, the draft contract, and the procurement process. If time allows, this extra step can help maximize interest and competition, especially on large or complex projects. However, this approach should only be pursued if the owner intends—and has the funding—to sign a contract for the project within the next twelve months.

NOTE: If proposing firms are required to include design concepts and drawings in the proposals, it is appropriate for the owner to consider paying a stipend to unsuccessful proposing firms. This remuneration not only promotes competition, but also gives the owner rights to all the ideas presented by the unsuccessful proposing firms.

The Montevina WTP pumping system delivers high quality water from the foothills south of Los Gatos, California.

Request for Proposal (RFP) Basics

An owner will issue an RFP to the short list established by the RFQ. Occasionally, an owner may decide to use only an RFP in a single-step process, to select the design-build or CMAR firm based on qualifications and cost.

A successful RFP will:

- Attract competitive proposals;
- Communicate clearly the basis for evaluating proposals, including the weights assigned to various evaluation criteria;
- Promote collaboration, creativity, innovation and optimum value;
- Avoid potential barriers to the envisioned collaborative process;
- Define the project scope, quality, schedule, and performance requirements; and
- Minimize the number of topics requiring negotiation prior to awarding a contract.

An RFP generally includes the following contents:

- Project background, priorities and drivers (including budget if known).
- Description of the project and the required scope of services.
- Description of the procurement process, including how proposals will be evaluated, how the selection will be made, and a schedule for each procurement milestone.
- Instructions for proposing firms, including what information is needed and how it should be presented.
- Technical design requirements and performance criteria.
- How the owner will evaluate any innovative options that a respondent may incorporate into its proposal.
- A draft contract, to be reviewed and commented on by the proposer and included in its submittal, including insurance and bonding requirements.
- Special requirements for sole-source, pre-selected, or pre-qualified equipment manufacturers or suppliers.
- Requirements/limitations on self-performing work.
- Evaluation criteria and their relative importance.
- Performance incentives (if applicable).
- Protest procedures and rights of the owner and proposing firms.

The RFP should specify that technical and cost proposals be submitted simultaneously, in separate sealed envelopes. The technical proposals are evaluated and scored—based on criteria the owner specified in the RFP—first, before the cost proposals are opened. The cost proposals are then scored separately according to the requirements of the RFP. Finally, a total score is calculated for each proposal by applying the weights identified in the RFP for both the cost and non-cost factors, to determine which proposal offers the best value for the owner.

CMAR project delivery provides greater opportunities for owners to obtain input from constructors in collaboration with plant operations staff to provide facilities that are well planned for and provide for operational and maintenance considerations.

Evaluation Criteria

Clearly stating weighted evaluation criteria in the RFP enables proposing firms to understand the owner's priorities and project drivers and contributes to transparency in the selection process. Numerous combinations of criteria weighting are possible; and, owners are well served by selecting on a best-value basis, considering technical approach, management approach, risk sharing, schedule and cost factors.

Performance Criteria

The RFP and draft contract should state the criteria for satisfying the project's performance requirements, explicitly and, to the maximum extent possible, quantitatively. This creates trust between the owner and proposing firms and ultimately between the owner and the selected firm; and, it is vital to the project's success. Depending on the specific nature of the project, performance criteria may include standards for:

- Quantity and quality of untreated water or wastewater (influent), including daily and seasonal variability;
- Quantity and quality of treated water or wastewater (effluent);
- Quality of residuals;
- Environmental and nuisance factors, such as noise, dust, lighting, odor;
- Chemical, energy, and utility use and life-cycle costs;
- Building appearance and performance;
- Operational requirements and constraints;
- Coordination with on-going operations and subcontractors;
- Tie-in to existing facilities;
- On-site staffing and team availability;
- Schedule milestones, and
- Safety.

The timing of measurements—for example, chemical and energy use targets—may pose a challenge. Meeting such targets is normally the responsibility of the collaborative-delivery firm, and measurements are typically evaluated during acceptance testing. Following successful completion of acceptance testing, meeting those targets generally becomes the owner's responsibility (unless the owner is using DBO).

Increasingly, owners are using contracts that both incentivize performance that exceeds expectations and also imposes damages for performance that falls below established criteria. The potential consequences stated in damage clauses needs to be carefully considered, as they might require the design-build or CMAR firm to add a contingency fee to the proposed cost to cover events with a low likelihood of occurrence. And, if too onerous, they may even make it difficult or impossible for the collaborative-delivery firm to obtain performance bonds from the surety industry, limiting competition.

If damage clauses are included in the contract, incentive clauses should be included as well, to promote competition and motivate the selected firm to meet objectives. Positive incentives for performance—such as bonuses for completing the project ahead of deadlines or milestones—are generally more effective than negative incentives, which tend to motivate project behavior only in later stages of project delivery.

Competitive collaborative-delivery procurements that seek price and technical proposals should: include a clear evaluation and selection process; ensure that the process is fair, open and transparent; and value both technical concepts and price in the selection process.

Source: DBIA 2015 Design-Build Best Practices for the Water/ Wastewater Sector

Using the RFQ and RFP to Select a Design-Build or CMAR Firm

Chapter 2 introduced the CMAR and progressive and fixed-price design-build delivery methods. This section discusses and expands on the procurement processes for each, as well as for sole-source selection.

Single-Step and Two-Step Procurement Processes

Whether choosing CMAR, progressive design-build, or fixed-price design-build project delivery, an owner may use either a single-step or a two-step procurement process.

Single-Step Procurement

In the single-step approach, the owner may choose to issue only an RFQ and base its selection solely on the qualifications described in proposing firms' statements of qualifications (SOQs). Alternatively, an owner may issue only an RFP that requests qualifications information and describes proposal requirements. In either case, the owner begins negotiations with the selected firm. If an owner wants to consider price in a single-step process, there are a variety of ways in which the RFQ can require the design-build or CMAR firm to provide pricing information by including:

- Preconstruction services expressed as a fixed-price value;
- Project personnel rate schedule;
- General-conditions statement expressed as either a fixed-price value or a percentage of cost; or
- Overhead and profit expressed as either a fixed-price value or a percentage of cost.

Two-Step Procurement

In step one of a two-step approach, the owner issues an RFQ to all interested design-build or CMAR firms. *(It is also recommended that the owner include a draft of the RFP with the RFQ.)* Upon receipt of SOQs, the owner evaluates and ranks proposing firms and creates a short list of firms that will receive the RFP. Recommended Best Practice is to short-list three proposing firms for further consideration. Cost is generally not a factor in step one.

In step two, the owner issues an RFP to the short-listed proposing firms, evaluates their proposals, makes a selection, and begins negotiations.

Advantages of a Two-Step Procurement Process Over a Single-Step Process

- Responses to the RFQ give the owner an indication of the level of interest in the project.
- The owner has the opportunity to select the most qualified teams to receive the RFP.
- The owner avoids evaluating proposals from teams that may not be qualified.

These advantages are particularly important for larger projects or those with more complex scopes of work.

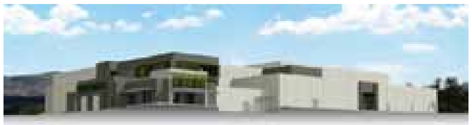
CMAR Procurement

CMAR project delivery enables the owner to realize a number of the benefits of design-build delivery, while maintaining direct contractual control of project definition and design. Unlike DB procurement, however, CMAR procurement involves hiring the design engineer separately from the construction contractor, and then pairing the two early in the design phase. Unlike design-build project delivery, in which the design-builder is the single (contracted) point of accountability for performance, the owner retains significant performance risk with CMAR delivery due to the need to coordinate the work of two contracting parties.

Typically, the owner selects and contracts with the engineering firm prior to selecting the CMAR firm. This enables the design engineer to begin developing the design while the owner conducts the CMAR procurement. Once selected, the CMAR firm is engaged to provide input into design and constructability reviews, as well as value engineering. Selecting the CMAR firm early, at the conceptual design stage, provides maximum benefits, as described in Chapter 2.

Wastewater Treatment Plant and Water Pump Station

Colorado Springs, Colorado



The Colorado Springs Utilities (CSU) needed to increase its water production in order to meet future demands within its service area. The first stage of the southern delivery system (SDS) includes a new water-treatment plant (WTP) and finished water pump station (FWPS). These facilities have an initial capacity of 50 mgd and are expandable to 130 mgd.

After reviewing and updating the delivery strategy for the various components of the SDS, CSU affirmed the use of a progressive design-build approach for the WTP and FWPS. It was also determined that a 100% level of design should be achieved for all the facilities before establishing a final guaranteed maximum price (GMP) for construction. Through a formal procurement process, proposing firms were required to submit their qualifications, a detailed technical approach, a fixed price for design development, and fees that would apply during the construction phase. Proposals were evaluated on a best-value basis: qualifications 15%, technical approach 40%, and cost 45%. The Carollo team was selected as the design-builder, and after negotiations, a contract was executed in August 2011.

Through the progressive design-build process, construction cost estimates were prepared at 30%, 60%, 90%, and 100% levels of design. At completion of the design, the construction was divided into 59 work categories, and bids were solicited. At the end of the bidding process, a final GMP was established at $124.6 million. Based on the conceptual design, the initial construction cost estimate was $190 million. The final GMP represents a 34% reduction from the initial construction cost estimate.

carollo
Engineers...Working Wonders With Water®

Occasionally, however, an owner will use a single-step RFP or a two-step RFQ/RFP process.

When the owner has selected the CMAR firm, the two parties execute the contract in two phases: phase one is for preconstruction services and phase two is for construction.

Preconstruction services may vary, but traditionally include collaboration with the owner and the engineering firm to perform design and constructability reviews, risk-reduction reviews, iterative estimates of construction cost, and value-engineering, as well as sequencing and scheduling of the entire project. Preconstruction activities should be planned and coordinated with the design milestones and deliverables included in the design engineer's contract. In addition to the tasks described above, preconstruction services usually include developing and executing a **procurement plan for construction work** that establishes bid packages, prequalifies vendors, and identifies potential long-lead material and equipment procurement requirements. At the conclusion of **phase one**—as early as 30% design completion and as late as 100%, with 60% being typical—the CMAR firm develops either a guaranteed maximum price (GMP) or fixed price for construction and proposes it to the owner.

The CMAR firm develops and presents the price proposal in an open-book manner (all costs documented and presented to the owner), using

Smart Partnerships Involve Equipment Suppliers in an Evolving Water Design-Build Industry

Equipment vendors and technology suppliers are quickly becoming important players in collaborative delivery for the water industry. As technologies become more advanced, equipment suppliers offer a wide portfolio of state-of-the art solutions with respect to operations, service impacts, and long-term performance.

Engineers and contractors who partner with an equipment supplier early in a project are better able to streamline design and construction through a more efficient design process and effective project management. As a result, they are less likely to encounter design pitfalls or constructability issues. Avoiding redundancies in controls and field-service support reduces unnecessary risk and significantly contributes to economic savings.

Additionally, today's sophisticated market demands that equipment suppliers offer efficient solutions for energy consumption, chemical usage, and residuals management. An equipment supplier must also consider service and labor, which can affect a project's bottom line, especially when following a design-build-operate model.

When a facility is commissioned and operating—long after the designer and builder have completed their work—the equipment supplier remains a committed partner with the owner, who ultimately depends on the facility's performance. The equipment supplier provides critical considerations in operational maintenance and long-term warranty planning to anticipate future needs.

Varying owner needs, site constraints, budget challenges, regulatory drivers, and treatment goals all promote a dynamic climate for collaborative delivery methods. When equipment vendors and technology suppliers are brought into the team early in the process, they become solutions providers, elevating a typical delivery pursuit into an evolved and meaningful engineering, delivery, and performance approach, and adding value every step of the way.

—Roman J. Aguirre, *Evoqua Water Technologies (WDBC Advisor Member)* competitive bids from prequalified subcontractors and materials and equipment vendors. On projects that allow self-performance either the CMAR firm and owner will agree on a scope to be performed or the firm will submit a proposal to self-perform certain bid packages—unless specifics of self-performance were already approved.

The price proposal will include the direct cost of work plus the CMAR firm's overhead, profit, allowances, statement of general conditions, and any appropriate contingencies.

Phase two begins when the owner and CMAR firm have negotiated and agreed on a price, and the phase one contract for preconstruction services is amended to incorporate the price and all the construction-related terms and conditions. If the owner and CMAR firm are unable to agree on the price and/or the construction-related terms and conditions, the owner may either negotiate with the second-highest-ranked CMAR firm or proceed with an alternative procurement approach, such as low-bid common contracting, as is the case in design-bid-build delivery.

Progressive Design-Build Procurement

Similar to CMAR project delivery, progressive design-build (PDB) delivery occurs in two phases. With PDB delivery, however, the owner has a single point of accountability: the design-builder.

Owners choosing PDB delivery predominately use a single-step procurement process, although some may defer to a two-step process. (Single-step and two-stop procurement processes are described earlier in this chapter.)

A PDB project begins with a contract for phase one: preconstruction services, including initial design and cost development. After signing the contract, the owner and design-builder proceed in a collaborative manner, with the owner retaining a substantial level of design input and control. As the design progresses, the owner benefits from the early incorporation of the design-builder's input on design and process creativity, constructability, value-engineering, scheduling, risk, and construction costs. Cost estimates can be developed and refined at regular design milestones, allowing the owner to modify priorities and requirements, if necessary, based on the overall project budget.

When the design has been completed to the agreed-to level in phase one, the design-builder develops a cost-reimbursable (time and materials with an agreed limit) fixed price or GMP for finalizing the design and constructing the project. The design-builder typically develops the cost on an open-book basis, using competitive bids solicited from subcontractors and from materials and equipment vendors. The total price combines the cost of work with the design-builder's general conditions, cost, fees, allowances and contingencies. On projects that allow self-performance, the design-builder may elect to submit a proposal to self-perform certain elements of work.

Phase two begins when the owner and design-builder have negotiated and agreed on a price to finalize the design and construct the project. If the owner and design-builder are unable to agree on a price, the owner may either negotiate with the second-highest-ranked design-builder or proceed with an alternative procurement approach, such as low-bid common contracting, as is the case in design-bid-build delivery. This gives the owner a measure of protection by creating an "off-ramp," a decision point when the design and construction prices are established, before committing to have the design-builder construct the detailed design.

Fixed-Price Design-Build Procurement

Procurement for fixed-price design-build (FPDB) project delivery differs from PDB procurement in two primary ways. First, in contrast with PDB, which generally uses a single-step process, FPDB procurements are more likely to use a two-step process. And second, and in contrast with PDB, the FPDB contract covers the project from design through construction, with no "off-ramp" in between. (Single-step and two-step procurement processes are described earlier in this chapter.)

The RFQ used in FPDB procurement is essentially the same as the RFQ used in CMAR and PDB procurement. Because FPDB proposals include a fixed price, however, the RFP needs to give proposing firms additional information with which to calculate their fixed price.

RFP for Fixed-Price Design-Build

The RFP's project requirements can be expressed as either prescriptive or performance-based, depending on the owner's objectives. Prescriptive and performance-based FPDB procurements are discussed in greater detail in Chapter 2. Including a draft contract with the RFP, with the requirement to provide comments on the draft with the proposal, provides further guidance to potential proposing firms and can reduce the time and uncertainty associated with contract negotiations after selection. Alternatively, an owner may request design-builders to submit a draft contract for the owner to consider as part of their proposals

Recommended Best Practice is using an industry standard form contract.

Proposing firms are generally required to quote cost as a fixed price, with contingencies or allowances for owner-specified changes and for unforeseen increases in the price of materials. Some owners request a detailed breakdown of costs. If the owner specifies a maximum cost for the project in the RFP, proposing firms are evaluated on their approach to meeting the performance criteria established in the RFP within the specified budget.

Sole-Source Procurement

Where legally permissible, some owners prefer to use sole-source procurement rather than conduct a formal RFQ and/or RFP process. In this approach, the owner enters directly into contract negotiations with a collaborative-delivery firm that the owner has chosen and trusts to do quality work, on time, and at a reasonable cost—often based on the owner's previous experience with the firm. Alternatively, the owner might discuss anticipated project needs with several potential collaborative-delivery firms in a series of meetings and then negotiate contract details with the one deemed to be most qualified. Although many states allow sole-source procurement for design engineering and other professional services, competitive selection has historically been required for construction services. In the government sector, sole-source procurement is not typically employed on collaborative-delivery projects unless emergency conditions dictate, or there is only one source for the required services.

The Principles of Open-Book Pricing

Several of our industry's best collaborative-delivery methods—particularly CMAR and progressive design-build—rely on an open-book process for developing cost and pricing during preconstruction. This process is used to achieve agreement on cost and, then, a price for the construction effort to proceed. In turn, the price is typically implemented either as a guaranteed maximum price (GMP) or a fixed-price contract provision.

Although this approach is straightforward in principle, we often get asked, "What, exactly, is an open-book approach?" The answer comes down to defining "cost" and "price."

- **Cost-is-cost-is-cost.** Construction estimates should be based on the actual cost of work. This can mean actual labor, expenses, materials, equipment, and production rates for the self-performed scope, combined with stand-alone subcontractor quotes obtained via a best-value, competitive-bidding approach. All of these documentable expenditures are set forth without any add-ons—with all the assumptions underlying them clearly stated—to equal a project ***cost estimate***.
- **Price includes everything else.** Once a cost estimate is set forth, anything that gets added to it for the delivery firm's or contractor's overhead—operating costs, burdens, encumbrances, profit, turnover, mark-ups, fees, charges, levies, incentives, and any other relevant items—is extra money that is added on top of actual cost to create a ***price estimate***.

CMAR and progressive design-build are popular delivery methods because they allow projects to proceed on a collaborative basis in advance of a completed design or even a full project definition. Both delivery methods are typically procured on the basis of qualifications, in conjunction with some form of as-bid fees for the pricing components. The cost is developed by the design-build or CMAR firm *after* project award based on several **Foundational Principles**.

- **Transparency and validation.** Costs must be developed in a completely transparent manner, with no hidden amounts and nothing embedded or inflated. Transparency means full, confidential disclosure of all the details and can include third party verification, if required. The pricing process is truly an open book.
- **Accuracy and completeness.** In fairness to both owners and design-build or CMAR firms, the development of costs and price must include everything that everyone can reasonably think of, in terms of both estimate line items and also expenses and indirect costs. Leave nothing out!
- **Realism and fairness.** Open-book pricing is often used to "design to budget," but that does not mean "make it fit to budget." Cost and pricing must be both realistic and fair to both parties. Sometimes it takes a bit of work to get there, but a realistic number means a complete and fair number.
- **Risk and opportunity assessment.** Not everything on a project is entirely predictable, especially within the early stages. Anything that is an undefined risk or opportunity should be quantitatively assessed and evaluated as a project-contingency amount. The actual contingency should be seen as a project cost before any add-ons are included to create a price.

So what happens after everyone mutually agrees on a project's cost, everything else is added, and the price is settled? The following two options are the most common actions.

- **Moving forward under a GMP model** means that actual spending during construction is monitored using the same open-book transparency principles. The savings from spending under the GMP is often shared between the owner and the design-build or CMAR firm (this incentivizes continued efficiency)—and the risk of having to spend anything *over* the GMP is at the design-build or CMAR firm's risk. This is a terrific way to share any unused contingency.
- In contrast to the GMP approach, a **fixed-price implementation closes the books after the price is agreed on**, and the design-build or CMAR firm proceeds with construction at its own risk—and opportunity—for meeting the price figure. This approach keeps things simple by eliminating the need for an ongoing auditing function during construction, and offsetting risks by retaining any unspent contingency.

Of course, there are many details that accompany all of the points discussed above, but **any effective open-book approach will be true to these principles. Mutual trust is the foundation of collaborative delivery—and open-book transparency is the building block.**

With the FPDB approach, the new Lawton Valley Water Treatment Plant in Rhode Island was designed and constructed on the site of a buried 4-mgd reservoir.

The Contract

Regardless of whether the project is CMAR, PDB, FPDB, or sole-source, the contract price will generally be for either a fixed-price amount, a budgeted amount based on the estimated units of work, or a negotiated GMP, usually with a shared-savings provision.

Common Contract Pricing Models

In procurements where the cost is expressed as a fixed price, the design-build or CMAR firm generally absorbs costs that exceed the fixed-price amount, except as provided in the contract, and retains any savings. In the case of a GMP, many owners incorporate shared-savings clauses into the contract to enable both the owner and the design-build or CMAR firm to benefit from cost savings; this requires an open-book approach. A shared-savings clause in a contract is motivation for both the owner and the design-build or CMAR firm to reduce cost throughout construction. The owner should recognize that an open-book GMP requires an additional level of effort on its part to review costs over the life of the project.

Design-build or CMAR contracts may enable the owner to directly purchase construction equipment and materials—an arrangement known as owner direct purchases (ODP)—particularly where it might be tax-efficient. In this situation, the owner generally retains responsibility for the delivery and storage of the equipment and materials, and for warranty considerations and damages they sustain prior to assignment to the design-build or CMAR firm. This situation can open the owner to a claim by the design-build or CMAR firm for costs related to delivery, performance and scope-coordination gaps. In some cases, the owner may be able to obtain the tax advantages provided by ODP, while still having the design-build or CMAR firm do all the purchasing.

Pre-Contract Meetings

Many owners find it beneficial to initially meet with firms responding to the RFQ and/or RFP, prior to making their selection. These meetings, often referred to as proprietary one-on-one meetings, give the owner an opportunity to judge firsthand how well each design-build or CMAR firm's team works together, how willing each one is to partner with the owner's team, and how effectively all parties can be expected to collaborate with one another. Such factors can make the difference between success and failure. A design-build or CMAR firm's team that has worked together in similar roles on similar projects may be better prepared for a smooth start than a team that has no history of working together. However, even team members who have not completed a project together have presumably collaborated on preparing an SOQ or a proposal.

The interview process should include distinct discussions about the experience of individual team members and key personnel, including subcontractors, with collaborative-delivery projects. The focus should be on how these collective experiences will contribute to achieving the owner's project goals.

A note on subcontractors: Although some owners (or some state procurement rules for public projects) may require that subcontractors be selected by competitive bidding, many design-build and CMAR firms find they can deliver more effectively when they are allowed to choose subcontractors on the basis of experience and prior working relationships.

Contracts used on collaborative-delivery projects should be fair, balanced and clear. They should promote the collaborative aspects inherent in the process by proactively and cooperatively identifying project-specific risks, determining how such risks will be handled, and reasonably allocating each risk to the party that is best able to address and mitigate it.

Source: DBIA 2015 Design-Build Best Practices for the Water/Wastewater Sector

Guidelines for Owners to Implement a Successful DB or CMAR Procurement

- Clearly define project objectives and understand state and local policies, laws, regulations and other requirements that may affect the project. If the project will use federal funds, it is important to understand federal restrictions as well.
- Decide which delivery method to use— construction management at-risk (CMAR), progressive design-build (PDB), or fixed-price design-build (FPDB). When choosing FPDB, an owner also needs to decide whether project requirements will be prescriptive, performance-based, or a combination.
- Seek the advice of other owners who have conducted collaborative-delivery procurements, and obtain appropriate legal, technical and financial guidance.
- Determine whether, and to what extent, the selected design-build or CMAR firm will be allowed to self-perform. This often depends on state laws that reflect the balance of influence among owners, general contractors, and subcontractors.

- Complete any work related to permitting, environmental impacts, and site geotechnical investigations—and make this information available to proposing firms.
- In developing procurement documents, clearly describe the scope of services, project requirements (including desired LEED certification level, if applicable), and owner's desired level of involvement and control.
- Develop a draft contract that identifies risks and allocates each risk to the party best suited to control or absorb it, and incorporate the contract into the procurement documents.
- Clearly define payment terms, considering logical options (e.g., fixed price, GMP, time and materials.)
- Keep the contract language clear and the format uncomplicated—avoiding unnecessary complexity that can reduce participation, create delays, or increase costs.
- Include the draft contract—as well as a schedule, selection criteria and process, owner's rights and responsibilities, and protocols for communications during the procurement process—in the procurement documents to gain prospective proposing firms' understanding and agreement.

The Use of a Continuous, Real-Time Approach in Collaborative Projects

In design-build delivery, the CMAR firm's ability to provide real-time services in an integrated and collaborative environment, is key to delivering the project on a reliable schedule and with a higher level of assurance of meeting the GMP during preconstruction services.

Use of a continuous, real-time approach to developing a GMP is based on a process that is founded with historical benchmarks, established from actual self-perform experience, and consistent collaboration with the design professional. Equipped with the knowledge gained from past projects, the CMAR project team is able to constantly provide accurate insights into constructability and value engineering. This approach not only assists in cost savings and value added, but effectively results in an accurate construction schedule, while driving a high degree of safety and quality.

The process incorporates countless lessons learned and has been developed and refined through more than 50 CMAR, progressive, and design-build water sector projects. Conversely, through traditional preconstruction methods, owners and designers typically experience a fragmented methodology that leads to reactionary decision making, wasted effort on redesign, and, ultimately, unpredictable results with less value added and lower assurance of meeting the GMP.

By providing continuous feedback on the design progression, the team is focused on the enhancing the project value, while maintaining the owner's vision for the project.

— Dan Reynolds*, The Walsh Group (WDBC Advisor Member)*

Water Treatment Plant and Reservoir Replacement Project

Jacksonville, Florida

Located in a historic neighborhood of Jacksonville, Florida, the 24 million gallons per day (24-mgd) Main Street Water Treatment Facility Plant provides water to more than 329,000 customers. In 2012, JEA discovered excessive deterioration at the 100-year-old Orange Street Water Reservoir facility, due to elevated levels of hydrogen sulfide (H_2S). Contractors needed to have an approach that was both attractive and aesthetically compatible with the historic nature of the neighborhood.

Based on their qualifications, project approach, and previous experience with JEA, Haskell was selected to examine several available treatment options for removing H_2S from the raw water. After consultation with the client, it was determined that the best solution was an advanced ozone treatment system with additional finished-water storage capacity for future purposes.

Haskell used several strategies to bring the project in on time and within budget, including investigating potential ozone solutions and selecting the most cost-effective one. Haskell also developed a hybrid foundation system that used new pile foundations in conjunction with existing tank foundations. Haskell also reused as much of the existing site as possible, reconfiguring an existing building to house the ozone system and reusing sections of the existing reservoir foundation to support the new concrete tank.

Haskell succeeded in providing an optimized ozone solution within JEA's budgetary constraints of less than $11 million.

"The most critical component of any preconstruction effort is price development. As part of this progressive design- build project the Haskell team has been very responsive in meeting JEA's budgetary constraints and identifying ways of completing the project within the available budget"

—Hai Vu, PE, Manager, Water Plants Engineering and Construction

HASKELL

CHAPTER 5

Managing Collaborative-Delivery Projects

Successful design-build and CMAR projects are built on trust, respect and collaboration among the owner's team members and those of the design-build or CMAR firm—together with the owner's advisor (OA), if one is involved in the project.

Once the contract is signed, the owner and the collaborative-delivery firm now work together as a team throughout the project, with the shared goal of delivering a quality project on time and/or within budget. Communication among all team members is transparent, frequent, and timely—focusing on project items as they occur, before they become issues.

In design-build projects, the owner may choose to be an active participant in the design process, but does not need to serve as an intermediary between design and construction because the design-builder is the single point of contact, responsible for both design and construction.

In a CMAR project, however, the owner has separate contractual relationships with the engineering and the CMAR firms and therefore necessarily functions as an intermediary between the two.

NOTE: Although the CMAR firm serves as the construction manager during design and is actively involved in the design process, the firm assumes no design risk or responsibility, which remains with the owner.

This chapter focuses on the management activities that commence once the contract with the collaborative-delivery firm is signed. Guidance provided on furthering the overall collaboration among the respective parties throughout the implementation of the project is based on successful accomplishments.

Early collaboration between the design engineer and the CMAR firm is key to a successful CMAR project, because the firm's input during the early stages of design development is important. In addition, the owner needs to be actively involved in design decisions, which can have significant cost and schedule ramifications.

Source: DBIA 2015 Design-Build Best Practices for the Water/Wastewater Sector

Owner Leadership and Management

Once the procurement process is completed and the contract has been signed, the owner's organization will have in place two levels of management: a leadership team of decision-makers and project champions, and a project management team that includes experienced managers and staff from all relevant functions within the organization.

The leadership team, comprising executives or other high-level decision-makers with strong collaboration and communication skills and the ability to develop teamwork and trust, ensures that complex or unexpected issues are resolved clearly and in a timely manner. The project management team includes representatives from the owner's engineering, operations, finance, and legal departments. Although both teams must have a clear understanding of the project's goals and priorities, as well as the

Making a Difference in CMAR with Early Contractor Involvement

A collaborative process is particularly important in construction management at-risk (CMAR) delivery. Early involvement of the CMAR firm as construction manager/general contractor is a best practice that enables the firm to become a true partner, allied with the owner and the owner's project team. Involving the firm early in a project fosters a cooperative team approach and creates an interactive, inclusive working relationship that engages all participants. Applying this best practice can ensure an early and predictable project outcome, minimizing surprises, saving time and money, and reducing risk to all parties.

Involving the CMAR firm early in the design phase helps ensure that the project is delivered on time and within the established budget. By providing a proactive, well-informed analysis of the project schedule, the firm can identify and resolve issues and challenges that could arise during construction, thereby avoiding or minimizing costly delays that could occur later on. This enables the CMAR firm to develop appropriate and precise project budgets based on accurate, detailed construction estimates. Through constructability reviews, the firm ensures that plans and specifications are buildable, thus minimizing the potential for expensive reworking. During value engineering, the CMAR firm applies its experience with self-performance and with materials, means, and methods to identify opportunities to save time and money.

As an example, the Gwinnett County, Georgia, Department of Water Resources needed to complete a $250 million upgrade to its Yellow River Water Reclamation Facility. Recognizing the significant advantages of CMAR project delivery and the importance of assembling the full project team early in the process, County officials selected CMAR delivery for the project. The County's first priority was to physically co-locate the teams, with every trailer housing a mix of County workers, design engineers and CMAR firm staff. The resulting information sharing, quick response to questions and inquiries, and overall camaraderie are cited as undeniably invaluable benefits to the project. This highly collaborative approach generated innovative solutions and approaches that produced more than $10 million in cost savings.

—John Giachino*, PC Construction (WDBC Advisor Member)*

chosen collaborative delivery method, the project management team is responsible for the overall project on a daily basis. The individual members of the owner's teams should have sufficient knowledge and experience to offer constructive comments, suggestions, and input to their counterparts in the collaborative-delivery firm.

Members of the collaborative-delivery firm's staff are responsible not only for their assigned tasks, but also for coordinating with members of the owner's teams and subcontractors as well. Roles, responsibilities, and reporting relationships must be clearly defined within the owner's organization, within the collaborative-delivery firm, and between the owner and the firm.

Progressive design-build delivery, in particular, fosters these principles, as the owner's and design-builder's teams work together from the beginning of design through construction and commissioning. With fixed-price design-build delivery, achieving a collaborative mindset can be somewhat more challenging, as the design-builder has proposed a fixed price for the scope of work, and there are typically more constraints on the owner's participation in developing the design.

Preceding chapters discussed the importance of clearly defining the scope of work, establishing performance criteria, and assigning risks at the outset. Although careful planning and contracting are necessary factors for success, teamwork throughout the project is equally significant.

Owner's Final Project Implementation Plan

The project implementation plan, developed in the planning period, used during procurement, and finalized in contract negotiations, will often contain the following components.

- The organizational structure, including individual roles and responsibilities
- The detailed schedule and scope of work, addressing design, construction, and commissioning
- The owner's expectations for the collaborative-delivery firm's oversight (QA/QC) of design and construction
- Financial-management policies and procedures
- Decision-making and dispute-resolution procedures, including guidelines for appropriately escalating issues
- Health and safety planning and protocols
- Communication procedures
- A draft risk-management plan, including a preliminary risk register
- A change-management plan to address unplanned occurrences and unexpected situations

As previously noted, including the draft project implementation plan in procurement documents gives collaborative-delivery firms a thorough understanding of the owner's priorities, which helps them propose an appropriate work plan and effective collaborative approach. The owner uses the draft project implementation plan to elicit proposing firms' input on collaboration, communication procedures, decision-making and issue-escalation processes, as well as comments on contractual requirements and risk management.

The owner revises the project implementation plan based on input from the selected collaborative-delivery firm and—although they "finalize" it together—both parties should consider it a living document that can be adjusted or amended based on experience and unplanned incidents, such as a change in personnel.

Owner's Management Structure

"Beginning with the end in mind" is a recognized management principle for realizing organizational and project goals and achieving positive results. Establishing a common project mission, identifying measurable project goals, and achieving internal understanding and agreement are perhaps the most important steps owners take in preparing for any capital project, large or small.

These actions are especially important in the current climate of financial pressure, stakeholder participation, political scrutiny, and the need for increased operational and project-delivery efficiencies. Developing an organization-wide understanding and realistic expectations of a project's priorities helps an owner avoid costly inefficiencies in decision-making, eliminates confusion over staff roles and responsibilities, and establishes and clearly communicates well defined project procedures.

Setting and communicating goals and priorities, based on lessons learned and best practices, further enables an owner to strengthen its internal understanding and agreement on how decisions are made and how teams

Individuals on the owner's project team should be educated and knowledgeable about implementing collaborative-delivery best practices, with senior leadership committed to their project's success and actively supporting best practices.

Source: DBIA 2015 Design-Build Best Practices for the Water/Wastewater Sector

Construction of a new water supply line in Jacksonville, Florida.

interact. Without addressing these critical topics, a project is subject to backtracking and possible derailment by unanticipated events.

Again to reinforce the messages in Chapter 1 and how they relate to the overall management of a collaborative-delivery project, it is within the planning effort that the owner both identifies specific functions and areas of responsibility, organizational staffing and management, and also defines the processes to work collaboratively with the selected firm in delivering the project.

The resulting project implementation plan creates the roadmap that the owner's project team will use to complete its work and coordinate its management functions with the design-build or CMAR firm. As this process gives proposing firms the necessary information on the owner's operational and management structure, they are also able to determine how to most effectively integrate their working procedures in a collaborative process.

Project Scope of Work and Schedule

An owner should include in its final project implementation plan the following information on scope of work and anticipated schedule.

- The owner's criteria such as technical requirements and performance standards.
- Reference materials including preliminary site plans, concept/schematic drawings, and other owner specifications, including a preliminary design or basis-of-design, if the owner has prepared one.
- A description of anticipated design and construction activities, tasks, work flows, and milestones for the collaborative-delivery firm.
- A list of anticipated permit requirements, as well as other activities and items for which the owner, the collaborative-delivery firm, or other parties will be responsible.

- A preliminary project schedule that identifies all major milestones and includes review of design progress documents, transition from design to construction, substantial and final completion dates, start-up and commissioning, and turnover of the facility to the owner.
- A preliminary risk and responsibilities matrix.

Although the initial project schedule is based on the owner's assumptions and expectations, the final schedule is subject to changes that will occur in the design, procurement, construction, and commissioning activities suggested by the proposing firms and the selected firm. It is critical that the owner's and collaborative-delivery firm's key activities (perhaps 40 to 80 line items at the managerial level of detail) are listed in the proper sequence and with sufficient time allocated for each item within the overall project schedule. The final schedule will serve as the basis for the contract, which typically includes key milestones and may also include procedures for schedule adjustments or alignment in case of delay. If the delay is caused either by the owner or by an uncontrollable circumstance, the contract schedule and price may need to be appropriately adjusted.

Design and Construction Oversight

Quality assurance and quality control (QA/QC) procedures help ensure that the project is designed and constructed to meet owner requirements. Contracts often specify quality criteria, and collaborative-delivery firms typically include both QA and QC procedures as integral parts of project implementation, documenting and reporting results to the owner on a regular basis.

An owner may also require its own oversight of the project, essentially checking on the collaborative-delivery firm's QA procedures. Owner-initiated oversight may cover construction and field auditing, materials sampling and testing, reviews of design documents, schedules, selected submittals, and value-engineering decisions. Other methods of evaluating the collaborative-delivery firm's adherence to established quality criteria may also be an option. The owner will alert the firm if it finds any deviations from the contract in areas such as project plans, specifications, or quality management. **An owner planning to participate actively in QA should decide in advance which QA/QC documents it needs to approve before allowing the project to proceed, and the owner's project implementation plan should establish its QA/QC expectations and reflect the owner's own QA plans.**

Financial Management

Both the owner and the collaborative-delivery firm have internal requirements to meet specific financial obligations. Well articulated policies and procedures for financial management help build and maintain mutual trust and cooperation.

- The owner is responsible for securing the funds necessary to pay the collaborative-delivery firm's invoices in a timely manner; contracts typically grant firms interest on late payments and/or the ability to stop work should delinquency exceed a pre-determined duration—important protections, as firms may not be positioned to extend more than a month or two of service credit to owners.
- The collaborative-delivery firm is responsible for documenting project progress and milestones.

The owner and the collaborative-delivery firm agree on a schedule for submitting and paying invoices, with the owner usually specifying invoice form and content that will expedite approval, and agreeing to pay all undisputed elements when required by the contract.

Most contracts require the collaborative-delivery firm to submit progress reports on a fixed schedule—weekly, biweekly, or monthly, depending on the duration and complexity of the project, or occasionally on a milestone basis. These reports generally include the following content:

- A summary record of project activities and accomplishments during the reporting period;
- Details of any schedule revisions and resulting changes in the overall construction schedule or critical-path schedule;
- Addressing short- and long-term scheduling and cash-flow forecasting;
- Identifying issues and challenges that require action by the owner or the collaborative-delivery firm; and
- Information to help substantiate payment requests.

As required by the contract, the collaborative-delivery firm's invoices or payment requests should include the specified documentation—typically submittals, transmittal records, or construction schedules documenting specific progress—to demonstrate that relevant milestones have been achieved.

In the project implementation plan, owners need to both establish a process for review and timely approval of the collaborative-delivery firm's expenditures, and also budget for internal staff to conduct these reviews. The plan, schedule and budget for completing the project, which the collaborative-delivery firm typically provides the owner, should be sufficiently detailed to track progress, but not to the extent that realistic tracking is lost in the detail.[1]

The owner usually pays the collaborative-delivery firm in the manner specified in the contract. Design-phase payments are generally based on milestones, such as submittal of drawings when the design is 30% complete. Depending on the type of collaborative project delivery used, the basis for payment may change during construction. Under a fixed-price design-build contract, construction payments are generally based on the design-builder's progress against a predetermined schedule of values—a detailed statement of the contract's elements and the value of each, the total of which equals the contract sum. In contrast, construction payments made under a progressive design-build contract are likely to be based on costs incurred by the design-builder.

Decision Making and Dispute Resolution

As discussed in Chapters 1 and 3, embarking on a design-build or CMAR project delivery with a collaborative mindset substantially reduces the potential for disputes, unplanned occurrences, unexpected situations, or questions that may arise in the contracting process. Despite the best intentions of owners and collaborative-delivery firms to address such

[1] A usable, manageable, and comprehensive project schedule might have 40 to 80 line items, not 1500 line items.

matters amicably, sometimes the differing expectations or needs of the parties cannot be resolved without involving a third party. It is again emphasized that a well defined process for decision management, both within an owner's organization and with the collaborative-delivery firm, helps to minimize the need for formal dispute resolution. Defining a decision-management process ensures that good and effective decisions are made in a timely manner. Key components of a decision-making management process include:

- Incident tracking;
- Problem solving; and
- Escalating unresolved situations.

Tracking

Any incidents or situations that arise should be monitored and tracked. Tracking ensures that all critical issues are identified and that the project team can address them in a timely manner. Tracking tools can include action logs, monthly progress reports, and team performance evaluations. Once an issue has been identified, the applicable functional team should address it—defining the action plan, making the mitigation decision, or solving the problem, whichever the case may be. When an issue cannot be resolved at the relevant team's level, it is escalated to the next level for resolution.

Solutions

Defining a process for escalating an unresolved situation will help ensure that it is satisfactorily addressed in a timely manner and has no negative impact on the project. Effective incident escalation and resolution requires defining escalation triggers. For example, the solution exceeds the authorized budget or would create a delay in the overall project schedule, or the issue is one, such as a contract, that requires a higher level of authority to resolve. It also requires defining escalation levels by individuals and teams, incident-escalation guidelines based on items such as project performance, financial impacts, quality and safety, and having a formal process in place.

Incident Resolution Escalation

One of the fastest, most efficient and cost-effective ways of resolving incidents between the owner and the collaborative-delivery firm—thereby avoiding any significant impact on the project schedule or budget—is to advance the matter directly to the parties' respective senior management. In the case where an incident-escalation process has not

Charnock Well Field Restoration Plant provides quality water to California customers.

provided resolution, a widely accepted approach, known as alternative dispute resolution (ADR), is to use a neutral third party in a non-binding process. ADR is increasingly being employed within the industry and should be considered for these types of situations. A number of ADR process variations are available, such as negotiations with senior (non-project) representatives, mediation, mini-trial, dispute review board, and standing arbitrators. What ADR processes all have in common is the early and non-binding participation of a neutral third party, whose objective, independent, and pragmatic perspective helps the parties reach a timely and amicable agreement, avoiding the traditional adversarial and confrontational approach. In selecting the most appropriate ADR process, owners and collaborative-delivery firms should consider factors specific to the project, such as size, complexity, and schedule, as well as both parties' preferences. The ADR process that both parties have agreed to should be included in the project implementation plan and should also be reflected in the general-conditions statement agreed to by the owner and collaborative-delivery firm.

Health and Safety

Because safety is a bottom-line requirement in any project, most owners now consider each collaborative-delivery firm's safety record—along with its stated approach to health and safety—as a key selection criteria. All members of the owner's and firm's teams need to understand the importance of health and safety in relation to planning and execution and to participate fully in those activities.

At the outset of the project, the owner's project manager and the collaborative-delivery firm should establish processes to facilitate effective communication, collaboration and issues resolution and develop processes that enable key stakeholders (e.g., government agencies and third-party operators) to interface directly with the firm and its design professionals on significant elements of the work.

Source: DBIA 2015 Design-Build Best Practices for the Water/ Wastewater Sector

The owner's project management plan should detail the owner's health and safety expectations for all members of the firm's team when operating within an owner-controlled facility, as well as expectations for its own team members while operating on a site controlled by the collaborative-delivery firm. Although the firm's health and safety plan will be controlling on an active construction site, the owner's staff must also adhere to its own internal health and safety plan, as long as it does not conflict with the collaborative-delivery firm's plan. The project management plan should dictate to the firm the owner's health and safety reporting requirements.

Communication

Frequent and open communication—even the communication of incomplete data— between the owner and the collaborative-delivery firm is critical to a successful project. Developing and implementing a good communication plan predicated on the project team's organizational structure will help the team resolve—and may even prevent—misunderstandings, disagreements, and disputes. The objective of a communication plan is to keep all participants informed about the project's status and provide a forum for resolving incidents, situations, and concerns as they arise—and even before.

To facilitate effective decision-making, the communication plan needs to be based on a broad and open dialogue and information exchange. It should generally include internal and external procedures for the following project-related activities.

- Requirements for producing project designs, including the drawing system to be used such as AutoCAD or BIM, nomenclature, and unique conventions including symbols and references.

- A secure electronic document-control system to manage correspondence, drawings and other documents— including the process for storage, access, and retrieval.
- Written correspondence—procedures and distribution.
- Telephone calls.
- E-mail protocols and back-ups.
- Site visits.
- Meetings.
- Payment processing.
- Complaints management.
- Emergency response protocols.

Risk Management

The purpose of a risk-management plan is to reduce the overall risk profile for the project and to generate cost and schedule benefits for both parties. A risk-management process in a collaborative delivery provides both the owner and the collaborative-delivery firm opportunities—during the pre-proposal (before the RFP is issued) and proposal periods, and throughout project execution—to develop and implement comprehensive risk-management plans. In general, the earlier project risks can be identified and appropriate steps taken to manage them, the more effective the risk-management planning will be, from both a cost and a schedule standpoint. Many owners have also found that including comprehensive risk-management planning in the draft project implementation plan results in significant benefits from the proposal process through project execution.

Unplanned Occurrences: Change Management

Water and wastewater construction projects are complex undertakings with unexpected situations likely to occur during the project delivery process. Owners often choose collaborative delivery for their most complex and longest-duration projects because the process includes a well defined method for managing change that helps to avoid delays and disappointments.

One of the primary reasons owners have embraced progressive design-build delivery, in particular, is the flexibility it allows for changes in scope and schedule, when compared with fixed-price design-build delivery.

Change-management situations are generally of one of four types.

- Expected (but unquantifiable) changes, such as materials cost escalation.
- Differing site conditions, changes in law, permitting delays, and labor issues.
- Completely unforeseen changes or unforeseeable circumstances.
- Owner-directed changes.

Defining a way to address both expected and unexpected changes helps preserve the collaborative nature of design-build and CMAR delivery, through even the most challenging and unexpected situations. Changes can be made more easily and at lower cost in the early stages of a project than in the later stages. This reinforces the importance of an owner's comprehensive pre-RFP risk-management planning, a well crafted RFP, and close communication between the owner and the design-builder from contract initiation through completion.

Whenever a situation arises that may change the scope, schedule, or budget, the collaborative-delivery firm's project manager and the owner's project manager should be alerted immediately—and, if applicable, the established incident-escalation and resolution process initiated. The owner and the firm should discuss the incident or situation as soon as possible and agree on any necessary changes, documenting needed actions and anticipating impacts to avoid or minimize the need to revisit decisions.

The design-builder's project management plan should describe the change-management process and stipulate that decision-making and issue-escalation processes be considered first, to minimize the need for change management.

Additional Requirements for CMAR Projects

Although many facets of managing a CMAR project are similar to managing a design-build project, there are important differences. Similar to design-build projects, CMAR projects are all about teamwork and realizing the benefits of collaboration between the engineering and CMAR firm as early as possible. Unlike a design-build project, however, the owner has separate contractual relationships with the designer engineer and the CMAR firm.

Beginning the collaboration between the design engineer and the CMAR firm early in the design process is one of the keys to a successful project, as the CMAR firm's input is critical during design development. Because decisions made early in the design process can have significant cost and schedule ramifications, the owner should function as an active member of the team along with the design engineer and the CMAR firm.

Owner's CMAR Project-Management Team

Members of the owner's project-management team need project management skills, including collaboration, communication, teamwork, and trust. The team should include representatives from different departments such as engineering, operations, finance, and legal. In addition, all members of the owner's team must have a clear understanding of CMAR-delivery practices, as well as the project's priorities. Individual representatives from each department need to have sufficient knowledge and experience to be able to offer constructive comments and suggestions to their counterparts in the CMAR firm.

Designating a qualified individual with project management and appropriate decision-making authority to oversee the work of the design engineer and the CMAR firm is an important priority. The project manager (a role that may be shared) is responsible for assessing any recommendations from both firms in order to make decisions that serve the best interests of the owner. The project manager needs strong consensus-building skills and expertise in establishing and maintaining understanding and agreement within its own organization, as well as between the design engineer and the CMAR firm.

The owner's project manager and associated team members may all be in-house staff. If any of the required functional skills are not available in-house, an outside consultant (such as an owner's advisor, as described in Chapter 1) may be useful to support the project manager or to fill particular roles such as financing, permitting, or legal support.

Creating the Collaborative Mindset in CMAR Delivery

Even though CMAR and design-bid-build (DBB) methods both require the owner to enter into two separate contracts—one for design and one for construction—CMAR calls for a paradigm shift in mindset from DBB. Having the entire team commit to achieving the defined project priorities is especially important, given that two different firms—the design engineer and the CMAR firm—are both working for the same owner, and performing in the best interests of the project.

Producing the CMAR Project Implementation Plan

In addition to the topics discussed earlier, owners should consider including the following additional components in the CMAR project management plans.

- An integrated project schedule including major procurement activities to be completed by the CMAR firm.

Generating Team Collaboration in Construction Management at-Risk

The single most important factor in ensuring the success of a collaborative process is the careful selection of the individuals involved. This is perhaps even more critical in CMAR project delivery than design-build delivery, due to the nature of CMAR contracting arrangements. Within the typical CMAR project structure, the owner has two separate contracts—with the engineering firm to design the project and the CMAR firm to build it.

This contractual separation between designer and builder makes it even more important that all team members fully embrace the prospect of working together to optimize the design. Despite having no direct contractual relationship between them, the CMAR and engineering firms' teams must enthusiastically embrace the opportunity to work in a fully integrated fashion. Each team member and organizational leader from both the CMAR firm and the engineering firm must fully buy into the cooperative team atmosphere and the advantages it brings to the project.

This point becomes particularly important when the owner does not decide to use CMAR delivery until after engaging the engineering firm to design the project. Optimally, the designer will know, from the outset, that the project is going to use CMAR delivery, so that the higher level of interaction required of the designer can inform the engineering firm's team-selection process.

When CMAR delivery is selected later in the design process, it is critical that the owner clearly communicate its expectations for collaboration to both the engineering firm and the CMAR firm. In this case, the engineering firm must be fully aware of the subtle change in its role from a traditional, somewhat isolated designer, to an active member of a collaborative team. At this point, the engineering firm can adjust the composition of the design team, if necessary.

—Tommy Brennan, *Ulliman Schutte (WDBC Advisor Member)*

- A document that defines the collaboration and communications between the design engineer and the CMAR firm, including an understanding of when and how the CMAR firm will engage with the designer. Often, the CMAR firm's input can reduce the overall project cost and may also affect the cost of engineering design.
- The responsibilities of each team member for QA and QC.
- The procurement approach to be used in selecting the CMAR firm.
- A process by which the owner pays the CMAR firm for services during the design phase.
- The level of self-performance, if any, to be allowed (or required) of the CMAR firm.
- The level of transparency that will be required in developing the cost of work to finalize the fixed price or open-book GMP.
- The level of transparency in the cost of the work required for invoicing the construction work.
- Instructions in how the CMAR firm is to prepare procurement and subcontracting packages.
- A process for addressing changes and incidents with the CMAR firm.
- A clear delineation of responsibilities among the design engineer, the CMAR firm, and the owner during the startup and commissioning period.

CMAR Firm's Design Input

The owner, design engineer, and CMAR firm need to develop a clear process for the CMAR firm's input to the design-development process. The input from the CMAR firm is similar in many respects to the value-engineering process often used in conventionally designed projects. The firm's comments and suggestions need to be taken into account at each major review and input point, ensuring that each recommendation is reviewed before the design advances. Also important in this process is the owner's operations and maintenance team.

A full review of each of the CMAR firm's recommendations mitigates the risks associated with redesign work that often results in additional costs to the owner. Similarly, the owner will need to be timely and proactive in reviewing the CMAR firm's recommendations, together with the design engineer's responses, in addition to analyzing the potential financial impacts.

CMAR Firm's Design and Construction (QA/QC) Oversight

The owner must recognize that with a CMAR project, unlike progressive or fixed-price design-build, **the owner remains ultimately responsible for the performance** of the water and wastewater facilities. Quality assurance and quality control (QA/QC) procedures help to ensure that the project is being designed and constructed to meet owner requirements. As previously noted, contracts often specify quality criteria, but for CMAR projects, the owner needs to establish the appropriate QA and QC responsibilities between the designer and the CMAR firm because the two functions are contractually independent.

Preparing for the Unexpected in CMAR Delivery

Hiring both an independent design engineer and an independent CMAR firm may introduce a higher likelihood of change orders than in other collaborative delivery models. Because these changes are likely to occur, a well defined method for managing them helps avoid delays and disappointments.

Defining a method to address expected and unexpected changes will also facilitate and preserve the collaborative nature of the CMAR effort. The CMAR agreement may include terms (identified below) that guide the participating parties to an equitable resolution.

- A measurement and payment structure that defines allowable costs of the work and has flexibility to accommodate changes without delay or finger-pointing between the parties.
- Recognition that parties to the agreement are committed to resolving the actual impacts on the project to the extent that they are responsible for, or each can control.
- In the best case, a provision for a decision-making mechanism for mitigating unforeseeable events, perhaps linked to the same mechanism used to evaluate price change orders.

Installation of a liquid oxygen system — one component in treating water to high quality standards.

The need for changes in scope, schedule, or budget should be called to the attention of the owner's project manager as soon as the need is recognized. The owner, the design engineer, and the CMAR firm should discuss the emerging situation as soon as possible and agree on how to resolve it, as well as any changes that may be necessary. The identified actions and anticipated effects on the project should be documented to avoid, or at least minimize, the need to revisit change decisions.

CHAPTER

6

Transition to Owner Operations

This chapter describes the final stages of a design-build or CMAR project—startup, testing, training, and commissioning—leading to acceptance and transition of the completed project from the collaborative-delivery firm to owner operation. As illustrated in Figure 6.1, the difference between collaborative delivery methods and design-bid-build (in the context of this chapter) is the extent of involvement of the owner's operators. In collaborative project delivery, the owner's operations team becomes involved early in the project—specifically, during the planning process in order to ensure a cohesive and successful transition from builder to owner.

Planning for Successful Transition

Both the owner and the selected collaborative-delivery firm share responsibility for ensuring a smooth transition from construction to operation. This process actually begins during the planning stage, when the owner drafts the implementation plan. The transition process is later addressed in the owner's procurement documents, contract, and final project implementation plan. The reasons for beginning transition planning early is that the owner is able to incorporate the knowledge and experienced input of the existing facility's operations and maintenance teams into the project's development. It is also at this point in time that the owner needs to identify the education and training that may be required to operate the project with the envisioned new equipment—and possibly new technology.

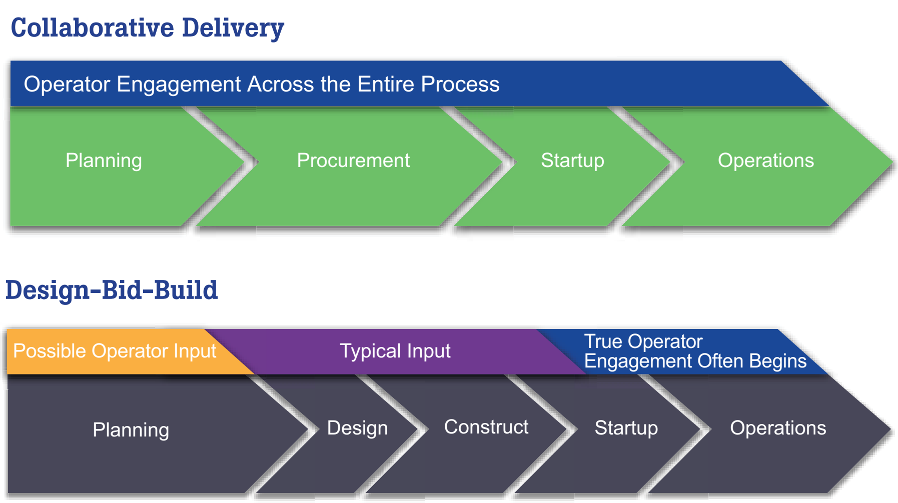


Figure 6.1 – In collaborative project delivery, the owner is fully engaged throughout the entire process, in contrast with the owner's more limited role in a DBB project.

Early in the project, along with overseeing design, the owner should also focus on eventual commissioning and turnover to ensure understanding and agreement within and between the teams about how to execute these procedures.

Source: DBIA 2015 Design-Build Best Practices for the Water/ Wastewater Sector

The foundation of a successful project transition begins with incorporating the owner's priorities into the draft project implementation plan (described in chapters 1 and 5), which should always include elements on transition. Anticipating and developing plans for startup, testing, training, and transition activities is a core responsibility of the owner during project planning, as is identifying transition responsibilities of the owner's team members. Subsequently, while owners identify their transition priorities in the draft project implementation plan, they also use it in the RFP, instructing proposing firms to include language for a draft plan for appropriate start-up, acceptance testing, and O&M training. Table 6.1 provides examples of the differences in the transition process between collaborative-delivery and design-bid-build projects.

Table 6.1. *Major Transitional Process Differences*

Collaborative Delivery	Design-Bid-Build
Can include performance guarantee	Typically, no performance guarantee
Delivery team established levels of training defined	Training specified by designer or vendors
Equipment selected for successful performance	Three or equal rule; low cost to contractor
More collaborative, with operator involvement throughout process	Operator involvement varies

Once selected, the collaborative-delivery firm begins working with the owner to refine the transition and start-up plans, integrating input from all project participants. The updated and now jointly developed project implementation plan includes such items as:

- A risk and responsibilities matrix that delineates the responsibilities of the owner, its staff members, and either the design-builder or the design engineer (in CMAR delivery) during start-up and commissioning;
- Identification of needed resources and additional equipment;
- The proposed schedule of the operator's education and training program, including site visits to similar facilities;
- A schedule of early meetings in which start-up procedures will be discussed;
- The roles of the respective parties in acceptance testing and transition to owner operations; and
- A description of the strategies for handling unexpected incidents and situations.

Within the transition plan and matrix of responsibilities, it is also essential that the owner and collaborative-delivery firm identify which party is responsible for each of the following elements in the transition process.

- Paying for power and chemicals to operate the facility during startup and commissioning, both prior to and after acceptance.
- Disposal of treated effluent and residuals that are not marketable or dischargeable.
- Meeting license requirements for operation, both prior to and following facility acceptance.

Training

In collaborative project delivery, the design-builder (or design-engineer in the case of a CMAR) is probably in the best position to prepare the operations and maintenance (O&M) manual. The owner should allocate sufficient funds to have the project-delivery firm train the O&M staff.

Increasingly, owners are also requiring online O&M manuals and asset management programs, in addition to hard-copy O&M manuals. These web-based operations and maintenance information systems (OMIS) integrate a wide variety of project information such as vendor cut sheets, project as-built drawings and videos of operator training sessions. This new level of information now provides operators and owner staff a single system to quickly access all aspects of the facility's operations. Collaborative-delivery firms are particularly well-placed to help owners put together such systems since during construction, as they are the single source responsible for producing and coordinating the delivery of the content that forms the backbone of these systems.

Optimizing Power and Control Solutions on Collaborative-Delivery Projects

Delivering maximum value to the owner, at minimal cost, is key to the success of any collaborative-delivery project. This includes long-term cost of ownership, initial capital cost, effectiveness of the solution, reliability and resiliency, and—in our current global environment—the safety and security of the installation and the people operating it.

No stage in a project poses more risk for delays and cost overruns than the startup of a plant, specifically the control systems. The expertise and knowledge of a technology partner—in addition to the owner and the collaborative-delivery firm—can help minimize that risk by optimizing controls design, minimizing construction and installation time, and reducing the complexity of bringing multiple vendors together in the late stages of a project. Such a partner should have extensive water/wastewater expertise in addition to SCADA, instrumentation and control (I&C), electrical and software technologies and capabilities.

Having an integrated power and controls solution, with fewer interfaces, has repeatedly proven successful in collaborative-delivery projects. A dedicated project manager who leads the owner's team from the earliest stages of design conceptualization, through equipment manufacturing, delivery, and startup, has also proven critical to a project's success.

In today's technology environment, where connectivity is of paramount importance, the industrial internet of things (IIOT) presents even more new opportunities for effective and efficient operations. At the same time, it unfortunately also brings new challenges, as the convergence of information technology and operational technology can make a plant highly vulnerable to cyber-attacks. Navigating this convergence, and implementing cyber-security measures within the control design, are absolutely mandatory.

Finally, designing and implementing technologies and systems that connect the plant team (management, operations, maintenance) with critical operations procedures and historical data—and using proven technologies—will lead to safe, efficient, and cost-effective operations throughout the plant's lifetime.

—Christopher Peta, *Schneider-Electric (WDBC Advisor Member)*

The use of unfamiliar, new or emerging technologies, such as sophisticated supervisory control and data acquisition (SCADA) systems, may require additional training or an extended start-up period with hands-on support. In these circumstances, both the owner and the collaborative-delivery firm are responsible for ensuring that all appropriate staff are trained on the new equipment and are knowledgeable about new operational procedures—before the transition process begins. The owner and the collaborative-delivery firm should work together early in the project to plan, schedule and initiate this training and, when needed, to provide classroom and field training, as well as other relevant O&M information.

In CMAR project delivery (as previously stated), the engineering firm is likely the best suited to conduct the training and prepare the O&M manual, particularly if the CMAR firm lacks the ability to perform O&M tasks. In a CMAR delivery, these activities include:

- The design engineer providing the detailed startup, testing and commissioning plan early in the project, addressing and confirming the owner's expectations and priorities for acceptance and transition.
- The owner working with the design engineer to clearly define the project's construction scope and related requirements—including its expectations for transitioning prior to final acceptance.

Prior to start-up and commissioning of collaborative-delivery projects, the design-builder is typically required to test and certify systems and individual equipment. During this period, the firm also provides the owner's operations and maintenance staff with additional project-specific operation and maintenance information, including operating instructions, training modules, O&M strategies, and checkout requirements.

Project Acceptance

Following successful startup, testing and commissioning, the owner accepts the project, unless acceptance testing is required. Whenever acceptance testing is to be performed, it is typically conducted under the guidance and direction of the design-build or CMAR firm, in collaboration with the owner's operations staff to verify that the system satisfies the owner's objectives, as stated in the project agreement.

The successful acceptance of treatment trains in the start-up process (e.g., West Basin facility) begins with early involvement of the owner's operations team.

Water Treatment Rehabilitation and Expansion

Lee County, Florida

Lee County Utilities (Florida) was facing increases in potable water demands in the Pinewoods service area, with limited fresh water resources available. Subsequently it became necessary to rehabilitate its existing nanofiltration membrane water treatment plant and expand the plant's capacity from 2.1 to 2.3 mgd. It was further determined that an additional 3.0 mgd of capacity would be required through a reverse-osmosis system to treat water from the brackish Lower Floridian Aquifer.

Using a progressive design-build procurement, Lee County Utilities selected the Carollo Engineering Design-Build team to complete the required rehabilitation and expansion of the $17 million project within an 18-month project schedule. During the construction phase of the project, the owner identified the need to also rehabilitate the existing 1 mg concentrate storage tank, as the inside lining of the tank had deteriorated and the concrete walls were showing signs of erosion. The Carollo team also designed a process whereby the tank could be temporarily bypassed to allow for the refurbishment, while the plant continued to produce water and not impact the overall project schedule.

During the execution of the project, additional pilot testing was conducted to determine if less chemicals could be used to pre-treat the NF water. The result of this testing enabled the utility to save the capital cost associated with an additional storage tank and continues to save the county money in ongoing chemical costs. As a result, the newly reconditioned and expanded water treatment plant is large enough to reliably meet the potable water demands of the Pinewoods service area for the foreseeable future.

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Engineers...Working Wonders With Water®

The acceptance-testing period involves operating the entire system over a range of specified operating conditions—for the period of time defined in the contract—while collecting data and documenting the system's overall performance. The goal of acceptance testing is to demonstrate that the complete project meets the performance criteria stipulated in the contract, including tolerance levels for each performance criterion.

In design-build contracts, performance criteria may include process-performance guarantees in which the design-builder agrees to guarantee that the installed process systems will meet the process guarantee criteria in the contract. In contrast, a CMAR firm is held accountable only for constructing the project as designed and for providing the services required to transition the project back to the owner—not generally for process performance.

Matters related to adhering to performance requirements in a collaborative-delivery contract can be complicated. The performance criteria defined in the contract should be measurable, achievable, and within the control of the collaborative-delivery firm. The following illustrate some of the challenges that may be encountered in developing and applying sound performance criteria.

The owner and design-builder or CMAR firm should collaboratively develop and implement an acceptance-testing plan to demonstrate that performance requirements have been met, and the plan should include the following characteristics: clear definition of the quantity and quality parameters of the raw and treated water and/or wastewater influent and effluent; tests that are measurable and not subjective; test parameters, including testing duration, and processes, as well as responsibility matrices showing for which entity will be performing each test; clear definition of what constitutes test passage or failure; and steps to be taken in the event of failure.

Source: DBIA 2015 Design-Build Best Practices for the Water/Wastewater Sector

- If the owner-supplied equipment does not function properly, the collaborative-delivery firm's responsibility is generally limited to correcting deficiencies in the installation, unless the owner has assigned its owner-supplied equipment purchase contract to the collaborative-delivery firm.
- If the owner-supplied equipment was properly installed according to instructions, but does not function properly due to a non-installation defect—and if the purchase contract executed by the owner was not assigned to the collaborative-delivery firm—the owner is responsible for the defective equipment.
- When an owner requires that a water or wastewater project be designed and constructed to meet a future increase in capacity requirements, the contract needs to specify the use of modeling to extrapolate from the acceptance-testing conditions to conditions at the anticipated full capacity.
- If influent data provided during the process by the owner for acceptance testing does not conform to the criteria specified in the contract, the owner and the collaborative-delivery firm must agree on appropriate adjustments to the required regulatory performance criteria so that performance testing can be satisfactorily performed.

Contracts for larger or more complex projects often specify conditions that allow for partial or substantial completion. This enables the owner to accept certain aspects of the project—for example, equipment and process performance of certain portions of the plant, or non-treatment-related tasks such as paving or landscaping—prior to completion of the entire project. If some minor performance requirements are not achieved during initial acceptance testing, the owner may be able to grant the collaborative-delivery firm provisional acceptance, with final acceptance being granted once the remaining criteria are met—only if such an occurrence was anticipated and addressed in the contract.

Once the owner acknowledges successful completion of performance testing, the collaborative-delivery firm begins the project closeout activities and final transition of plant operations and responsibilities to the owner. *NOTE: The effort required of the owner in this final stage of project delivery can be significant and should not be underestimated.*

Turning over the Keys

Transitioning from construction by the design-build or CMAR firm through acceptance and ownership of the project by the owner and operations staff can occur quickly. Early and proper planning and staff preparedness are essential to ensuring that the transition from the collaborative-delivery team to the owner's staff is a positive experience. The collaborative-delivery team is responsible for demonstrating that the owner's new assets will operate in a manner consistent with the design documents and contract requirements. Involving the owner's operations and maintenance staff in the process with manufacturers' representatives in certifying equipment further reinforces classroom training and provides a review of O&M procedures. Active involvement in the startup and commissioning of key equipment and systems over a range of flow and water-quality conditions gives the operations staff an understanding of systems and increases their ability to troubleshoot any problems that may arise.

A 52' deep underground storm and wet weather station in southwest Florida with 27 mgd pumping capabilities.

Typically, the collaborative-delivery team will be required to conduct an acceptance test. This test requires a specified period of time usually ranging from 7 to 30 days over a host of flow and operational scenarios. Data are collected at various locations and specified time periods in order to document conformance with the design criteria and contract requirements. Involving the owner's operations staff during acceptance testing is critical to continuing the collaborative relationship. This step gives the owner's staff the benefit of running the plant with guidance and oversight from the collaborative-delivery team, key subcontractors, startup specialists, and key manufacturer's representatives. Not only does this collective effort demonstrate that the facility complies with contract requirements, it also gives the operations staff a chance to become familiar with the wide range of operational conditions while the collaborative-delivery team is in place to address any questions or other issues. Additionally, the owner's operations staff works closely with the designated collaborative-delivery team representatives to perform the start-up operations to customize key set points, alarms, reports, and displays to further optimize the plant for their day-to-day needs.

Post-Transition Support

Following acceptance of the project, the owner then assumes permanent control of the project. The collaborative-delivery team is responsible for honoring any obligations associated with performance guarantees and warranty items. Typically, equipment-related warranties are limited to a one-year period following the beneficial use of the item by the owner; however longer periods can also be stipulated in the procurement documents.

Similarly, owners have found that access to a single point of contact on the collaborative-delivery team streamlines the resolution of items that arise during the warranty period. Having a single point of contact facilitates resolving issues in a timely manner, compared to traditional delivery methods. It also enables the owner to confer with an integrated group regarding operational modifications or unusual events and then receive cohesive feedback about design, construction and equipment optimization and adjustments that may emerge.

Another benefit of collaborative delivery is that it enables owners to contract with a single entity for follow-up training, process optimization, and operational support following project acceptance. This element enables owners to establish a transitional, or on-call, arrangement with the collaborative-delivery firm, in order to conduct periodic refresher training, evaluate seasonal water-quality challenges, and re-optimize the process train to operate at peak conditions. This type of unrestricted access to the integrated team that designed, built and commissioned the plant provides owner's operation staff with a safety net of professionals that immediately help with troubleshooting difficult situations.

CHAPTER

7

Leachate-Pretreatment Plant | Johnson, Rhode Island

Design-Build-Operate

Design-build-operate (DBO) represents an important expansion of the design-build (DB) project-delivery method that will be of particular interest to some owners in the water and wastewater industry. DBO includes all of the components of DB—including procurement, design, construction, and commissioning—as well as operation and maintenance (O&M) of the completed facility. Thus, the delivery of project and services to the owner does not end at final acceptance, but continues with operations services through a defined period or term.

The use of DBO is particularly suited for circumstances where one or more of the following conditions exists.

- An owner wants to incorporate new or emerging water or wastewater technology into the project.
- An owner's operations staff resources are limited.
- An owner seeks to transfer operational and performance risk to a third entity.
- An owner seeks an efficient delivery method that encompasses and optimizes both the capital and O&M components of a new project.

It is important to recognize that DBO delivery can significantly increase both capital and lifecycle cost efficiencies, which are best realized through early and continual collaboration between the design-builder and the owner's operations team. This interaction optimizes trade-offs between capital investment and long-term O&M costs, and—given the broad scope of the DBO team's services—the owner typically allows wide flexibility in the project's design and relies heavily on the DBO firm for successful, cost-effective operation over the project's life cycle (see Figure 7.1).

In assuming a facility's performance risk (typically for a period between 5 and 25 years, possibly with renewal options), the DBO firm provides a facility performance guarantee for the agreed upon period. The long-term obligation to operate and maintain the project also serves as an important incentive for the DBO team to maximize lifecycle cost efficiencies during design and construction.

DBO Organization Models

Owners opting for DBO delivery can choose among several structural models. The two presented in this Handbook are the most frequently used within the U.S. publicly financed and private water and wastewater industry. Moreover, DBO is the primary delivery method used when public or commercial projects are privately financed (i.e., financed by a third

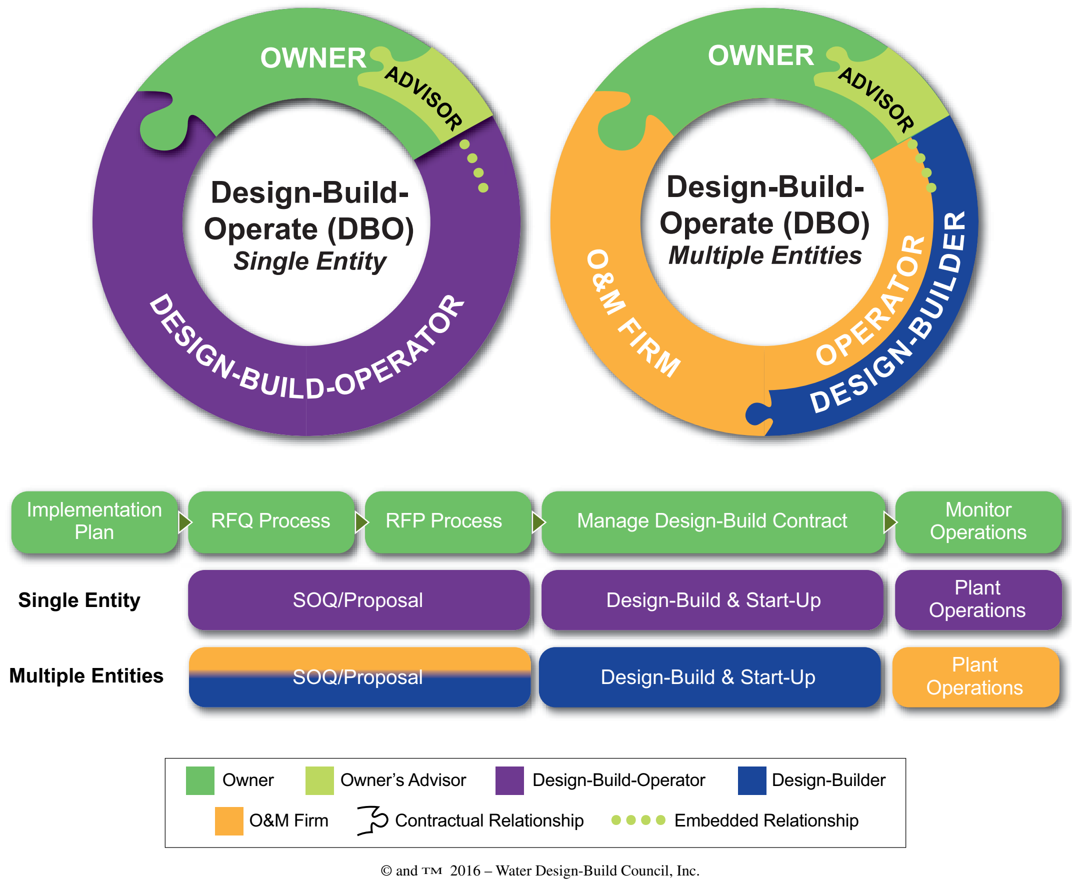

Figure 7.1 — Design-Build-Operate

entity). In this latter instance, DBO is the service delivery mechanism under a public-private partnership (P3) approach. See Chapter 8 for additional information about public-private partnerships.

Model I — Single Entity

The most common DBO structure is the single-entity model. A single firm—or, sometimes, a joint venture between a design-build firm and an operations firm—executes the DBO contract with the owner. In this approach, the DBO firm assumes responsibility for design, engineering, construction, and long-term O&M of the project (Figure 7.1).

In the case of a single-entity DBO—whether a single firm or a joint venture—an owner may elect to accept a single performance guarantee from the DBO team. Alternatively, an owner may choose to get a performance guarantee from each of the participating firms—with one being responsible for the project from inception through acceptance testing, and the other assuming responsibility for long-term operational performance and maintenance. Rather than both firms having joint-and-several liabilities during the entire life of the project, risk and related performance guarantees for different performance periods are allocated to the DBO participant best equipped to manage the associated risks. In the dual performance guarantee model, the owner should be aware and understand additional complexities in developing its contracts with the two participating firms. For example, the interface of a designer, builder, and operator during commissioning and start-up must be clearly defined, and the responsibilities for fine-tuning treatment-process performance during the first several years of operation must be addressed.

Model II — Multiple Entity

Another frequently used DBO structure is one in which the O&M firm executes the entire DBO contract with the owner and serves as prime contractor, assuming full responsibility for the design and construction of the project, as well as long-term O&M. As the prime contractor, the O&M firm subcontracts either with a design-builder or with separate design engineering and construction firms (see Figure 7.1), allocating risk among the firms as appropriate.

Comparing DBO to DB Delivery

Although both regulated private-sector firms and public-utility owners use DBO, their decision-making criteria and processes are quite different.

Private-sector owners tend to have more decision-making flexibility, and their decisions are driven almost entirely by the cost-effectiveness (including any related tax impacts) of operating a facility over its defined project life.

Public owners may need to consider more than cost-effectiveness, as their operations may be subject to regulations that govern, for example, whether or not the facility can be operated by an outside contractor.

- Labor agreements: Is there a public-union workforce in place, and if so, how does DBO fit into the existing union labor agreement?
- Employee retention: Will the DBO contractor be required to hire the owner's existing personnel?
- Public perception: In the case of public projects, does the community consider DBO a positive or a negative delivery model?
- As-is risk: Given that a DBO firm provides a long-term guarantee of performance and quality (for example, delivery of treated water from the facility at a predetermined price over the life of the DBO contract), the owner and DBO firm need to address a number of inherent risks, including the responsibility to prevent existing assets—which are likely to be older and have their own operational problems, that may be included in the O&M agreement—from affecting the performance of the new facility. Owners also need to understand and provide for periodic assessments of the facility's condition and the state of repair when the facility is turned over to the owner at the end of the O&M period.

The typical scope of services and related terms and conditions associated with a DBO contract differ from those of a DB contract. In addition to permitting, design, construction, and acceptance testing (typical items in a DB contract), a DBO contract also encompasses long-term O&M, which requires managing the facility on a day-to-day basis and periodically evaluating, renewing and replacing equipment.

Agua Nueva Water Reclamation Facility

Pima County, Arizona

The Agua Nueva Water Reclamation Facility (AGWRF), (formerly the Pima County Water Reclamation Facility) project consists of the design, construction, acceptance testing, operation and maintenance (including all capital maintenance) of a new water-reclamation facility as part of Pima County's new Water-Reclamation Campus. Additional capital improvements included an influent pipeline from the facility to the county's plant interconnect, an effluent pipeline from the facility to the county's existing Santa Cruz River outfall, a primary sludge line from the facility to the county's existing sludge transfer pipeline, a bypass sludge line from the facility to the plant interconnect, and all related capital improvements. The capacity of the new facility is 32 million gallons per day (mgd), based on annual average daily flow, with an ultimate capacity of 48 mgd.

The County chose to use design-build-operate (DBO) project delivery to secure substantial benefits for its customers, including timely, efficient and cost-effective scheduling, optimal risk allocation, competitive design selection, clear assignment of performance responsibility to a single contracting entity, long-term O&M efficiencies, cost savings beyond any that could have been expected with design-bid-build (DBB) project delivery. In 2010, the County awarded the contract to CH2M, which devised an innovative treatment process that uses Dissolved Air Flotation as primary clarification and five-stage Bardenpho wastewater treatment_enhanced with step-feed capabilities, followed by deep-tank secondary clarification. The odor-control solution, which consists of two separate systems—a centralized odor-control biofilter system and a dual-bed carbon absorption system—offers low lifecycle cost and exceptional performance.

The ANWRF project began operation in 2014. Overall safety performance has been excellent, with only a single recordable incident in over 825,000 hours of operation The contract amount was $164 million—almost a third (32%) lower than the budget cap of $240 million. CH2M will operate the facility for 20 years. The site layout allows room to expand to accommodate future population growth of Pima County.

ch2m℠

It is interesting to note that DBO is not commonly used for stand-alone water distribution systems, wastewater collection infrastructure, other pipelines, or pumping stations. Unlike water and wastewater treatment plants, which require relatively sophisticated O&M, stand-alone water/wastewater conveyance or transmission projects do not warrant long-term operation by a third party. Some owners may still use a DBO approach for these types of assets, so they can outsource responsibility for their entire system to a single O&M firm.

Table 7.1 summarizes differences between the design-build and the design-build-operate delivery methods, addressing the relative advantages of each, as well as potential concerns that owners should consider.

Table 7.1. *Comparison Between DBO and DB: Advantages and Possible Other Considerations*

	DESIGN-BUILD-OPERATE		DESIGN-BUILD	
	Advantage	**Other Considerations**	**Advantage**	**Other Considerations**
Procurement	Can allow a relatively wide range of technical solutions.	Complex process can be costly and time-consuming. Number of qualified proposing firms may be limited.	Less complex. More likely to have desired level of competition.	Owner will be responsible for operation and maintenance.
Project Cost	Often results in lowest life-cycle cost. Higher degree of cost certainty for long-term costs of operation and maintenance.	Some added costs when multi-firm teaming, as each firm requires opportunities to turn a profit.	Competitive process brings best value to owner with a defined scope of project.	Potential for increased costs in long-term operation and maintenance, due to owner inefficiencies and inexperience.
Project Quality	Level of service can be controlled with performance/quality standards during design, construction, and operations period.	Requires quality testing and oversight, which can increase project cost.	Can establish minimum design criteria and mandate quality testing and reporting.	Limited period for performance testing prior to acceptance as specified in contract.
Project Risk	Optimum allocation of risk: DBO contractor responsible for design, performance and client interaction during entire project life cycle or duration of the contract.	Insurance and bonding will be complicated. Uncontrollable risks (change in law, inflation, site conditions, etc.) remain with owner.	Design-build firm fully responsible for schedule, cost, and performance of the asset.	Risk allocation limited to design and construction phases of project. Uncontrollable risks (change in law, inflation, site conditions, etc.) remain with owner.
Project Schedule	Can shorten the time to place project into operation.	Extended time for procurement process can delay schedule.	Can reduce time by integrating design and construction.	May challenge owner's decision process and schedule given the need for expedient owner review and approval of project deliverables.
Accountability	Single point of accountability for entire life cycle and design-construction-operation interfaces.	Reliance on one contractor for all phases of the project. There may be the perception by owners of a loss of control in certain project decision making.	Single point of accountability limited to design and construction and does not extend to operations.	Owner holds accountability for long-term operations.
Contract Administration	Single contract to be administered by owner.	Long-term duration and comprehensive scope of contract requires careful and attentive administration.	Contract administration limited to design and construction phases.	Should problems arise during operations, the owner is responsible for addressing issue.
Workforce	Cost of O&M workforce, including benefits, allocated to DBO contractor.	May require "equal or better" benefits (including medical, pension, etc.) and job protection as part of union labor agreement.	Owner controls size and composition of O&M workforce; pays salaries; provides benefits (medical, pension, etc.).	Owner's labor union engaged.

Procurement

In most circumstances, the DBO procurement process follows the same steps as the two-step DB procurement process: a broadly issued RFQ to develop a short list, which then receives the RFP.

Adding long-term O&M requirements, however, changes the procurement process in several ways.

- Adding the operations scope, and the interface between design-builders and operators, increases the complexity of the procurement documents.
- As few design-builders have the appropriate qualifications needed to operate and maintain treatment facilities, the number of qualified teams may be limited.
- Because there are usually fewer specific design requirements or constraints defined in the RFP, however, DBO technical proposals often feature a wider variety of innovative design solutions.
- The best-value selection approach for DBO procurement emphasizes the project's entire lifecycle cost, whereas in DB procurement it typically does not.
- DBO project costs are based on long-term operational performance, which increases the complexity of contract negotiations, but also provides long-term benefits.

Adjacent to a residential community, public park and the Willamette River, environmental considerations were a key concern during the construction of the Wilsonville Wastewater Treatment Plant improvements.

- Certain contract terms need to be flexible to reflect the long-term (i.e., 5–25 years) operations period.

Typical contract terms requiring flexibility include the following components:

- Estimated long-term operating costs, which often are preliminarily quantified and then reviewed and adjusted yearly throughout the life of the contract.
- Maximum allowed level of energy use, which often is tied to variability in quantity and quality of influent (raw water) and may therefore vary considerably over the life of the contract.
- Future staffing levels, as the DBO contractor can revise staffing levels based on any increase or decrease in resource consumption, subject to regulatory staffing requirements.
- Repairing and replacing equipment, to be accounted for in the operations and maintenance pricing provided by the DBO firm.
- Due to the long-term nature of the contract, an owner will generally put even greater weight on the ability to achieve a collaborative and cooperative relationship as a criterion for selecting the DBO firm.
- It is important that the owner and the DBO team understand and agree on risk allocation. Table 7.2 shows how various risks are commonly allocated.

Table 7.2. *Examples of Allocated Responsibilities in DBO Delivery*

	Primary Responsibility	
	DBO Contractor	**Owner**
Land/Easement Acquisition – site conditions		X
Technical Requirements		X
Project Design/Technology	X	
Building and Administrative Permits	X	
Environmental Approvals and Permits	Shared	Shared
Quality and Quantity of Influent (raw water)		X
Quality and Quantity of Effluent (finished water)	X	
Project Performance/Guarantees	X	
Project Financing	X	
Schedule	X	
Costs: DB and O&M	X	
Construction start-up / commissioning / acceptance	X	

Design-Build-Operate

Wastewater Treatment Facility

Woonsocket, Rhode Island

Challenge

Built in the early 1930s with subsequent upgrades in the 1960s, 1970s and 1990s, the Woonsocket WWTF is burdened with aging equipment and faces increasingly stringent regulatory requirements from the Rhode Island Department of Environmental Management.

An early example of CH2M's collaboration with the City to lower project costs was the redesign of the liquids treatment process which saved $1.3 million in capital costs.

Approach

Woonsocket selected CH2M to perform design-build upgrades and to assume long-term operations of both the current and improved wastewater treatment facility. The project includes the following features.

Upon award of the contract in October 2012, CH2M immediately began operating the existing wastewater treatment facility, which involved completing the following work.

- Designing and constructing an innovative treatment process by upgrading the existing aeration basins and adding a second-stage activated-sludge system and chemically enhanced primary treatment.
- Upgrading the existing electrical system to support newly installed equipment.
- Designing and installing a new SCADA system to integrate new and existing equipment.

The upgrade consists of the following components.

- Design-build-operate a $84.1 million facility upgrade (capital: $36.9 million, 20-year O&M: $47.3 million).
- Develop an advanced process technology that improves the city's water quality and environment by reducing the phosphorus and nitrogen discharged to the Blackstone River.
- Pursuing a workshop approach to ongoing decision making involved the client, regulatory authority, operating company, and the DBO team in a collaborative setting.

Results

The upgrade will expand capacity from 10 to 16 mgd—when completed in 2016—and is expected to significantly improve the City's wastewater treatment capabilities. The plant also improves overall water quality and the environment by reducing phosphorus and nitrogen discharge to the Blackstone River. As of March 2016 the project was approximately 85 percent complete, with facility commissioning scheduled for May 2016. CH2M is contracted to operate the facility for 20 years.

Design-Build-Operate

Sediment-Consolidated Area Water-Treatment Plant

Syracuse, New York

Challenge

Pretreatment system for sediment at Onondaga Lake.

A 20-year undertaking, the remediation and restoration of the Onondaga Lake Superfund site in central New York is one of the largest and most complex remediation programs in the United States.

The Onondaga County (Lake) cleanup and restoration program, being completed under supervision of the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Environmental Protection Agency (EPA), included the removal of approximately two million cubic yards of sediment. The hydraulically dredged sediment from the lake was first pumped to a sediment-processing area (SPA), and then to a sediment-consolidation area (SCA) for dewatering by geotube and long-term isolation. The effluent from the SPA and SCA was pretreated in the SCA water-treatment plant (WTP); and then discharged for final polishing (removal) of ammonia and phosphorous at the municipal publicly owned treatment works (POTW). The SCA WTP was a critical component of the Lake dredging program, as its design and construction were the critical path to the initiation of lake-dredging operations.

Approach

OBG (O'Brien & Gere) was responsible for the design, construction, and operation of the 6.5-mgd sediment-consolidation area water-treatment plant. During the implementation of this dynamic project, key considerations included:

- The treatment of mercury to meet 50-ng/L effluent limits,
- Enhancement of the project schedule to allow lake-dredging operations to commence as soon as possible, and
- The application of adaptive changes during dredge operations to address the highly variable nature of the dredged material.

In an alliance partnership role with Honeywell, OBG provides leadership for the 15 uplands subsites, also part of the Onondaga Lake Superfund site, as well as the water management and treatment lead for all the Onondaga Lake sites. A recognized industry leader in dredging-related water management for collaborative delivery, OBG provided bench-scale treatability testing, design, construction, start-up, and commissioning services, as well as operations and maintenance services for the SCA WTP to achieve the following results.

- Building onto the bench-scale testing as part of the conceptual design, allows the SCA WTP to consistently comply with the 50-ng/L effluent limit for mercury, using pH adjustment and chemical co-precipitation.
- Through an early issuance of design packages to facilitate equipment procurement and site work, the design and construction schedule was shortened by two months; together with the use of adaptive strategies during construction of the WTP, allowed the initiation of lake-dredging operations ahead of schedule.
- Pursing the use of adaptive changes during WTP operation and dredging included:
  - Developing a field test, using kaolin clay, to quantify excess polymer in the influent, significantly reduces polymer usage in the SPA and minimizing polymer carryover to the SCA WTP.
  - Negotiating effluent limits for direct discharge from the SCA WTP during wet weather events at the municipal POTW; prevents the resulting suspension of dredge operations during combined sewer overflow events and was a key factor in completing dredging a year ahead of schedule.

Results

A high level of coordination among the owner, local municipality, and NYSDEC was required to implement the project successfully. The project was completed ahead of schedule and under budget. In addition, the project has brought significant improvements to water quality, aiding in the return of native plants and animals and helping to restore the habitat of Onondaga Lake.

This project received a Western Dredging Association (WEDA) Annual Safety Award for its outstanding safety record and performance.

CHAPTER

8

Public-Private Partnerships for Water and Wastewater Infrastructure Projects

This chapter focuses on understanding the fundamentals of the public-private partnership model as they apply to water and wastewater projects. A public-private partnership, often referred to as P3, typically involves a form of collaborative delivery with financing support, combined with a performance commitment and some level of responsibility for operations and maintenance of a capital works project. P3s almost always embed collaborative delivery (as defined in Chapter 2) for the design and construction of a project. P3s also typically expand the collaboration model by including long-term operations, maintenance, repair, and refurbishment of capital projects.

Currently, there is no uniformly accepted definition of P3 in the water/wastewater market sector. For example, water/wastewater P3s may—or may not—include financing or long-term operations. As such, this chapter necessarily covers a range of P3 models. And unless otherwise noted, the most common P3 model (where the private sector design, builds, finances and provides some form of operations and maintenance and a public entity owns the infrastructure) is generally assumed. For the purpose of this Handbook, what is common to all envisioned P3 water and wastewater projects is the integration of collaborative-delivery methods.

Although relatively few P3 water or wastewater projects have been completed to date in North America, the success of transportation (highway and transit), social infrastructure (hospitals and housing), and public facilities (such as courthouses) projects is fueling current interest. If P3s are to become a more prevalent part of the water and wastewater market sector, public owners and collaborative-delivery firms need to understand the fundamental best practices as well as how to adapt existing P3 approaches for water and wastewater projects.

As municipal utilities look to broaden their collaborative-delivery options for water and wastewater projects, the evolving P3 model may be suited to meeting specific needs under the right conditions.

- **Obtaining all, or a portion, of the funding from alternative financing sources** using a combination of private equity and debt that is typically repaid by the public owner after construction is complete.
- **Promoting development of innovative projects** that would otherwise fall outside a public entity's capabilities.
- **Leveraging the value of existing infrastructure assets** to help fund economic development initiatives or resolve budget challenges.
- **Increasing accountability and efficiency, as well as optimizing assets**, through the use of private resources and expertise.

- **Allocating a portion of the delivery and performance risks to private entities**, with the public interest and performance secured through a strong contractual control of the future repayment stream.
- **Providing flexibility in project structuring and governance**;
- **Supporting a Business Case** to offset the potential added cost of private funds in return for added performance commitments and risk transfer.
- **Accessing unique technology solutions** by allowing design flexibility in conjunction with appropriate performance guarantees.
- **Providing a mechanism for rate stability** by providing price certainty for an extended term of operations, maintenance, and capital renewal.

At their core, P3s require collaborative project approaches. Implementing DBIA and WDBC collaborative delivery best practices is fundamental to P3 success.

As illustrated below (Figure 8.1) in a typical P3 model, the owner enters into a contractual relationship with a business entity known as a Project Company (also referred to as a Special Purpose Entity or Special Purpose Vehicle). The Project Company has full responsibility for design, construction and, typically, operations and maintenance. Unique to this delivery method, P3s often include some form of short- or long-term financing—a combination of equity invested by the Project Company's sponsors in combination with debt sourced from third parties. The constructed asset will often remain municipally owned with operations contracted to the Project Company. Since ultimate operational

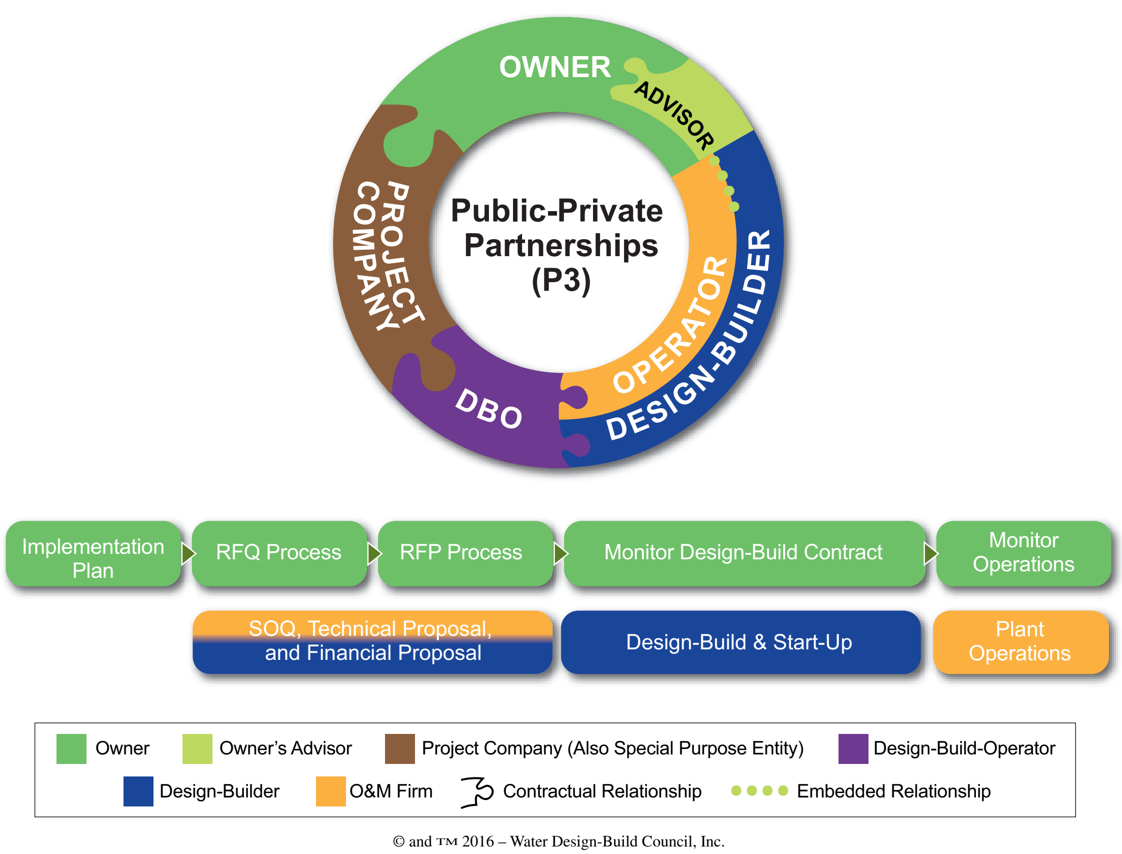

Figure 8.1 — Public-Private Partnerships

responsibility, control of the asset and associated permits remain with the public sector owner, ***P3 is not privatization***. (In some instances, such as the Carlsbad case study located at the end of this chapter, a build-own-operate-transfer model is used where title to assets are held by the Project Company for the duration of the operating period before ultimately being transferred.)

The Project Company, in turn, contracts with firms to design, construct, operate, and maintain the finished project—and is responsible for overseeing the project from beginning to end. The Project Company may choose to contract with a collaborative-delivery team in any of the arrangements discussed in this Handbook, ranging from CMAR to DBO. The resulting contractual obligations and relationships may be implemented by the Project Company individually with each design, construction, and operations entity, in a combination of design-build and operations contracts, or as a single DBO contract. In any case, the Project Company is bound by its contract with the owner and its agreements with equity and debt providers.

Assuming contractual performance by all of the parties, the owner is ultimately responsible to pay for the design, construction, operation and maintenance of the facility, as well as for any transaction and financing costs. Capital payments may take place through milestone increments during construction or soon after construction is completed. Construction payments may be supplemented over a longer period of time, in parallel with an operations, maintenance, and repair term. However, it is important to note that P3s do not inherently provide an additional source of funds without an adequate ratepayer base or other capital funding mechanism.

P3 Project Agreement and Structure

P3 delivery models are structured in a wide variety of ways. They typically consist of a Project Company capitalized by equity providers that holds the primary contract (often referred to as a project agreement) with the owner. In conjunction with the project agreement, the owner enters into financing agreements with debt providers (as arranged by the Project Company). In turn, project agreement terms typically flow through to the collaborative project-delivery entity for actual design, construction, operations, and maintenance. Project agreements broadly conform to one of two payment approaches.:

- **Availability-based** contracts are based on regular payments by a public owner in return for the ongoing availability of the asset in accordance with contractually agreed service levels.
- **Demand-based contracts** are based on user payments related to the actual usage of the project asset.

A Project Company can include ownership participation from any of the collaborative-delivery firms involved on the project who choose to invest equity. However, few design-builders implement a Project Company without a third-party equity financing. A financial advisor or underwriter may also be retained by the Project Company to assist with structuring and arrangement of third-party debt and with preparing a financial model for the project .

Figure 8.2 illustrates a typical P3 project structure. P3 project implementations vary greatly; this illustration is typical of an availability-based, municipal project .

P3 organizational approaches are unique among water and wastewater project-delivery structures in that the Project Company is in a direct contractual relationship with the owner and, in turn, all the other members of the project team contract with the Project Company or its subcontractors. Because of the complexity of the contract's features, risk transfer, and project-specific performance requirements that can be incorporated into the agreement between the owner and the Project Company, each such contract has historically been unique, involving significant transaction costs, negotiations, and requiring legal counsel.

In the North American water and wastewater sector, long-term O&M contracts with any capital improvement component have often been characterized as P3, even when the ratio of capital improvement relative to the overall operations and maintenance scope is relatively small.

Specifically in Canada, where P3s are more consistently implemented, they are defined as having either a finance or an O&M component; in practice, however, Canadian P3s generally have both. P3s can also refer to projects that provide services to the public without direct public owner involvement. These instances can encompass a broad array of private developments, public-private purchase agreements, and industrial supply arrangements.

P3 Procurement

P3s are most commonly procured via industry-recognized, precedent processes and documents, many of which have evolved from the transportation, social infrastructure, and public facility markets and may not be appropriate for water and wastewater projects. P3s are often

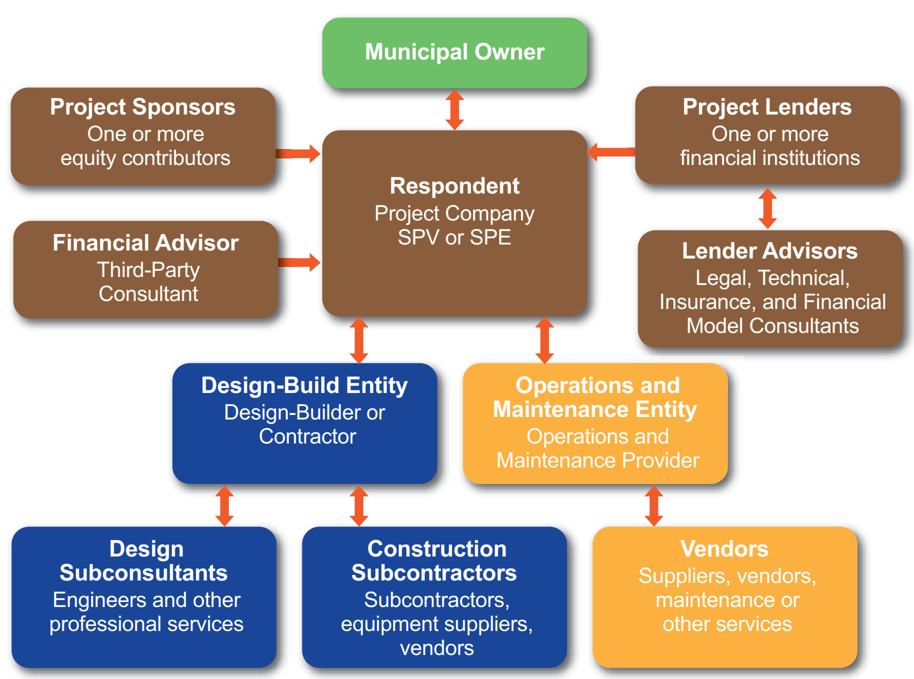

Figure 8.2 — Typical P3 project structure

initiated with a formal or informal business-case analysis that establishes the need for the project, sets performance criteria, and evaluates the potential advantages and disadvantages of transferring project financing, implementation, and performance risk to the private sector.

In the United States, many public owners use tax exempt debt for capital projects, which is available at a low cost relative to private financing—and often a barrier to choosing a P3 delivery method. When the potentially higher cost of private financing is offset by any potential benefits identified as valuable by the owner (such as risk transfer, innovation, or schedule savings), the term "value for money" is used to describe the exchange. An owner receives value for money if the gain to the public (as perceived in qualitative terms or quantified in monetary terms) is greater than the added cost. A project does not offer value for money when any added cost of private capital is not offset by net gain from risk transfer, accelerated schedule, innovation or other project priority as evaluated by the public entity.

Business cases normally rely on several key variables.

- **Discount rate** – a rate used to reflect the time value of money, a significant variable in determining the Business Case outcome.
- **Efficiency factors** – factors applied to calculate credit for schedule efficiency, innovation, and any other potential savings.
- **O&M savings** – an additional efficiency factor applied to savings expected from having the facility privately operated and maintained over a specified period.
- **Risk premium** – added costs, contingencies, and credits applied to one approach versus another to reflect the monetary value of transferring risk from one party to another.

If a business-case analysis establishes the benefit of proceeding with a P3 model, the following project attributes are typically defined to establish the basis of a P3 procurement.

- A design/construction period followed by substantial completion and performance milestones that set payment and financing triggers.
- Parameters for financing the capital component, with a suggested payment mechanism tied to the above approaches and the recommended minimum equity participation relative to debt.
- Operations, maintenance, repair and capital renewal requirements for the completed facility to ensure long-term performance.

Once a project is defined, procurement documents are usually derived from past market practice. These documents are normally based on those used for collaborative-delivery methods, typically a fixed-price, performance-based design-build or DBO. A typical P3 practice relies on precedent P3 transactions and documents, usually via a two-step procurement process: a widely distributed RFQ to establish a short list, and an RFP for fixed-price design-build, operate and maintain, and finance proposals. It should be noted, however, that some state laws allow for a "progressive" P3 procurement process, similar in many respects to the progressive design-build process that has gained wide acceptance for water and wastewater projects. While not considered a best practice for water and wastewater projects, some procurement precedents are based on proposal-phase evaluation criterion that consists of a single evaluated price output from a lifecycle-based financial model rather than a best value evaluation.

A typical P3 procurement process also includes multiple, confidential one-on-one meetings during the proposal process to discuss both technical and commercial/contractual issues. The purpose of one-on-one meetings is primarily to reach concurrence on technical approach and a P3 contract that is acceptable to all proponents and that may be required as a condition of bid without revision.

When a P3 contract is awarded, projects are often initiated with a single project notice to proceed at financial close that eliminates any distinct design or construction stage, but starts the clock to the project's substantial completion milestone (often with several progress milestones in-between). However, there is no single, consistent approach to P3 procurements across all regions or markets and the dominant P3 precedents from transportation, social infrastructure, and public facilities may not always entirely appropriate to water and wastewater best practice.

Issues and Best Practices for P3 Projects

As P3s almost always include a collaborative-delivery component, the best practices discussed for each of the delivery methods in this Handbook apply to the design-build and operations components of P3 projects.

While water and wastewater P3s may be expected to follow many precedents established in the transportation, social infrastructure, and public facilities sectors, existing P3 model will not always be appropriate. Since there have been relatively few water and wastewater P3 projects delivered to date in the U.S., public owners should consider the following issues when evaluating municipal P3 projects.

- **Project size.** Although water and wastewater capital projects are typically smaller than those in other sectors that generally use P3s ($100 million is a typical initial threshold of viability, and $500 million and larger projects are common), the O&M cost element for water and wastewater projects is significantly larger than for other types of projects. Given their relatively high transaction costs and complexity, owners should recognize that P3s may not be efficient for smaller capital projects. However, this disadvantage may be at least partially offset by long-term operational benefits
- **Project viability.** Municipal utilities operate in diverse funding environments, where existing rate structures may not be sufficient for funding capital or ongoing maintenance requirements. Owners should clearly identify short- and long-term funding sources and resolve any conflict created by cross-subsidies in either direction with other public functions.
- **Public perception.** Given the historic gap between the public's perception of the cost of a potable water supply and wastewater treatment and the actual cost of providing these services, owners should clearly communicate project benefits and governance structure—and proactively address potential concerns around perceived privatization.
- **Public responsibility.** Water and wastewater treatment must be recognized as fundamental needs, with governmental responsibility to own and protect a universal resource, to obtain and hold permits, and to protect the public interest.
- **Public health.** Public-health protections in terms of the environment as well as the health of the publics, are fundamental legal and ethical

The P3 Bidding Process: What's Different?

P3 procurements are complex; they expand upon many established best practices used for collaborative delivery. Examples of ways in which P3 procurements differ from collaborative-delivery method procurements include:

- **Nomenclature.** In P3 procurements, proposers may also be referred to proponents.
- **Duration and Cost.** P3 procurements are typically longer than even complex, non-P3 collaborative-delivery procurements. Owners typically engage technical, financial, and legal advisors experienced with the P3 model. For proposers, potential lenders' third-party advisors must independently validate the Project company's approach, financing must be arranged, and the contract must be finalized in advance of final pricing submittals. All of these factors add time and cost to the proposal process. In addition, usually several months elapse between selection of the successful proposer and financial close.
- **Bifurcated Submittals.** Many P3 procurements require separate technical submittals that must be evaluated and approved before proposers are asked to submit cost information.
- **Emphasis on Solutions During the Qualifications Phase.** As procurements trend toward proposal-phase evaluation criteria with financial factors as the primary basis of selection, the RFQ is sometimes used to differentiate firms' project approaches and technical solutions. This approach can have the effect of treating SOQs more like a technical proposal and it conflicts with the fundamental collaborative delivery best practice of best value selection.
- **Emphasis on Price Alone.** Proposals for a P3 project are sometimes evaluated based entirely on monetary factors. These factors may include design, construction, operations and maintenance, repair and replacement, and financing components – and these are often combined into a single lifecycle cost criterion. In parallel with under-emphasizing technical innovation, this approach is not in owners' best interest as it also shifts from the best practice of a best value evaluation process where a combination price and non-price evaluation criteria are applied.
- **Communication.** For P3s, the project companies or similar entities are the proposers, and as such, all formal communication throughout the procurement and delivery process is between the owner and the Project Company. The Project Company communicates with its lenders, the collaborative-delivery firm, O&M and entities. While lenders typically have direct contractual "step-in rights" to protect their investments, lenders and lower-tier participants otherwise do not have direct communication with the owner.
- **Contract Definition.** Many P3 procurements are based on a single project agreement that is modified based on the Proponents' input during the procurement process. A final contract, to which all parties must agree, may be issued as part of the final RFP prior to the proposal submittal date. In such cases, Proponents base their pricing and lower-tier agreements on the as-issued form of contract, and no significant negotiations are permitted after award.
- **Security for Performance.** As defined during the procurement process and implemented upon contract execution, many P3 projects require security for performance that differs from DBB or other collaborative-delivery projects. Performance security may be in the form of surety bonds or letters of credit (irrevocable letters of credit are often the preferred security of lending institutions). Since the Project Company typically performs design and construction work and finances the work in advance of payment from the owner, absent legal restrictions, the size of the security can be less than 100% of the value of the work, but it often required to be "liquid" and fully accessible. Security for performance can be over-prescriptive or over-protective, which can be costly. Striking the right balance of project risk mitigation is critical to achieving a cost-effective project.

issues, and related risks cannot be fully transferred to the private sector, even via a P3.

- **Permitting and change-in-law.** Recognizing that providing safe drinking water and adequately treating wastewater involves extensive regulation and permitting, P3 agreements must accommodate a high potential for regulatory change over the duration of an operation.
- **Utility system integrity.** For an existing utility system with an in-place operations and maintenance program, the P3 approach must accommodate the need to effectively coordinate and operate multiple components of a treatment system.
- **Impact on existing facilities.** Recognizing that existing water and wastewater infrastructure cannot generally be taken out of service or re-located as improvements are made or replacement facilities are built, the P3 approach must equitably facilitate the maintenance of complex existing operations in conjunction with construction.
- **Solution customization.** In recognition that water and wastewater facilities encompass a wide variety of solutions that require project- and site-specific technical approaches, evaluation criteria for reliability and quality of treatment should be flexible, particularly when a proposed solution may provide significant benefit to the public. Procurement evaluations and decisions should include best-value criteria evaluated against performance-based requirements that account for variable conditions.
- **Performance validation.** Since start-up commissioning is an extended process that requires adjustments over time and seasons, P3 commissioning and performance requirements must accommodate adequate break-in time, as well as flexibility to adjust process performance over time.

The use of reverse osmosis – such as within the Carlsbad Seawater Desalination Project – is an integral component in the treatment process to produce quality water for customers.

- **Emphasis on the operations lifecycle.** Compared with other types of infrastructure, water and wastewater treatment facilities have a higher ratio of operating and replacement costs to initial capital costs that must be accommodated in financial models. For treatment plant projects, O&M approaches should be integral with the design and development of the treatment process design.
- **Understanding long-term repair and replacement.** Water and wastewater facilities are subject to highly variable wear and tear that is largely dependent upon flows and loads, as well as preventive and predictive maintenance practices. As such, P3 repair and replacement schemes must therefore accommodate significant variability and unpredictability.
- **Turnover requirements.** Requirements for future turnover of water and wastewater facilities are inherently different than for other types of infrastructure. They require alternative contract mechanisms for ongoing inspection, certification, and determination of remaining useful life at the end of any operations and maintenance term. Turnover requirements should be specified in the project agreement, taking into account cost implications to the owner.
- **Flexibility.** In North America, a patchwork of municipal, state, and provincial preferences, policies, and laws affect collaborative delivery. Moreover, a fragmented capital funding system that relies on a combination of local, state/provincial, and federal funding requires flexible P3 implementation. Every project will be different.

All of these issues require evolution and further refinement of the P3 model. Existing procurement practices and documents, forms of contracts, and lender guidelines and requirements establish a set of precedents and common practices that may not always apply to water and wastewater facilities and O&M best practices. In addition, expectations in the water and wastewater sector are very high for collaborative interaction among designers, builders, operators, and owners. The P3 model can create a level of separation between owners and practitioners via the Project Company. Owners should recognize these challenges and adapt existing P3 approaches to their specific project requirements. Fortunately, the P3 model is extremely flexible and able to accommodate unique requirements and objectives.

P3 Funding and Financing

Any combination of public funding and private financing may be applied to any phase in a water or wastewater project's lifecycle. For the purposes if this discussion, funding refers to monies obtained by public entities through traditional appropriations, rate collection, fees, grants, and capital budgets. Funding can be used for the direct support of a project in the traditional manner or to secure and eventually pay back privately obtained monies (financing) to implement the project .

In the water and wastewater sector, some level of public funding is almost always required. However, P3s commonly use public funding contributions and commitments in combination with privately obtained financing; and, most P3s are predicated on private financing in conjunction with the normal public-sector funding mechanism. Typical availability-payment P3s include both private financing in the form of debt equity obtained by the Project

Company to finance the capital costs of the project, and public funding to repay the capital costs and to pay for operations and maintenance over time.

The duration and amount of private financing varies widely among P3 projects, whether ultimately secured by the direct allocation of public funds—via dedication of user fees or other revenue available to the public entity or via long-term availability payment commitments.

In a P3 project, the private financing typically consists of debt and equity components. An equity investment is typically required from the private entities/investors in the Project company that is responsible for delivering the project. The ratio of the equity contribution to the amount of long-term debt (referred to as gearing) is a key project attribute that represents the equity investors' "skin in the game." The expected equity contributions to the Project Company by its sponsors is typically in the 10-25 percent range (although this varies greatly by market and type of project) with repayment concurrent with the long-term debt repayment. As equity contributions normally require a higher return than debt, there is pressure from a cost standpoint to reduce the amount of equity. However, the higher return for equity is often a reflection of project risk (e.g., as institutional lenders evaluate a higher risk, they require more equity), and reducing the amount of equity can reduce the effectiveness of any contractual risk transfer to the private party.

It should be noted that projects resulting from various state legislative Public Private Partnership Acts may be characterized as P3 even though they are 100 percent publicly-funded. In these cases, public funds are re-prioritized from existing budgets or re-allocated from elsewhere in the public sector for the purposes of the private-sector involvement in the project .

The financing component, methods, security, and repayment practices vary greatly across markets, jurisdictions, and types of facility. It is not practical to cover the full breadth and depth of project financing in this Handbook, but basic costs and corresponding methods of financing and payments for water/wastewater projects through the project lifecycle are summarized in Table 8.1.

When addressing the repayment of the financed components shown the table, there has been a significant shift in the North America P3 market in recent years as it has evolved from the use of concession or demand-based models (such as for many toll roads and some water and wastewater projects) to an availability model as defined earlier.

Regardless of the model, public funding for capital projects can come from a variety of sources.

- **Direct income** — payment streams generated from the direct income from the completed facility (e.g., water/wastewater sales contracts, biosolids processing fees).
- **Fee/tax diversion commitment** — payment streams generated from indirect income from the completed facility (e.g., payment of public bonds or sequestration of a portion of utility rates to fund a specific infrastructure project).

- Direct installment payment — payment committed to, and specifically set aside by, the owner to repay costs over time. This is typically found Canada P3s where provincial and federal entities may make multi-year appropriation commitments for a fixed payment stream.

Table 8.1. *Summary of common approaches to private financing and payment of costs by the owner throughout the lifecycle of a water/wastewater P3 project using an availability payment structure.*

Scope:	**Capital Price, Short- and/or Long-Term**
Includes:	Design, Construction, Start-up, and Commissioning
Repayment Time Period:	Design and construction through substantial completion or completion of satisfactory performance demonstration, and post construction for a period of typically 20 to 30 years (concurrent with any operations and maintenance term).
Risk and Payment:	The Project Company includes in its price proposal the expected capital price for the project. The Project Company may obtain both short-term and long term financing for the capital price of the project. The public owner may pay for all or a portion of the capital price of the project in lump sum when the facility is completed and/or in interim milestone payments as construction proceeds. Any remaining portion of the capital price not paid as a milestone payment or at substantial completion (or after successful performance demonstration) may be converted to long-term financing. Under an availability payment structure, the public owner will pay for the capital costs of the project financed with long-term financing through a fixed amount on a monthly basis for a set term, commencing upon substantial completion and successful performance demonstration. A variation sometimes considered for water and wastewater projects is a holdback of a portion of the substantial completion payment for an additional year while the facility is demonstrated to operate at the required performance criteria—often this performance holdback is applied in lieu of a longer-term finance component, when longer-term O&M participation by the private sector is not feasible or desired.
Scope:	**Operations and Maintenance**
Includes:	O&M labor, consumable materials, regular preventive maintenance, and upkeep
Repayment Time Period:	Annual O&M payments are often divided into a fixed monthly amount (to cover baseline staffing and operating expenses) and a variable payment calculated monthly or quarterly (to cover costs that change due to the flow actually processed by a facility). Payments are typically adjusted for inflation of the operating term using a combination of economic indices.
Risk and Payment:	The Project Company prices the expected O&M costs through the term in its proposals. The Project Company may be repaid for its O&M costs from normal utility revenues (e.g., as collected from ratepayers) dedicated by the public owner, or from other owner funding sources, to cover O&M separately from the capital cost payments noted above. Any excess O&M costs are at the Project Company's risk. Availability payments, inclusive of the O&M and capital components, are often considered an additional layer of performance security and are subject to being adjusted downward for poor performance. Contractual treatment of consumable chemicals and power varies, but the operator is almost always at risk for unforecasted increases in consumption and sometimes at risk for future market pricing of commodities. This is a particular issue for water and wastewater for two key reasons: • the operations and maintenance provider is often a separate entity from the initial builder, requiring an Interface Agreement to manage the hand-off of risk from design and construction to operations and maintenance; and • operations and maintenance represents a larger portion of the overall lifecycle cost as a ratio to capital costs for water and wastewater facilities, creating a much different balance between capital and operations and maintenance risk than for other P3 market sectors.

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Table 8.1. *(continued)*

Scope:	**Major Repairs and Replacements**
Includes:	Periodic physical repairs, major equipment replacements, upgrades, rehabilitations, and planned expansions.
Time Period:	A major repair and replacement budget is established to predict major replacement items. The schedule for such costs will vary over the O&M term: they are typically lower when the facility is new and peak at major equipment replacement intervals.
Risk and Payment:	The Project Company prices the expected major repair-and-replacement costs over the term. The Project Company may be repaid for its repair and replacement costs as part of the O&M payment discussed above. Any excess repair-and-replacement costs are at the Project Company's risk. There is no standard, accepted delineation between regular O&M scope and major repair-and-replacement scope, although the DBO market offers some precedent for delineating between normal maintenance and major repair or replacement. Given the unpredictability and relative size of the repair and replacement scope, this is very much a challenge for water/wastewater P3s. Lenders often require that the Project Company set aside a reserve to cover costs of anticipated major repair and replacements when needed, providing additional security to ensure appropriate and adequate maintenance is performed. Where an asset has been maintained such that renewal work is not necessary to maintain the contractual performance standards but is called for in the renewal work schedule, lenders may take the view that repair and replacement funds must be spent according to schedule nonetheless. This approach is intended ensure that facilities are adequately maintained so as to protect lenders' investments, and that if funds are not spent according to schedule, they are at risk. However, an appropriate mechanism for shifting spending to match actual need in time is not well defined or accepted for water/wastewater P3s, and it is a particular challenge as water/wastewater repair and replacement budgets are higher as a component of lifecycle value and the needs are more variable and unpredictable.
Scope:	**Facility Rehabilitation for Facility Turnover or Decommissioning**
Includes:	Repairs and renovation to bring the facility to the contractual requirements for turnover at the end of the operating period (or, in some cases, decommissioning at the end of the facility's useful life). These requirements are usually stated in terms of specific facility condition metrics or in terms of useful remaining life.
Time Period:	Coverage for these expenses are typically included in the last few years of the repair and replacement budget and payment stream.
Risk and Payment:	The public owner will typically require a reserve as additional security to cover costs of work required to bring the asset up to the specified handback condition at the end of the term. The projects company prices the expected costs to bring the facility up to the contract turnover standards at the end of the term. The Project Company may be repaid for its expected costs to bring the facility up to the contract turnover standards as part of the O&M payment discussed above. Any excess costs to bring the facility up to the contract turnover standards is the at the projects company's risk. The key issues in this transition are: • defining the required condition as a function of overall remaining life versus requirements for specific equipment and facilities; • defining quantitative versus qualitative metrics that will be applied 20 or 30 years in the future; • ensuring adequate funds and contractual leverage in the future to ensure the facility is maintained; and • engaging third parties to validate asset condition and acceptable repair and maintenance performance for the lenders.

Public-Private Partnership

Carlsbad Seawater Desalination Project/ San Diego County Water Authority

Carlsbad, California

Challenge

San Diego-area businesses and residents have long needed a consistent, drought-proof supply of high-quality water. The Carlsbad Seawater Desalination Project—located 35 miles north of San Diego in the City of Carlsbad—was envisioned as a solution. The construction process faced significant constraints: it would need to share the five-acre site with an operational power-generating station, and the schedule allowed less than 36 months for design and construction.

A new water supply source is now available to the communities and industries served by San Diego County Water Authority, increasing local water reliability.

Approach

Poseidon Water, a private project developer, initiated the project by establishing a water-purchase agreement through a public-private partnership with San Diego County Water Authority. Then, using design-build delivery, Poseidon Water hired a joint venture—consisting of Kiewit-Shea Desalination as prime contractor, IDE Technologies as process contractor, and Arcadis as engineer—to design and construct the desalination plant. Through a separate agreement, Poseidon Water also retained IDE Technologies to operate the completed plant.

To meet the tight schedule, the joint-venture team produced several hundred design deliverables in a 13-month period, which significantly advanced the construction ability of field-operations staff. Arcadis's scope of work included the detailed design engineering needed for plant construction, with the exception of detailed process design and engineering, which was provided by IDE Technologies.

Results

The Carlsbad Seawater Desalination Project is the largest desalination plant in the western hemisphere and marks a major milestone for seawater desalination. This impressive collaborative-delivery project, with an estimated cost of $922 million, includes a seawater intake, world-class desalination technology, interconnecting civil works, and conveyance pipeline. Project design began in January 2013, and the facility was online in late 2015, meeting the accelerated 36-month design and construction schedule. The project was financed with approximately 80% tax-exempt bonds and 20% private equity. The Carlsbad Seawater Desalination Project demonstrates true economic stimulus by creating in excess of 200 direct construction and engineering jobs, in addition to large purchases of equipment and materials, both locally and across the United States.

Reverse osmosis treated water is stabilized through chemical post-treatment (shown under construction) to ensure compatibility with other treated water supplies provided by the San Diego County Water Authority.

GLOSSARY
CASE STUDIES
REFERENCES

Wastewater Treatment Plant | Providence, Rhode Island

Glossary

Absorption of risk – Assuming a risk (or risks) and the associated potential financial burden. The term is used in allocating risks among various parties by determining which party is best able to absorb and manage—and therefore is responsible for—a specific risk. (Chapter 3, p. 42)

Availability-based contract – A business arrangement in which an asset is always available to deliver a defined level of service to an owner in return for a steady stream of payments, often used in DBOF and in P3 projects. (Chapter 8, p. 111)

Business case – The documentation developed by an owner when evaluating the financial implications of a public-private partnership (P3) for financing a capital project. The business case considers the discount rate applied to cash flows expected from a project, efficiency factors resulting from delivery of the project by a third party, the potential for capital and operations-and-maintenance cost savings, and any risk premiums to compensate for transferring risk from the project owner to the third party. (Chapter 8, p. 110)

Collaborative delivery methods – Approaches to procuring and delivering a capital project that involve close collaboration among the owner, the designer, and the contractor—from design through completion. These include construction management at-risk (CMAR), design-build (DB)—both fixed-price and progressive, design-build-operate (DBO) and public-private partnerships (P3). Collaborative project-delivery methods differ from the design-bid-build (DBB) method in two important ways: first, construction personnel become involved early in the design process; and second, selection of the collaborative-delivery firm is generally based on best value—rather than on the lowest bid. (Chapter 2, p. 21)

Consequential damages – The indirect results of alleged failures. Collaborative-delivery contracts hold neither the owner nor the design-builder or CMAR firm responsible for the indirect results of its alleged failures. Due to the subjective nature and varying scope of state laws, it may be desirable to include in the contract a waiver of consequential damages, which clearly defines the types of damage that are expressly excluded. (Chapter 3, p. 56)

Construction management at-risk (CMAR) – A collaborative project-delivery method in which the owner retains an engineering firm and a CMAR firm under two separate contracts: one for design and one for construction. CMAR project delivery is most often chosen when the owner wants to capture some of the benefits of design-build delivery, while maintaining direct control of project definition and design. (Chapter 2, p. 23)

Demand-based contract – A business arrangement in which an owner makes payments to a service provider in return for the actual level of service provided. (Chapter 8, p. 111)

Design-build (DB) – A delivery method in which an owner enters into a single contract with a design-builder to design, permit, construct, test and commission a project. Within design-build project delivery there are two basic variations: progressive and fixed-price. (Chapter 2, p. 22)

Design-bid-build (DBB) – A commonly used delivery method in which an owner first procures and contracts with an engineer to prepare detailed design plans and specifications for a project. The owner then conducts a second procurement process and contracts with a separate firm to construct the project, based on the plans and specifications completed by the engineer. (Chapter 2, p. 23)

Designer/Engineer – Traditionally the engineer of record for the design of a project, who signs off on the finished product. (Chapter 2, p. 23)

Design-build-operate (DBO) – A delivery method that combines the components of design-build—design, permitting, procurement, construction, testing and commissioning—with operation and maintenance (O&M) services into a single contract. The owner's final acceptance of the project does not conclude with delivery and related services, but continues through a defined operational term. (Chapter 2, p. 33 and Chapter 7)

Design-build-operate-finance (DBOF) – A further extension of design-build-operate delivery, in which an owner enters into a single contract with a DBOF team for the design, construction, long-term operations and maintenance—and financing—of a project. The financing arrangement may encompass either the entire project—in which case fees paid to the DBOF team cover all costs for constructing the project—or a long-term financing structure with repayment of the financing costs over the contractual period for long-term operations. (Chapter 2, p. 34)

Embedded relationship – A separate (and inserted) contractual relationship with an entity for the purpose of providing specific services to integrate and facilitate work components in a collaborative-delivery project. (Chapter 2, p. 22)

Fixed-price design-build (FPDB) – A project-delivery method in which a single fixed price, which encompasses both designing and constructing the project, is established when the contract is signed. FPDB is used when the owner has defined the project requirements and scope of work sufficiently for proposing firms to accurately predict the project cost early in the procurement process. The owner's requirements, as expressed in procurement documents, may be either prescriptive (well defined) or performance-based, which encourages and allows more innovation on the design-builder's part. The fixed price is an established price for a fixed scope of work, and it may or may not include allowances. (Chapter 2, p. 30)

Gearing –The ratio of the equity contribution to the amount of long-term debt in a P3 project, a key consideration that functions much like the down payment required for a residential mortgage. (Chapter 8, p. 118)

Guaranteed maximum price (GMP) – An approach to pricing services in a collaborative-delivery proposal and contract. The GMP is the sum of all reimbursable costs, plus a fee that usually includes overhead and profit. Costs incurred above the GMP are the responsibility of the design-builder or CMAR firm, unless they result from an owner-approved change in project scope. GMP pricing is commonly used when an owner chooses either progressive design-build or construction management at-risk project delivery. (Chapter 4, p. 68)

Interface agreement – A contract—commonly used in DBO and P3 projects in which the design and construction entity is separate from the operations entity—between a design-builder or CMAR firm and the operations entity. The interface agreement describes the conditions for testing, turnover, and warranty of a facility and typically covers contractual obligations for both parties, including risk transfer from design and construction to long-term operations and maintenance. (Chapter 6, p. 95)

Joint venture – A business arrangement of two or more firms that agree to form a new entity for a specific business purpose. The parties to the joint venture manage the enterprise—sharing all profits, losses, expenses and assets—and have joint-and-several liability to the owner. Joint ventures can be formed for any collaborative project-delivery method; they usually involve an engineering firm and a construction firm. (Chapter 7, p. 100)

Liquidated damages – Compensation paid by a design-builder or CMAR firm to an owner, in lieu of all liability for any extra costs, losses, expenses, claims, penalties and any other damages that result from any delay in completing a project. (Chapter 3, p. 56)

Loss prevention – The act of taking measures to prevent, or reduce the likelihood of, adverse events. Collaborative-delivery contracts spell out, for each foreseeable adverse event, which party can most efficiently be responsible for taking loss-prevention measures. (Chapter 3, p. 42)

Loss control – The act of taking measures to minimize the extent of damage resulting from an adverse event. Collaborative-delivery contracts spell out, for each foreseeable adverse event, which party can most efficiently be responsible for taking loss-control measures. (Chapter 3, p. 42)

Materials cost escalation – Unforeseen increases in the cost of materials, which can be an issue, particularly in contracts that span several years. The materials escalation clause in a collaborative-delivery contract may be premised on agreed-to cost components in the fixed price or GMP. (Chapter 3 p. 45)

Owner's advisor (OA) – An individual or firm retained to provide technical and management resources to an owner and to serve as its representative and advisor during procurement, contracting, and / or management of a project. (Chapter 1, p. 12)

Owner-directed changes – Changes, within the scope of work, that an owner is contractually entitled to request. Owner-directed changes may result in additional compensation owed to the design-builder or CMAR firm. (Chapter 5, p. 85)

Performance-based requirements – Criteria in an RFP for FPDB procurement that focus on measurable plant-performance criteria and operational objectives, rather than on specific details. These criteria include technical requirements, standard construction specifications, and minimum quality standards. Performance-based FPDB procurement allows and encourages more innovation than does prescriptive procurement. (Chapter 2, p. 30)

Plant-performance warranty – An element in the contract between the design-builder and the owner that requires the firm to demonstrate that the project will operate as intended, consistent with the technical and operational criteria and project design. If the project does not meet the defined performance standards, the design-builder may be required to pay liquidated damages and to make any modifications needed for the project to perform as intended.(Chapter 3, p. 51)

Prescriptive requirements – Specific details within an RFP (typically in FPDB procurement) that may include design drawings and/or a description of specific design approaches. Proposing firms may be required to include their own designs—depending on the requirements stated in the RFP—in their proposals. A proposing firm can submit design documentation to validate its conformance with the owner's requirements and design preferences. (Chapter 2, p. 30)

Process-performance criteria – Detailed operational and technical requirements on which the design of process systems and equipment is based. These requirements address all input (influent or raw water) and output material (NPDES permit or finished-water quality standards). (Chapter 4, p. 65)

Progressive design-build (PDB) – A two-phase delivery method in which the project's design, cost-estimating, construction schedule and final GMP or fixed price are developed during the first phase. If the owner and design-builder agree on the schedule and the GMP or fixed price during the first phase, the final design, construction, and commissioning are completed during the second phase. (Chapter 2, p. 28)

Project agreement – A legal arrangement in P3 project delivery that defines all the elements of any collaborative-delivery project. (In financing arrangements other than P3, the project agreement is usually referred to as a contract.) Chapter 8 addresses project agreements for a P3 transaction, which may include design, construction, and operations and maintenance of a project. The project agreement also specifies risk allocation between the owner and the P3 firm, the basis of payment for services, and the term (in years) during which the P3 arrangement will remain in place. (Chapter 8, p. 111)

Project Company – The business entity with which an owner enters into an agreement for the delivery of services for a specific project using a public-private partnership (P3). The Project Company has full responsibility for design, construction and, typically, operations and maintenance. P3s are unique: they often include some form of short- or long-term financing—a combination of equity invested by the project company or its sponsors and debt sourced from third parties. The Project Company is sometimes referred to as the special-purpose entity or special-purpose vehicle. (Chapter 8, p. 109)

Project implementation plan – The document developed by the owner as a roadmap to successfully completing a project. The document defines the owner's capabilities and its goals, priorities and drivers for the project, along with its process for selecting a delivery method, procuring a design-builder or CMAR firm, and managing the project. (Chapter 1, p. 1)

Proponent – A firm or entity that is capable of performing all of the services requested in an RFP for P3 services and that responds to the RFP. The entity may be a single firm, joint venture or consortium encompassing firms that will perform design, construction, operations and maintenance, equity investment and overall management of the completed asset. The proponent is sometimes referred to as the proposer. (Chapter 8, p. 115)

Proprietary processes or equipment – Equipment or a system or process owned by a business entity and sold commercially in the open marketplace through direct licensing to the purchaser. (Chapter 4, p. 45)

Public-private partnership (P3) – A project with a contractual relationship between a public and a private entity that relies on collaborative interaction, generally design-build or DBO. (Chapter 2, p. 35 and Chapter 8)

Quantity and quality of untreated water or wastewater influent – The measurement and characteristics of untreated water or wastewater entering a facility, which affect the facility's ability to perform as required. (Chapter 3, p. 51)

Risk – The possibility of loss or injury. Effective risk management for a capital project requires recognizing and understanding what could potentially go wrong and then determining which individual or entity is responsible for owning, mitigating, or managing the risk. This understanding is often based on a thorough evaluation of the project, in conjunction with each party's experience in similar projects—a combination of precedent and lessons learned. (Chapter 3, p. 41)

Risk-allocation principles – The rules or guidelines underlying the process of determining which party in an agreement will assume each envisioned risk. In collaborative-delivery contracts, risks should be allocated to the party best positioned to manage them; it is critical that all parties understand and agree to the designated allocation of risk. (Chapter 3, p. 41)

Risk/responsibilities matrix – A table, created by either the owner or the collaborative-delivery firm and agreed to by both parties, that identifies potential project risks and allocates responsibility for each between the owner and the firm, with the objective of reducing the project's risk-related costs by addressing them at the outset. (Chapter 3, p. 59)

Risk shifting – In allocating risk—for example, between an owner and a project-delivery firm—holding one party responsible for a specific risk that is not within that party's ability to control. (Chapter 3, p. 42)

Subrogation – A legal right, which an insurance carrier frequently reserves, to pursue a third party that caused an insurance loss to the insured, as a means of recovering the amount of the claim the carrier paid to the insured. Collaborative-delivery contracts generally include waivers of subrogation by both parties, which prohibit each party's insurer from attempting to recover a claim paid to the other party. (Chapter 3, p. 50)

Surety bond – A performance security, issued by a third party called a surety, that protects the owner by guaranteeing that the design-builder will perform its contractual obligations in designing and constructing the project, or that the CMAR firm will perform its obligations in constructing the project. (Chapter 3, p. 54)

Turnover – milestone at which an operating facility is "handed back" to a public owner at the end of a private operations and maintenance contract term. May also apply to the transition from one operator to another. Typically associated with pre-defined facility condition or useful life requirements that must be met. (Chapter 8, p. 117)

Uncontrollable circumstances – Those acts, omissions, conditions, events, or circumstances that are beyond the control of the collaborative-delivery firm—and are not the fault of either the firm or others for whom the firm is responsible. Examples of uncontrollable circumstances include acts or omissions of the owner or anyone under the owner's control, changes in the scope of work, differing site conditions, hazardous conditions, wars, floods, labor disputes, unusual transportation delay, epidemics, earthquakes, adverse weather conditions that cannot reasonably be anticipated, and other circumstances beyond the reasonable control of the design-builder or CMAR firm. An uncontrollable circumstance might lead the firm to seek a change order that would provide schedule and cost relief under the contract. (Chapter 3, p. 45)

Value for money – The result of a calculation to determine whether the potentially higher cost of private financing in a P3 project will be offset by potential benefits that the owner has identified as valuable (such as risk transfer, innovation, or schedule savings). (Chapter 8, p. 113)

Waiver of consequential damages – A standard contract term incorporated in collaborative-delivery contracts in which each party—the owner and the design-builder or CMAR firm—agrees not to hold the other party responsible for incidental, indirect, special, punitive or consequential damages resulting from its failure to meet contractual obligations. Matters that are considered as part of such a waiver include, but are not limited to, harm to reputation, economic losses, loss of use of a facility, loss of market position, loss of customers, or debt-service costs. (Chapter 3, p. 56)

Case Studies

Construction management at-risk (CMAR), progressive design-build, and fixed-price design-build delivery methods for water and wastewater projects are now used throughout the United States. These case studies feature a selection of projects representing the delivery methods discussed in the Handbook. For additional information on these and other design-build projects completed by WDBC members, please visit the WDBC website: WaterDesignBuild.com/water-design-build-projects. Please remember that laws vary from state to state; to determine whether you can use a specific collaborative-delivery method, seek local legal advice.

Construction Management at-Risk

Progressive Design-Build

Fixed-Price Design-Build

Construction Management at-Risk

Sullivan's Island Barrier Project

Town of Sullivan's Island, South Carolina

Challenge

The Town of Sullivan's Island, a barrier island east of Charleston, South Carolina, owns and manages a municipal wastewater treatment plant and collection system that serves a population of 400,000. Because the existing sewer pipelines were made of clay, 68% of the 585,000-gpd flow was attributable to infiltration and inflow (I&I). The wastewater system was subjected to frequent wet weather flows, which exceed three times the average flow, with rising sea levels causing I&I to also increase with each passing year. In addition to the island's sandy soils and high groundwater table, Sullivan's Town officials were growing increasingly concerned about the site conditions of the plant and pipelines. Because sewer line laterals also cross swales, the Sullivan's Island project needed a programmatic approach that would minimize any potential need for regulatory action, reduce operating and long-term sustainability costs, and ultimately minimize impacts to the community.

Through the use of cameras to inspect sewer lines, I&I conditions in the pipes can be fixed without disruptive construction.

Approach

Sullivan's Island, which valued its long-standing and positive relationship with Arcadis as innovative thought leaders, reached out to Arcadis for direction on how best to achieve its goals. To fully understand Sullivan's Island's issues, Arcadis held numerous discussions with town officials, examining all available options in detail. Thorough and probing questions helped Arcadis arrive at an option that was both less costly and also more efficient. By inspecting the sewer lines with cameras and grouting where necessary, Arcadis could address the I&I issues without highly disruptive digging. Deploying multiple teams at various locations—and working with the town's smaller in-house team—enabled Arcadis to accomplish the work quickly. The CMAR framework made it possible to shift the bulk of the project's implementation risk to Arcadis, allowing the Sullivan's Island team to focus on its most pressing concerns: population impact, budget, and, ultimately, mitigation of I&I issues

Results

The project was implemented under an accelerated schedule with guaranteed maximum price to achieve immediate flow reductions and reduce the sewer system's overall operations costs. Beginning as the work was initiated, flow reduction benefits were evaluated, with operations reports showing that immediate impacts of lower than typical flow responses to the rainfall events were occurring.

"This project has been a success in large measure to the high degree of collaboration between the Sullivan's Island engineer-construction manager and the subcontractors during both the final design phase and as field changes have dictated needed changes. The free exchange of ideas, and our ability as the utility to be involved in these problem-solving situations, has provided us with a level of confidence not typically provided by normal design-bid-build projects."

—Greg Gress, Sullivan's Island Water and Sewer Manager

Construction Management at-Risk

Southwest Water Treatment Plant Upgrade

Orlando Utilities Commission

Challenge

The Orlando Utilities Commission (OUC), which owns and operates seven groundwater-treatment facilities, uses ozone to treat the hydrogen sulfide in the water. The largest facility, the Southwest Water Treatment Plant (WTP), was the last to go through the conversion process from the oxygen-fed ozone. While the existing ozone equipment at the Southwest plant was nearing the end of its useful life, the collective ozone operations and maintenance processes presented numerous efficiency challenges.

Approach

The OUC awarded Black & Veatch a construction management at-risk (CMAR) contract for implementing upgraded ozone equipment at its Southwest WTP.

Throughout the seven-month preconstruction phase Black & Veatch was responsible for all constructability reviews at 60%, 90%, and 100% design completion; the permitting process; developing the initial budget, with a guaranteed maximum price (GMP); and project schedule. The company also identified and pre-qualified the subcontractors and equipment vendors in advance so that these costs were used during budget preparation and developing the GMP. For the owner-furnished equipment, Black & Veatch coordinated vendor selection and compliance process, as prescribed within the Florida Sales & Tax Use Savings Program.

The 14-month construction phase included: (1) replacing three ozone-generator systems and (2) installing a new liquid oxygen system, new motor control centers, feed piping and retrofitting.

Pipework throughout the plant consisted of both below-ground and underground piping, including the addition of new valves in the existing system. This work also included an upgrade of the plant's system integration and operational system. Throughout the process, multiple, complex shutdowns were required to coordinate the activities requiring incorporation of new equipment and process piping into the existing operational system.

Results

Successfully completing this $9.1 million project resulted in both enhanced efficiency and performance for OUC and its Southwest WTP. All its facilities are now operating with oxygen-fed ozone systems, and spare parts are simpler to obtain due to manufacturer consistency. Replacing aging equipment enhanced process performance, and made operations and maintenance more efficient and effective.

The 14-month construction phase included replacing three ozone-generator systems and installing a new liquid oxygen system, new motor control centers, feed piping, and retrofitting.

Construction Management at-Risk

Water Treatment Plant

Weslaco, Texas

Challenge

Weslaco, Texas, is a small border town in the Rio Grande Valley in the middle of the country's arid, economically depressed, yet fastest-growing county. However, the Weslaco Water Treatment Plant, which treats water from the Rio Grande River through an irrigation canal operated by Hidalgo and Cameron County WCID No. 9 could not keep up with anticipated demand. The Weslaco WTP, originally constructed in 1945, has been expanded three times to meet increased water demands, with the last expansion occurring in 1983. Additionally, in the late 1980s and early 1990s, a new 162-acre-foot raw water reservoir was built.

Improvements to the Weslaco WTP and surrounding system enable an ultimate capacity of 10 mgd for the area's needs.

Approach

To support the City in securing bond funding for its infrastructure improvements, CDM Smith got involved early and then stayed the course through design and construction of this much-needed project. Improvements to the Weslaco WTP include upgrades and hydraulic modifications to the existing three plants to gain 2.18 mgd of additional capacity, expanding the combined capacity of these plants to 10.3 mgd. Additionally, construction of a new 8-mgd plant on the existing site and surrounding area creates a total WTP capacity of 18.3 mgd.

Using the CMAR delivery method, this complex project upgrades the following existing processes: the raw water pump station, rapid mix basin, sludge collectors, filters, and chemical facilities. As part of the expansion, the following major processes include: a new treatment structure including rapid mix basin, flocculation basins, sedimentation basin, filters, sludge handling facilities, clearwell, and high service pump station. Other WTP improvements include the addition of a new supervisory control and data acquisition (SCADA) system, new sludge handling facilities, and major electrical improvements.

Additional improvements to the City's distribution system include a new 1.0 million-gallon elevated storage tank together with over two miles of 12" and 20" diameter transmission pipelines to accommodate the higher flows.

Results

The numerous challenges on this complex infrastructure project were accomplished through an aggressive collaborative relationship within the CMAR framework that included an exceptional program involving local contractors and regulatory officials.

- To comply with the TCEQ regulatory deadline, the advantage of CMAR enabled the design work to be accomplished in discrete buildable components. This allowed an early start on the design packages to be released at 70%, and enabled the builders to begin the foundation construction, nearly three months ahead of schedule.
- Budget constraints were realized by the collaborative process of designers and builders working together to achieve constructability and value engineering ideas and incentivizing the builder to save money by offering a share in the savings.
- Local contractor involvement was achieved by structuring a CMAR process so that a greater score was given to area businesses based on their skill levels, in addition to instituting a training and mentoring program for local subcontractors. As a result, a significant portion of the construction budget was awarded to M/WBE firms, which supported achieving a successful project schedule and timeliness.

This $38.5 million CMAR project is currently $2M under budget through 99% buyout and three months ahead of schedule through 70% completion.

Southwest Water Reclamation Facility Biosolids Waste-to-Energy Project

City of St. Petersburg, Florida

Challenge

The project serves and is located in the southwestern portion of the City of St. Petersburg, FL. The purpose of the project is to consolidate the City's biosolids operations at one facility and generate enough biogas to fuel its trash truck fleet. However, the plant is in close proximity to a college and residential neighborhoods and has long been plagued by odor control issues and biosolids handling challenges.

Recovered energy in the form of biogas will be used to fuel the City of St. Petersburg's sanitation trucks.

Approach

Due to the highly complex nature of the project, the proximity of the adjacent college and absolute necessity of keeping the current facility operational during the construction period, the City selected CMAR as the preferred delivery approach. Haskell's Water Division was awarded the CMAR contract for the City of St. Petersburg's Biosolids Waste-to-Energy Project, valued at $64,868,267 with a construction schedule of 38 months. Once completed, the facility has the potential to save the City $3.7 million in operational costs each year through the production of Class AA biosolids and biogas, and by consolidating the City's biosolids processing to the Southwest Water Reclamation Facility (SWWRF). The project is dually funded through SRF and City funds. Using value engineering and constructability, the Haskell team was able to work with the City to cut costs to make this project a reality. As the CMAR firm, Haskell is managing four design teams—Brown & Caldwell, AECOM, Black & Veatch and Carollo Engineers.

Results

The project will improve the facility's ability to produce Class AA biosolids using a temperature-phased anaerobic digestion (TPAD) process. Class AA biosolids meet the U.S. EPA guidelines to use as fertilizer, which the City can sell for additional revenue.

The facility will produce enough biogas to fill the City's fleet of sanitation trucks and run the SWWRF during peak periods of electric usage.

Pipes will run sludge from the City's two other biosolids processing plants to the SWWRF, saving the City a considerable amount in operational costs. Upon completion, the City will also be able to accept fats, oils and grease waste from the community, which enhances biogas production.

The new facility will have specialized odor control systems ensuring that it will remain a good neighbor; and will use anaerobic digesters to produce Class AA biosolid and renewable biogas, which will power the City's trash trucks.

Brackish Groundwater Desalination Program

San Antonio, Texas

PARSONS

Challenge

To reduce dependency on the Edwards Aquifer, the main water supply source for nearly 1.6 million in San Antonio, Texas, officials with the San Antonio Water System (SAWS) approved a unique brackish groundwater desalination program as part of its overall 2012 water management plan. Located in the southern Bexar County region, this previously untapped source of brackish groundwater will both diversify and meet regional water needs over the next 50 years. Once treated, the brackish groundwater will augment current surface water sources with production of 30 million gallons per day (mgd).

Approach

As the CMAR firm for the project, Parsons Environment & Infrastructure Group, Inc., and its joint venture (JV) partner constructed the first portion of this critical brackish groundwater desalination (BGD) program. Projected to cost $119 million, the project includes: a 12-mgd reverse-osmosis membrane water treatment plant, 12 raw water production wells, raw and finished water conveyance, residual conveyance, a new deep injection well, a chemical treatment system, supervisory and data acquisition controls, and a new administration building.

Using a unique milestone constructability review and cost-estimate process, Parsons collaborated with designers to adapt alternative construction methods, resulting in substantial cost savings. The permit team—consisting of experts from SAWS, Parsons, and its JV partner—worked quickly to obtain needed environmental and construction permits and avoid delays.

To address complex soil conditions that can lead to borehole instability, a construction method that uses polymer slurry for the drilled pier foundations kept the borehole stable for the entire depth of the excavation. Reinforcing steel is placed into the slurry and concrete pumped to the bottom of the excavation, replacing polymer slurry.

Creating individual work packages for local subcontractor participation during the early critical-path scope also involved coordinating the multiple complexities associated with these elements within an accelerated schedule.

A significant factor in any project is its safety program—which is designed to be proactive and interactive in order to achieve a safety goal of zero incidents. The SAWS project safety program includes: daily "Take 5" meetings, weekly safety meetings, monthly mass safety meetings, and a host of safety-related items resulting in a record of zero lost time to date, not only meeting the target milestones, but also exceeding all quality standards.

"San Antonio Water System (SAWS) is proud to have partnered with Parsons and their JV for this critical CMAR project. Constructing the 12-mgd brackish water desalination plant is momentous for SAWS and the citizens of San Antonio and must be executed flawlessly. Currently we are under Level 2 water restrictions, so tapping into the groundwater resource for much needed drinking water is vital to our region."

—Esther Harrah, Project Manager, San Antonio Water System

Results

SAWS' BGD plant will generate approximately 12 million gallons of water a day. 12 mgd equates to withdrawing 13,440 acre-feet per year of water from the Wilcox Aquifer, thus preserving a valuable resource. In contributing to the local economy, the projects SMBE/SWBE program exceeded SAWS's goal of awarding 17% to these groups by actually achieving 36% participation.

Northeast Ohio Regional Sewer District Westerly WWTP Centrifuge Replacement

Cleveland, Ohio

Challenge

Northeast Ohio Regional Sewer District (NEORSD) needed to replace dewatering centrifuges at their 26-mgd Westerly Wastewater Treatment Plant (WWTP).

Approach

NEORSD's decision to use progressive design-build (PDB) project delivery was based on the need to move more quickly, save money, and promote collaboration—resulting in a better approach than would be possible with traditional design-bid-build (DBB). PDB also gave NEORSD full insight into the costs of the work to be done throughout the project. NEORSD selected a contractor (Kokosing) and design engineer (Arcadis) as the design-build team. At NEORSD's request, proposals were solicited from at least three suppliers to furnish centrifuges and other major equipment. Throughout the procurement process, a critical feature was the conduct of numerous workshops discussing equipment specifications and vendor evaluation criteria.

Installation was accomplished with one dewatering train on line at all times.

As the design phase reached 60%, the Kokosing/Arcadis team provided a guaranteed maximum price (GMP) to NEORSD and prepared all documents with enough detail to enable equipment suppliers to provide cost quotes and subcontractors to price their specific scope of work. The collaboration process among the engineering, construction and NEORSD operation and maintenance (O&M) staff during development of the documents engaged all stakeholders, resulting in a design that improved O&M efficiency, utility cost savings, and safety. In addition, it was also imperative to maintain a risk profile throughout the project in order to identify, target, and mitigate risks. NEORSD appreciated the advantages of the PDB approach which gave them direct input into the scope development and led to the desired cost-effective construction without any contentious changes.

Results

The centrifuges were installed and the refined process train came online more cost effectively and efficiently than would have been possible with the DBB approach. Because of the broad-based collaboration, the NEORSD team realized the significant benefits of a project when all parties are working toward the same outcome.

Progressive Design-Build

North Davis Sewer District Biosolids Expansion and Improvement Project

Syracuse, Utah

Challenge

The North Davis Sewer District (NDSD) has a customer base of approximately 215,000 in seven communities including industry and the Hill Air Force Base. With Utah's population expected to nearly double by 2050, several of the biosolids-treatment facilities within the region were at or over capacity. In addition, outdated technology affected the efficiency of all NDSD's plant operations. The NDSD wanted to increase capacity to reliably and safely treat future solids, provide a robust biosolids process using a proven technology, reduce odors, improve air quality, increase overall efficiency, and meet current and future regulatory requirements.

The NDSD chose progressive design-build to secure proven team members and select the equipment it wanted. They also aimed to support the local economy and have an early understanding of cost to secure adequate financing.

Approach

Reaching a decision in 2010 to expand and improve the North Davis biosolids plant (NDBP), NDSD contracted with Brown and Caldwell (BC) to complete a biosolids master plan. The plan included recommending how to increase capacity at the plant, handle projected solids production, and increase energy efficiency. Due to BC's familiarity with the plant and proven performance, NDSD rehired them in 2012 to bring its recommendations to life through a $58 million capital improvement project. To maintain cash flow and maximize local contractor involvement, construction was accomplished through three projects.

1. Constructing a new mixing and heating system to increase secondary digesters' capacity. This process increases the digestion process capacity and brings the plant into compliance with state and federal regulations for Class A biosolids. Upgrades included installing four internal draft tube mixers in the digesters with jackets that heat the sludge as it circulates. The process enables the digesters to sustain necessary temperature conditions with minimal energy demand. BC also rehabilitated the existing 60-year-old concrete digester tanks and floating covers to prolong their lifespan and beneficial use.
2. Constructing a new 15,000 sq. ft. primary solids thickening building to increase capacity to obviate the need for two previously planned new primary digesters. When completed, the main level of the new building will house rotary-drum thickeners, which remove water from primary sludge prior to digestion, as well as a polymer system, scum concentrator, sludge-screenings room, control room, and electrical room. Thickening sludge earlier in the process both reduces heating requirements and also beneficially increases digester solids retention time. NDSD is now better prepared to process the projected 40% increase in volume anticipated over the next 25 years.
3. Develop a new 11,500 sq. ft cogeneration facility to harness and generate energy that includes two 1,100-kW high-efficiency advanced reciprocating engine system (ARES) lean-burn engine-generators—with space for a third. The building also includes space for one boiler for a backup heating supply, a biogas-treatment system, heat-recovery systems, an electrical room, a combination operator's office/control room, and a workshop.

Results

Overall, BC's cogeneration facility improvements increased the plant's electrical efficiency by 40%, both in terms of energy generation and day-to-day operations and maintenance. These facility improvements, which maximized the use and re-use of existing facilities, enabled the project to be accomplished without exceeding its $58 million budget.

By avoiding the need for two new digesters—and instead realizing increased capacity by heating and mixing in the existing digesters—the project saved the City $22 million. The structural analysis and condition assessment of the existing digesters enabled the reuse of the existing secondary digester tanks and covers, saving an additional $8 million. Although the facility is capable of producing 90% of the plant's power and heating needs, BC's new design also allows for future expansion and energy savings in using the fats, oil, and grease (FOG) waste generated from area businesses.

Progressive Design-Build

Wet Weather Storage Basin Project

City of Richmond, California

Engineers...*Working Wonders With Water*®

Challenge

The City of Richmond, California, located in the eastern region of the San Francisco Bay Area, encompasses an area of more than 52 square miles. Founded in 1905, the City now serves over 100,000 customers—all of whom depend on the reliability of the City's 80-year-old sewer system. While these structures capture both excess storm water and sewer flows and divert a highly diluted combined wastewater product directly into the San Francisco Bay, they also protect City residents from potential public health threats due to sewerage overflows onto its streets and public areas.

In 2006, the City entered into a Settlement Agreement with the San Francisco Baykeepers organization to find another solution to handling "normal" wet weather overflows, and reserving the use of the overflow structures to rare and extreme storm events.

During storm events, excess flows are diverted from trunk lines of a collection system, into the pump station, where it is then pumped into a storage facility.

The Approach

To address the aggressive timeline for a new solution required by the Settlement Agreement, the City elected to use a progressive design-build approach to complete the project. In February of 2014, Carollo Engineers was selected as the City's design-build firm. With a progressive design-build delivery method, the owner worked with a design-builder to define the project goals, specifications, and price early on, so that the owner had guarantees in place about what it would get, when it would get it, and how much it would cost. Progressive design-build met all the City's requirements for a cost-conscious, reliable project that would comply with the Settlement Agreement timeline.

The City's $20 million Wet Weather Storage Basin Project (WWSBP) added two major components to its existing wastewater collection system, just upstream of the wastewater treatment plant: a 52 foot deep, 27-mgd pump station, and a 5-mg storage tank. Subsequently, during wet weather events, excess flow is diverted from the 66-inch trunk line of the collection system into the pump station. The wastewater is then pumped to the storage tank through a 36-inch force main. After the storm event has subsided, the wastewater flows back via gravity through the same pipe and is re-introduced into the collection system for treatment.

Results

Because of the strong collaboration between the City, Carollo, and their subcontractors during the progressive design-build process, the project was completed one month ahead of schedule and under budget. The WWSBP now reliably protects the City, its residents, and the San Francisco Bay from public health threats during storm events.

The City devoted several years of research to identifying a reliable, cost-effective solution to its wet weather challenges before it reached a decision on the City's WWSBP. The major difference between this project and the original overflow structures is where the flows end up. With the older overflow structures, the wastewater flows ran directly into the San Francisco Bay; but with the WWSBP, the flows are stored and then drained back into the sewer system for treatment once the storm is over—thus protecting not only water quality, but also public health.

Progressive Design-Build

Delta Water Supply Project

City of Stockton, California

Challenge

Located 90 miles east of San Francisco, the City of Stockton, California, is home to approximately 300,000 people. Until 1977, groundwater was Stockton's sole source of domestic water. At that time, a surface-water supply was established for the Stockton metropolitan area with nearby reservoirs supplying about 60% of the area's water and underground wells supplying the remaining 40%. Needing to protect existing groundwater sources, increase water reliability, and provide for future planned growth, the City embarked on the Delta Water Supply Project to provide a new, supplemental high-quality surface water supply for Stockton residents and businesses.

Photovoltaic solar panels located on the parking area carport roofs, provide more than half of the power for the plant, the operations and administration buildings —a feature that earned the project a LEED© Gold Certification.

Approach

CDM Smith partnered with the City to integrate surface and groundwater management efforts and ensure an adequate, reliable water supply that supports current and future planned water needs. Using a progressive design-build procurement, the $176 million contract included a 12-mile raw water pipeline, a 6-mile pipeline of treated water and a new ozone and pressure-membrane-filtration treatment facility. This new 30-mgd treatment plant is also expandable to 60 mgd, and its site layout can accommodate an ultimate capacity of 160 mgd in the future.

Phase 1 of the project included 65% design and a cost proposal for project completion. After phase 1, the City chose to move forward with CDM Smith for phase 2—design completion and construction. The project incorporated sustainable building practices, particularly in the water treatment plant's administration and operations building. Photovoltaic solar panels on the parking area carport roofs provide more than half the building's power—a feature that helped earn the project LEED® Gold certification. Additional green features include reclaimed water and micro-irrigation systems for a 50% reduction in water consumption, ozone-safe heating and air conditioning systems, and recycled construction materials.

Results

Completing the facility in June 2012, CDM Smith continued to support the City for a one-year commissioning period in order to ensure water quality and performance requirements.

The significant effort to hire local subcontractors also brought in economic benefits to the community. As an example, at peak construction, 140 onsite jobs were created. In addition, 45% of the project cost consisted of local materials, suppliers and vendors—a number that jumps to 65% when items unavailable locally are not considered.

Progressive Design-Build

Sandy Run Water Pollution Control Plant

City of Warner Robins, Georgia

HASKELL

Challenge

Serving over 75,000 customers, the City of Warner Robins, GA's Sandy Run Creek WPC Plant had not been significantly renovated or had upgraded capacity since 1986. In addition to issuing minor NPDES permit modifications in May 2008, the Georgia Environmental Protection Division stated that future renovations would be needed to avoid violations. At the same time, the City also realized that in order to meet future growth needs, additional capacity would be required.

The new headworks system receiving wastewater influent for preliminary treatment

Approach

In pursuing the progressive design-build delivery method, the City of Warner Robins issued a request for qualifications, and selected Haskell for the phase one preconstruction services. Haskell partnered with the owner's engineer Constantine Engineering to design and build the required plant upgrades. As the design work was completed, Haskell used an open-book process to develop a guaranteed maximum price (GMP) and was selected for the phase two construction.

Begun in August 2012 and completed in December 2015, the project increased the monthly average flow from 9 million gallons per day (9 mgd) to a monthly average of 12 mgd and a peak flow of 30 mgd. The plant's new headworks system now receives the influent wastewater for preliminary treatment. Two new 140-foot diameter clarifiers—together with a combination mixed-liquor/suspended-solids flow splitter and return and waste activated-sludge pump station (RAS / WAS)—were constructed to manage the solids. The project also included a new administration building of roughly 2,000 square feet, which provided numerous technical improvements to the existing control building.

Results

To address the challenges affecting the Sandy Run Plant, Haskell's work included the following components.

- Constructing a new effluent-filter structure with integral new chlorine-contact basin, chlorination system and building.
- Modifying the existing chlorine-contact basins into post-aeration basin and filter backwash supply water wet well.
- Modifying the existing sludge holding tank into filter mud well.
- Constructing a new rotary drum thickener for waste activated sludge (WAS), thickening and modifying the existing digesters and digested sludge pumps.
- Constructing a new 2,000 SF administration building and making modifications and improvements to existing operations/lab building.
- Constructing a new electrical and I&C system for 90% of WPCP including existing solids handling and digestion systems.

Haskell delivered the 12-mgd capacity plant at a final cost of $28.5 million, which was below the City's budgeted $30 million. The facility now realizes a lower daily energy use and is able to treat more water with less energy. Overall, the facility's renovations enable the City to more cost effectively provide clean water not only to their current customers, but also for future growth.

Progressive Design-Build

Water Treatment Plant

City of Venice, Florida

Challenge

The City of Venice, Florida, needed to retrofit its existing reverse osmosis (RO) 4.5-mgd water treatment plant with new RO membrane skids that could meet the existing total demand situations (TDS) and flow conditions. The plant further needed flexibility in its operations to decrease the withdrawal of water from wells by using second-stage treatment to increase recovery and expand capacity without increasing withdrawals. The City's overall goal was to optimize the existing treatment system for the future, as well as get the best performance from existing membranes by installing new pumps and cartridge filters and upgrading the membrane cleaning system—and ultimately providing a new state-of-the-art fully automated SCADA system.

Installing new instrumentation and control systems.

The City faced several challenges. In order to maintain service, pressure and reliability within the system at all times, three out of the four skids had to be fully functional at all times during the construction. And the majority of construction work had to be done outside of the winter high season, when population grew from 25,000 to approximately 40,000, which increased the demand for potable water.

Newly renovated and upgraded reverse osmosis system skids

Approach

Due to the complexity of the project, including the need to reduce risk from unknown conditions at the site, manage the construction schedule around seasonal flows and control costs, the City of Venice used a progressive design-build procurement to select Haskell as the design-build firm. The Haskell design-build team and the City collaboratively developed a cost-effective construction sequencing plan that included maintaining service requirements, while completing: demolition, installation, start-up and testing, disinfecting and commissioning, as well as an extensive temporary piping plan for the start-up and testing of each RO skid. During transition from the old to the new system, the City needed to operate both the old and the new SCADA systems to maintain reliability during the training process.

Results

Completed in 2015, the project enables the City to achieve the high levels of performance from all the new equipment and the SCADA system and to optimize the system for the future. Through the use of an efficient design for the equipment, the overall motor horsepower of the system was reduced by 450 hp. resulting in significant power savings. The new equipment system consists of four new membrane skids, each with a capacity of 1.1 mgd at 50% recovery. In addition to replacing the membrane skids, the Haskell team evaluated and ultimately replaced the raw-water feed equipment, which included cartridge filters, feed pumps, field instruments, piping and valves. A new cleaning system was provided with the new RO system. Upgrades to the SCADA system included replacing all programmable logic controllers (PLC), remote terminal units (RTU), new operator workstations, SCADA servers, additional field instruments, plant fiber loop, and new radios for remote site communication.

Montevina Water Treatment Plant Improvements Project

San Jose Water Company, Los Gatos, California

Challenge

Founded in 1866, San Jose Water Company (SJWC) is an investor-owned public utility, and one of the largest and more technically sophisticated urban water system in the US. Serving over 1 million customers in its 140 square-mile service territory, SJWC also provides services to other utilities, including operations and maintenance, billing, and backflow testing. This service-sharing approach benefits local communities, lowers the cost of water operations, and improves opportunities.

The Montevina Water Treatment Plant (WTP), SJWC's largest surface water treatment facility, located in the foothills south of Los Gatos, CA has a treatment capacity of 30 MGD. The 40-year old Montevina WTP uses a mono media direct filtration process, with its source water coming from various intakes located in the Santa Cruz Mountains. During winter storm events, when abundant water is available, the existing plant cannot reliably treat the source water with high turbidity levels and comply with current state and federal standards for surface water filtration. In addition, the existing plant is unable to effectively manage the disinfection byproducts, making compliance with the Stage 2 Disinfectants/Disinfection Byproducts regulation even more challenging. Other water treatment plant processes and support facilities had reached the end of their useful life and needed retirement or replacement.

Approach

Results of a 2010 feasibility study examining plant improvement alternatives to address the high raw water turbidity challenge, as well as the disinfection byproduct compliance and aging infrastructure needs, recommended membrane treatment to replace the existing mono media direct filtration process as well as improved pretreatment and solids handling facilities. Because of the high level of collaboration and flexibility to modify the scope of the project to fit within SJWC's fixed budget progressive design-build was an attractive delivery method for SJWC. SJWC conducted a two-step procurement process and selected HDR from a list of three finalists.

Final plant improvements included an improved flash mix and flocculation process, followed by settling basins and a membrane filtration system; solids handling facilities containing clarifier thickeners and screw presses for managing residuals are yet to be constructed. The project also includes construction of a new administration building, water quality laboratory, standby power generation and site access improvements from the adjacent state highway and county road. Completing these projects allow SJWC to treat water with raw water turbidity levels as high as 100 to 500 NTU during and following storm events.

Results

The $50 million project was started in 2014 and will be completed in 2017. The progressive design-build approach met SJWC's expectations in terms of innovation, collaboration and flexibility to adjust the scope of the project to meet a fixed budget. The collaborative 12-month design phase yielded the ability to optimize the project by incorporating innovative ideas such as converting the existing filters to plate settling basins, using an existing clearwell for temporary off-spec basin storage during construction, and incorporating a new administration building into the project. Montevina WTP plant improvements will allow SJWC to continue to deliver high quality drinking water to its customers, increase the reliability of plant facilities, and reduce SJWC's need for more expensive imported water from other utilities.

"The progressive design-build approach used for the Montevina Water Treatment Improvement Project required significant dedication from a small team of internal resources as well as the HDR project team. We are confident, though, that this investment will ultimately result in a project that employs the best technology and process for our project conditions and goals, within the timeframe prescribed in the RFP and within the approved budget. I don't believe that we would have been able to have that same level of confidence with either a traditional design-bid-build delivery approach or even a conventional design-build approach."

—Craig Giordano, SJWC Vice President of Engineering

Water Treatment–Perchlorate Facility Anion Exchange Process

City of Pomona, California

Challenge

As the seventh largest city in Los Angeles County, Pomona has a population of over 151,000 residents, a progressive economy with ample business opportunities, and a strong workforce supported by attractive shopping, recreational, and real estate offerings. Supplying water to its customers, 70% of the City's potable water is produced by City-owned groundwater wells, with 25% imported through neighboring water agencies including Metropolitan Water District of S.CA, and the Three Valleys Municipal Water District; and the remaining 5% being local surface water originating from the adjacent San Gabriel Mountains.

However, City's groundwater production wells are impacted by contaminants, including nitrate, perchlorate, volatile organic chemicals, arsenic, MTBE, and chromium. Prior to the AEP Project, the City had to shut down nine of its groundwater wells after high levels of perchlorate were discovered in the aquifer. In order to meet its customers water needs, the City had to increase its purchase of imported water from other water utilities. At the same time, City was challenged with having to quickly adapt its existing groundwater treatment facilities to treat the increased levels of perchlorate.

"Our engineering staff was able to leverage the success of the Treatment-Perchlorate Facility (AEP) Project to justify amending the City Code to expand the use of design-build delivery to other City projects."

—Tim Hampton, City of Pomona

Approach

Recommendations from the City's study assessing alternatives for increasing output from the existing 23 mgd AEP plant by improving treatment for perchlorate removal, found that the best economic value to the City was to add new treatment trains for AEP flows utilizing a specialized perchlorate removal resin. Because the identified efficiencies in the delivery process, single point of responsibility, ability to incorporate innovative ideas, and lowering the City's management costs, the City decided to use the fixed-price design-build delivery method.

Following a two-step procurement process, HDR was selected after a proposal review and interview process for the project. The 23-mgd plant improvements included a new anionic exchange treatment process to provide optimal treatment for perchlorate removal, as well as improvements to prescreening and pumping and conveyance.

Results

Final plant improvement designs included a new single pass perchlorate resin treatment process accomplished directly from groundwater production wells or in series with the existing nitrate resin treatment process. Several innovative ideas proposed by HDR during the collaborative delivery procurement process incorporated into the project were over $200,000 in cost savings for the relocation of the booster pump station, optimization of the AEP layout, deletion of an unnecessary valve vault, and optimized pipeline alignments and pipe sizing. The project now allows the City to use its groundwater resources to deliver 23 mgd of reliable high quality potable water to its customers while reducing the City's need to purchase more expensive imported water from other water utilities. Beginning in August of 2011 the project was designed and built in thirteen months at a cost of $7.3 million.

The project was presented at the national DBIA water/wastewater conference in 2013 and the project won the "Best Project of the Year" award from the APWA Southern California Chapter in 2012.

Fixed-Price Design-Build

Water Treatment Plants

Newport, Rhode Island

AECOM

Challenge

Under a consent order to address challenges stemming from its nine surface water reservoirs, Newport, Rhode Island, needed to upgrade the existing Station No 1 water treatment plant, improve its process train, and demolish the 1940s-era water-treatment plant at the Lawton Valley site and replace it with a new plant. The new treatment plants would need to reduce the amount of total organic carbon (TOC), which—if not removed from the source water—would combine with the chlorine used for disinfection to produce toxins of total trihalomethanes (TTHMs) and haloacetic acids (HAAs). In addition, during construction of the new facilities, the City could not afford to lose the storage capacity provided by the existing 4-mg reservoir buried on the Lawton Valley site. Upgrades to the existing plants—from pulsator clarifiers to high-rate drinking water activated filters (DAF)—had to be made while continuing to deliver drinking water to customers.

The drinking water treatment process using high-rate DAF and GAC to effectively treat difficult surfaces waters.

Approach

AECOM, in a joint venture with C.H. Nickerson, was awarded a fixed-price design-build contract for the two plants. Working collaboratively with the City and regulatory agencies, the joint venture developed a complete set of design, testing and startup plans, together with a water-quality testing protocol to facilitate a smooth transition from the aging facilities to commissioning the new water treatment plants. AECOM's resourceful solution to the logistical challenges at the Lawton Valley site included adding a new 1-mg bolted steel storage tank that provided water to the existing plant operations and distribution to customers during the construction. The older buried reservoir could be demolished early in construction and the new plant built at a lower cost, due to eliminating costly sludge-pumping, storage and backwash tanks, and pumping at the plant. Design and permitting for both facilities was completed in six months, allowing construction to begin on schedule.

The Lawton Valley water treatment plant site, showing the buried 4-mg reservoir that was demolished to allow the new treatment plant to be built in its place.

Result

The new Lawton Valley WTP is a 7-mgd plant with a new O&M building, high-rate DAF and GAC filtration facilities, chemical-feed equipment, laboratory, clearwell for finished water storage, post-filter absorbers using nine new GAC contractors, and a new 2-mg elevated water storage tank for distribution system storage.

AECOM's unique design features multiple chemical dosing points and with ultimate flexibility to treat changing water conditions on site, resulting in a water-recycling system that makes the overall plant treatment process 99.5%water-efficient. High-efficiency motors, VFDs and a design approach focusing on LEED-certified standards make this plant one of the northeast's most energy-efficient and cost-effective facilities, as well as its first water-treatment facility to specifically target difficult-to-treat surface waters and significantly reduce TTHMs, using high-rate DAF and advanced water treatment using GAC contractors. Operators now draw from marginal raw-water sources they haven't been able to use for over 30 years, while exceeding all finished-water quality parameters.

The upgraded Station No. 1 plant was five months ahead of schedule, and the new Lawton Valley plant was more than three months of schedule—and both were delivered for less than the City's capital budget. The two water treatment plants will provide safe, reliable drinking water to Newport for years to come.

Fixed-Price Design-Build

Industrial Wastewater System

BioKyowa, Inc., Cape Girardeau, Missouri

The Challenge

BioKyowa, Inc., in Cape Girardeau, Missouri, is a clean industrial facility producing a line of biomedical products. However, the process for these products generates a highly variable amount of high-strength chemicals in the wastewater. Although BioKyowa's onsite 1.6-mgd wastewater treatment plant (WWTP) does not treat human waste, it does receive a form of *E. coli* bacteria as a byproduct of the manufacturing process. As a corrective measure, the Missouri Department of Natural Resources (MDNR) placed limits for *E. coli* on water released from BioKyowa's wastewater treatment plant into the Mississippi River, and gave the company only 13 months to comply with the regulation.

The level of membrane bioreactor water treatment technology used at the BioKyowa facility goes beyond the norm for an industrial discharger.

Approach

The $8.1 million fixed-price design-build contract was sole-sourced to Black & Veatch, which has a long history of assisting BioKyowa with wastewater treatment at its Cape Girardeau facility. While working on solutions to BioKyowa's regulatory challenge, Black & Veatch identified the potential to fast-track an alternative, state-of-the-art process using membrane bioreactors (MBRs) to remove bacteria, significantly improving the quality of wastewater effluent and meeting the tight compliance schedule.

Using the fixed-price design-build delivery method made it possible for Black & Veatch to begin working on the plant upgrade before the design had been completed, with the following approach.

- Black & Veatch worked closely with MDNR to gain rapid acceptance of both the fast-track delivery method and the innovative equipment that would be used.
- Black & Veatch and its self-perform construction subsidiary Overland Contracting, Inc. (OCI) designed and built the upgrades and expansion to the wastewater treatment facility in only 13 months to meet regulatory timelines.

The project also included design and construction of new aeration basins, membrane tanks, a membrane-equipment building, electrical upgrades and ancillary equipment, such as blowers, sludge pumps and additions to the existing SCADA.

The design-build also had to address technical construction challenges on the plant site posed by unsuitable soils and the potential for seismic activity (the plant is less than 50 miles from the New Madrid Fault). Working collaboratively with the geotechnical advisor, Geotechnology, Black & Veatch incorporated an innovative foundation system consisting of placing compacted stone columns at the plant. This saved BioKyowa more than $500,000 in construction costs and shortened the schedule by six-to-nine months.

Results

The new facility was delivered within BioKyowa's $8.1 million budget—not only on time, but only 13 months from preliminary design to substantial completion. In operation since August 2014, the upgraded plant has an unblemished record of regulatory performance for bacteria reduction. The level of MBR water-treatment technology goes beyond the norm for an industrial discharger, demonstrating BioKyowa's commitment to exceeding regulatory requirements. As the demand for BioKyowa's products continues to grow, the newly upgraded WWTP enables the plant to expand production, create new jobs and contribute to Cape Girardeau's economy—while decreasing its environmental impact on the Mississippi River. The plant's design, which uses modular components, will facilitate future expansion.

New Class A Biosolids and Energy Facilities at DC Water's Blue Plains Advanced Wastewater Treatment Plant

Washington, DC

Brown AND Caldwell

Challenge

Every wastewater utility throughout North America must establish a plan to dispose of its residuals identified as "biosolids." But Washington, DC's utility, located in the heart of the nation's capital and known as DC Water, made a significant commitment in 2008 to manage the biosolids generated at its Blue Plains Advanced Wastewater Treatment Facility (BPAWWTP) differently. Now after nearly a decade of planning and implementation, the result is a unique and notable biosolids management program (BMP) that is being considered the "World's Greenest Wastewater Project" because of its tremendous benefits. This exciting project is currently generating 13 megawatts of power—which equates to about a third of the plant's electrical needs, and also produces Class A biosolids to be turned into compost—a safe product for use in garden and landscaping projects.

DC Water used 4 contracts and 3 different delivery methods, including design-build and design-build-operate, to achieve best value selection of contractor, schedule benefits, process performance guarantees and early price certainty.

DC Water's advanced wastewater treatment plant, which is also the largest in the world, processes 370 mgd of wastewater from a population equivalent to 4 million residents, government and business facilities, and industry—not only from the District of Columbia, but also from parts of suburban Maryland and Northern Virginia.

Approach

The project began in 2009 when DC Water selected Brown and Caldwell as the biosolids program manager for its $470M program at Blue Plains. With initial drivers for the project identified as schedule savings and the potential for federal stimulus funds for a "shovel ready" project, DC Water made the decision to use fixed-price design-build delivery for the process-oriented project. After comprehensive analysis considering project details, numerous workshops involving an array of stakeholders, and two market sounding surveys, DC Water elected to use design-build delivery for the main process train (MPT) project and design-build-operate for the combined heat and power (CHP) project and design-bid-build for the delivery of the solids thickening upgrades, final dewatering and odor control projects.

Results

To facilitate the seamless implementation of the two collaborative-delivery projects, DC Water tasked Brown and Caldwell with preparing highly prescriptive preliminary design and contract bridging documents to ensure that the utility's primary project goals and objectives would be reflected in the constructed facilities. By using multiple procurement methods, DC Water was able to address market, risk and technical conditions unique to each project, while ensuring competition and compliance with owner requirements. DC Water estimates that without collaborative-delivery methods, the program would have taken at least an additional 12 months to implement. The following benefits to the DC Water project were realized through using collaborative-delivery methods.

- Achieving a best-value selection of contractor.
- Supporting contractor collaboration with entire design-build team.
- Obtaining price certainty at an early phase for budget management.
- Obtaining single-point accountability for process performance guarantees.
- Integrating main process train components seamlessly into plant operations.

Fixed-Price Design-Build

Clifton Water District MF/UF Water Treatment Plant

Clifton Water District, Colorado

Engineers...Working Wonders With Water®

Challenge

The Clifton Water District was formed in the early 1950s to serve the growing community in and around the Grand Valley of Western Colorado. Constructed in 1978, the District's original water treatment plant used conventional treatment technology to provide service to more than 13,000 residential and commercial customers over an area of approximately 11,000 acres.

Since 1978, the District has upgraded this plant to include nanofiltration and reverse osmosis (NF/RO) treatment trains, enhancing both treatment capacity and water quality for its customers.

However, as part of a recent master planning effort, the District recognized the need to further improve the NF/RO process, and selected the Carollo Design-Build Group to add a new ultrafiltration (UF) facility to the already congested site, while keeping the plant fully-operational and compliant with existing water quality permit requirements.

Carollo's open-platform design for the UF facility accommodates multiple membrane types, giving the District greater flexibility for membrane selection and replacement.

Approach

Carollo first identified a decommissioned pretreatment facility as the ideal location for the UF treatment process. Not only was the pretreatment facility hydraulically viable, but it would allow construction of the NF/RO train without disrupting current operations. Carollo's designers then optimized the connection between the existing and new treatment trains to simplify operations and maintenance, while meeting the District's high -standards for plant reliability and performance.

Through an "open platform" approach to the UF treatment train, the membrane area and connections were sized to accommodate a variety of membrane vendor products. This action gave the District more flexibility and options for membrane purchase and replacement. The approach also saved costs because the District is not tied to a single vendor or membrane, but is free to choose a supplier that best meets its capacity and cost demands.

Results

Because of the strong collaborative partnership between the Carollo Design-Build Group, its membrane suppliers and the District, the schedule accelerated from a 40 percent design to an operational plant in just 14 months. The new treatment process actually became fully-operational two days ahead of schedule! In addition, because of the cost-savings from the open-platform approach, the District was able to re-allocate funds to install new emergency generators—a project scheduled to occur at a much later period. Since the plant began operation with the new membrane system, the District's operators reported that the design significantly reduces membrane fouling—greater than 2.5 times less than the performance guarantees.

"The unique complexity of integrating new technology into an aging plant, the need to avoid plant disruptions, and the tight schedule made design-build the ideal project delivery method. Through our collaborative approach with Carollo and the contractor, we completed our project 10 percent under the budget we would have needed had we gone with a more traditional design-bid-build approach."

—Dale Tooker, Manager, Clifton Water District

Fixed-Price Design-Build

Wastewater Treatment Plant

Stonington, Connecticut

Challenge

Known for its charming picturesque harbor, the waterfront Town of Stonington, Connecticut, with a residential population of 18,000 residents is a popular tourist destination in the summer. Over the years, however, the Town's 1970s-era wastewater infrastructure had begun to show its age, resulting in numerous incidents. Odor-control issues and adverse press reporting, state regulations on nitrogen levels in effluent, and the rate of community and commercial growth all placed strain on the Town's wastewater system. The Town's Mystic, Borough and Pawcatuck water-pollution-control facilities were located near residential, commercial and cultural sites, and no additional real estate was available to expand the facilities or build a new one.

The BioMag technology at the Mystic facility was one of the first implemented in the US.

Approach

Using a fixed-price design-build delivery approach, CDM Smith made significant upgrades to all three facilities. The resulting collaboration among engineers, contractors, operators and the owner improved the design by encouraging constructability feedback that improved the project's speed and safety. Input from Town staff and contract operators from United Water made the finished facilities safer and more reliable. Value engineering and testing further maximized the facility's efficiency and effectiveness. Involving the construction team early on increased the effectiveness and efficiency of the detailed planning, equipment ordering, subcontractor selection and scheduling processes.

CDM Smith installed BioMag technology at the Mystic facility to achieve better effluent quality without additional tankage. BioMag uses specialized equipment, a process called ballasted flocculation, and the mineral magnetite to create performance improvements within a small footprint. This project was one of the first implementations of this technology in the United States. The Mystic facility also received I&C and SCADA system upgrades, new sludge-processing equipment, and building and grounds renovations. Disinfection technology at all three facilities was upgraded from chlorination to ultra-violet, and high-efficiency blowers were installed.

Results

Because the operations and design teams were committed to maintaining plant operations throughout the project, residents experienced no interruption to wastewater services during the upgrades—even during the busy summer tourist season. The project was completed on time and, at $16 million, $1 million under budget, with Stonington and CDM Smith sharing the savings. The upgraded system now runs cleaner and more reliably, with room for future growth.

Fixed-Price Design-Build

Wastewater Treatment Plant Improvements

Wilsonville, Oregon

Challenge

Faced with growth concerns affecting the permitting and performance of the community's only wastewater treatment plant, the City of Wilsonville embarked on an extended process to determine the most efficient and cost effective method of financing and constructing the needed improvements. Originally constructed in the early 1970s, the 2.25-mgd City of Wilsonville Wastewater Treatment Plant (WWTP), serving a population of 21,000 was in need of upgrades to consistently meet regulatory load requirements, while producing effluent and biosolids in compliance with current and future discharge requirements. The planned expansion would upgrade the plant to 4 mgd.

The Wilsonville WWTP was awarded the 2014 Design-Build Institute of America Merit Award in the Water/Wastewater Category and the 2014 Oregon Public Works Project of the Year in the Water/ Wastewater Category.

Approach

The City of Wilsonville, OR, selected CH2M to serve as its DBO delivery firm, using a best-value competitive procurement method, which evaluated each proposing firms' technical approach (55% of scoring) and lifecycle cost (45% of scoring). The projected scope of work for the plant included obtaining essential permits, producing designs for the needed capital improvements, constructing, commissioning, and long-term operations of the plant, together with ongoing maintenance, repair and replacement of the existing and upgraded WWTP at a cost of $44 million.

The overriding factor for successful delivery for the Wilsonville WWTP was the establishment of a true partnership—between the City, CH2M and its project stakeholders—that focused on the following components.

- **A transparent approach to problem solving.** Successfully delivering a project of this complexity meant that all parties worked together in a spirit of true collaboration. The solution involved trucking biosolids off site for processing at another facility, which freed up valuable site space and reduced the overall construction schedule.
- **A willingness to share risk.** Because of the DBO partnership established between the City and CH2M, there were numerous opportunities to equitably assign risks to the party most capable of managing them. CH2M and the City took a proactive approach to defining risk as part of the contract negotiations and worked together to determine optimal risk allocation for facility performance in relation to permit responsibility.
- **Maintaining facility operations.** A key component of the project risk was the requirement to maintain operations and treatment capabilities within permit regulations during construction. This required all project stakeholders—including the City, CH2M, the Oregon DEQ, and Clackamas County—to work together. In the rare instance when out-of-compliance effluent was produced, all parties worked together for a quick resolution.

Result

The City's DBO contract specified a duration-of-performance period spanning from August 2011 to January 2014. Construction began in March 2012 and was completed five months ahead of schedule in September 2013.

Given the Wilsonville WWTP's location adjacent to a residential community, a public park, and the Willamette River, environmental considerations were a key concern during construction. CH2M, the City, and the Oregon Department of Environmental Quality worked together to modify the Wilsonville WWTP's discharge permit, which achieves compliance with the facility's waste allocation by restoring vegetation on stream and river banks (riparian areas) in the Willamette basin to increase shading and prevent the sun from warming the water—an option known as "water quality trading."

Fixed-Price Design-Build

Arthur H. Bridge Water Treatment Plant

Cucamonga Valley Water District,
Los Angeles County, CA

Challenge

The Cucamonga Valley Water District's (CVWD) mission is to provide high-quality, safe and reliable water and wastewater services, while practicing stewardship of natural and financial resources. Serving a population of over 190,000 customers within a 47-square-mile area, CVWD supplies an average daily demand of approximately 50 million gallons per day (mgd), and is widely recognized for its innovation and leadership on regional and state-wide water issues.

An innovative solution for a surface diversion pond includes subterranean raw-water intake in Cucamonga Canyon.

Within the overall service area, the Arthur H. Bridge Water Treatment Plant (ABWTP), built in the mid-1990s, treats up to 3 mgd of surface water from the Cucamonga Canyon located in Rancho Cucamonga, CA. The ABWTP obtains water from a pond impoundment intake system in the Canyon and uses a microfiltration treatment system. However, in 2012 CVWD was confronted with two major issues at the ABWTP affecting its reliability and operations.

First, the raw-water source intake located in the Cucamonga Canyon diversion ponds was found to be seriously damaged by debris from the previous year's winter storms. Over the years, the intake had been damaged by heavy storms on more than one occasion. As a result, the ponds were plagued with algae growth causing raw-water quality challenges. In addition, the existing membrane-treatment process equipment within the plant had damaged components that were not covered by a warranty. As a result, CVWD shut the plant down until solutions for the intake and water treatment system were identified and implemented.

Approach

A feasibility study conducted by CVWD in 2012 identified alternative intake and treatment-plant improvements that consisted of replacing intake facilities, combined with using either membrane-filtration or contact-clarification/filtration treatment. Because of the speed of delivery, single point of accountability and the opportunity to identify a technical solution that provided the best value, the use of a fixed-price design-build delivery method was used by CVWD. Following the two-step procurement process, CBWD awarded HDR the contract.

HDR's innovative technical solutions for the intake and treatment plant, designed and built within an 18-month period included: a new subterranean raw-water intake in Cucamonga Canyon, replacing the existing membrane-treatment process with a two-stage sand-filtration process, a new backwash-return clarification process, and upgrades to the existing SCADA system at a cost of $4.5 million.

Results

The subterranean canyon intake allows debris flow from storm events to pass over the intake without major impacts on performance. Also, eliminating the intake-diversion ponds solved the algae growth that had plagued the previous configuration. The two-stage sand-filtration process allows complete gravity flow through the treatment plant, without pumping or breaking the hydraulic head. CVWD can now use its local surface-water sources to provide additional high-quality, economical potable water to its customers, while reducing the need to purchase more expensive imported water from other utilities.

Fixed-Price Design-Build

Leachate-Pretreatment Plant

Johnson, Rhode Island

Challenge

The Rhode Island Resource Recovery Corporation (RIRRC), which handles most of Rhode Island's municipal waste and recycling from neighboring cities and towns, needed to design and build a 0.650-mgd treatment plant to comply with projected changes in the discharge standards for disposal of wastewater, including leachate, into a public sewer system. Specifically, the new facility needed to pretreat landfill-related leachate from RIRRC's Central Landfill to help the RIRRC comply with projected changes in nitrogen-discharge standards set by the Rhode Island Department of Environmental Management (RIDEM) for the disposal of wastewater.

The improvement of water quality in a clarifier, reducing the BOC and nitrogen load before being discharged to a downstream treatment plant.

Approach

OBG (O'Brien & Gere), partnering with Carlin Contracting, Co., Inc., designed and built a $27 million, state-of-the-art leachate-pretreatment plant. Using green principles, the plant treats wastewater generated by the landfill before it is released into the public sewer system via the Field's Point Treatment Facility operated by the Narragansett Bay Commission (NBC). The contract was awarded by a pre-qualification approval process (SOQ) followed by a detailed fixed-price design-build procurement process.

The new facility's treatment process was designed with sequencing-batch-reactor (SBR) technology that could process up to 650,000 gallons of wastewater a day, reducing biochemical oxygen demand (BOD), total suspended solids, ammonia and nitrate, to comply with enhanced nutrient-removal pretreatment standards. The main components of the treatment process are: influent equalization and pumping, three 1.3-million-gallon SBRs and ancillary equipment, bulk-chemical storage and metering, effluent equalization and pumping, sludge holding and dewatering, a fully integrated control system consisting of a programmable logic controller (PLC) and a supervised computer and data-acquisition control system (SCADA), and electrical distribution and standby power.

In addition to providing the design for the facility, OBG also obtained regulatory permit approvals from RIDEM, designed the integrated instrumentation and control SCADA system, and performed commissioning and operational startup services for all equipment and systems.

"The building has been designed with great detail paid to various architectural and operational considerations —water efficient landscaping, construction waste and air quality management procedures. Water use reduction and the use of building materials with recycled content will all be incorporated into the building's construction. These considerations, among many others, will provide for a reduced consumption of natural resources over time."

—Mike O'Connell, Executive Director for RIRRC

Results

The new plant is allowing for more environmentally friendly processes, advancing regulatory compliance, and saving money by treating the leachate at the source. The overall project will improve water quality by reducing the BOD and the nitrogen load discharged from RIRRC to publicly owned treatment works (POTWs) located downstream. With sustainability in mind, the project is designed to LEED Silver standards and with architectural details to reduce consumption of natural resources. The new plant began operating in March 2015, allowing RIRRC to continue its mission of providing solid waste disposal services for the Rhode Island community, which is supported by the employment of more than 200 people.

Fixed-Price Design-Build

Water Pollution Control Plant

City of Valdosta, Georgia

PARSONS

Challenge

Due to several flooding events at the old water pollution control plant (WPCP) resulting in permit violations and spills into the Withlacoochee River, and in response to a Georgia Environmental Protection Division consent order, the City of Valdosta sought a design-builder to fast-track a new greenfield plant to meet stringent effluent limits (4 mg/L biochemical oxygen demand, 5 mg/L total suspended solids, 0.5 mg/L ammonia, and 1 mg/L phosphorus) and produce Class B biosolids.

The headworks for the new 12-mgd Withlacoochee water pollution control plant.

Approach

Using a one-step, performance-based fixed-price design-build procurement, the City of Valdosta selected Parsons to design and build the new 12 million gallons per day (12 mgd) Withlacoochee River Water Pollution Control Plant (WRWPCP). The procurement documents specified a qualifications-based proposal together with a technical and cost proposal, as well as phone interviews for any technical clarifications. The rigorous scoring system defined in the RFP placed significant value on the technical approach to be used to meet the regulatory-driven completion date, as well as ensuring that the City received the best value for its money for the $24 million project.

To comply with stringent permit limits and Class B biosolids requirements, Parsons chose Aqua-Aerobics Systems' sequencing batch reactor (SBR) biological nutrient-removal technology with rotating cloth filters and aerobic digestion. The gravity-flow design of the system provided significantly fewer structural requirements, as all process piping is underground, thus expediting the schedule and eliminating any change orders that would generate potential design conflicts.

"Parsons has exceeded our expectations so far on the new Withlacoochee River WPCP Design Build Project. They are ahead of schedule and always looking for a way to save the City of Valdosta additional money on this project. They provide a unique perspective in their design, focusing on ease of operations and maintenance for the end user. As a Utility Director, it is extremely refreshing to see this approach used in the design and construction of a new facility as well as other capital improvements they have performed at our facilities."

—Henry Hicks, Director of Utilities, City of Valdosta

Results

Parsons substantially completed the project—including start-up, testing, and commissioning—within 20 months from receiving the notice to proceed. To ensure that an early completion date could be achieved, Parsons worked collaboratively with Aqua-Aerobics to have all the process equipment delivered to the site within a four month period. Using CROM® prestressed tanks for the SBR and aerobic digester also expedited the construction process by three to four months.

More than $1 million in costs savings was achieved by reusing the following existing equipment, where possible.

- Influent fine screens and controls
- Positive-displacement blowers for the aerobic digester
- Two-meter BPF press
- Discharge line for chlorine contact,
- Dewatered cake screw conveyors
- Existing standby generator not being used at the Mud Creek WPCP (saving $1 million)
- Discharge piping for chlorine contact, for a new basin (saving more than $500,000)
- Three-belt gravity belt thickener/BFP as a unique solution for Class 1 biosolids reliability (saving $250,000)

As a result, the plant now provides a low-cost alternative of $1.93 per gallon for the project scope.

Fixed-Price Design-Build

Edward C. Little Water Reclamation Facility

West Basin Municipal Water District, California

PARSONS

Challenge

The West Basin Municipal Water District's (West Basin) Edward C. Little Water Recycling Facility (ECLWRF), produces an ultra-high-quality of recycled water for groundwater replenishment, seawater intrusion barrier, and various industrial uses. The plant also generates Title 22 recycled water for irrigation and other general reuse purposes. To maintain its ongoing quality and demands, the District embarked on a phase V expansion of the facility, an innovative first-of-its-kind collaborative ozone-pretreatment process.

RO membranes process equipment.

Approach

As the District's engineer-of-record, Parsons was selected as a fixed-price design-build firm, performing the design work as well as self-performing the construction for phase V expansion of the existing facility. A historically and technologically significant project, the facility was the first full-scale application of ozone for microfiltration (MF) pretreatment in the United States. A key benefit of this application is increased reliability and operability. Prior to the phase V expansion project, the membrane systems at the plant experienced rapid and severe fouling due to organic foulants in the non-nitrified secondary-effluent water supply.

The ozone pretreatment breaks down the organic foulants to pass through the MF system, which reduces the fouling rate, and through periodic cleaning, increases the operational period between cleanings and the reliability of water supply, and reduces operations and maintenance (O&M) costs for the MF system.

Because southwest Los Angeles County borders the ocean, seawater can seep into the aquifers and mix with groundwater. A seawater- intrusion barrier was constructed to protect the aquifers. As phases of the ECLWRF were completed, the amount of water imported for injection dropped. At the completion of the phase IV expansion, the facility was able to supply 75 percent of the fresh water injected into the aquifer.

The phase V work consists of adding a 30-million gallons per day (mgd) ozonation process for MF pretreatment and expanding existing advanced treatment processes consisting of MF, reverse osmosis (RO), and ultraviolet systems by a total of 5 mgd.

Result

The design accommodated an accelerated construction schedule and involved parallel design and construction work. Due to West Basin's commitments to continue delivering water to its industrial customers, the plant was fully operational for the duration of project construction with severe constraints on shutdowns for connections to existing facilities. The completion of phase V further decreased reliance on imported water by increasing the ECLWRF's design capacity from 46.8 mgd to 62.3 mgd, effectively increasing the fresh-water supply for the intrusion barrier to 100%. This locally-produced recycled water is more reliable than imported water, which is subject to drought, regulation, and changes in weather patterns.

References

Water Design-Build Council (waterdesignbuild.org)

The Municipal Water and Wastewater Design-Build Handbook (3rd Edition)

2014 Procurement Guide for Progressive Design-Build Projects

2016 Procurement Guide for Construction Management At-Risk

How to Select a Design-Build Delivery Method (Video & Training Session)

Risk & Liability in Water Design-Build Projects, (Video and Training Session)

2012 Customer Satisfaction Survey

2014 Research Study on Impediments to Design-Build Delivery

2015 Research Study on Lessons Learned from Owners Using Design-Build Delivery

Design-Build Institute of America (DBIA.org)

2015 Design-Build Best Practices for the Water/Wastewater Sector—
dbia.org/resource-center/Pages/Best-Practices.aspx

The DBIA Design-Build Manual of Practice—Directed to all industry sectors, this guidebook is about single-source responsibility contracting with instructions, procedural guidance, sample formats and best practices recommendations. As a comprehensive reference manual for owners and practitioners about aspects of design-build practice, the publication includes basic definitions, selection procedures, project execution checkpoints, tenets of professional ethics, risk management guidelines, contract formats, licensure data and regulatory and legal information.

Standard Contract Templates – In Sample Form as DBIA Contracts —
dbia.org/resource-center/Pages/Contracts.aspx

Document Titles

- Project Schedule of Values and Design-Builder's Application for Payment
- Design-Build Change Order Form
- Design-Builder's Affidavit of Final Release
- Certificate of Substantial Completion
- Design-Build Work Change Directive Form
- Consent of Surety to Reduction in or Partial Release of Retainage—both to general and subcontractors
- Consent of Surety to Final Payment—both to general and subcontractors
- Certificate of Final Completion
- Design-Builder's Request For and separate log
- Design-Build Contract Amendment
- Standard Form of Contract for Design-Build Consultant Services
- Standard Form of Preliminary Agreement between Owner and Design-Builder
- Standard Form of Agreement between Owner and Design-Builder—Lump Sum

- Standard Form of Agreement between Owner and Design-Builder—Cost Plus Fee with an Option for a Guaranteed Maximum Price
- Standard Form of Agreement between Owner and Design-Builder
- Standard Form of Agreement between Design-Builder and Design Consultant
- Standard Form of Agreement between Design-Builder and General Contractor - Cost Plus Fee with an Option for a Guaranteed Maximum Price
- Standard Form of Agreement between Design-Builder and General Contractor - Lump Sum
- Standard Form of Agreement between Design-Builder and Design-Build Subcontractor - Cost Plus Fee with an Option for a Guaranteed Maximum Price
- Standard Form of Agreement between Design-Builder and Design-Build Subcontractor - Lump Sum
- Standard Form of Agreement between Design-Builder and Subcontractor (Where Subcontractor Does Not Provide Design Services)
- Standard Form of Agreement between Design Consultant and Design-Build Sub-Consultant
- Standard form of Teaming Agreement between Design-Builder and Teaming Party
- Proposal Bond for Design-Build Projects
- Warranty Bond for Design-Build Projects
- Performance Bond for Design-Build Projects
- Payment Bond for Design-Build Projects
- Subcontractor Performance Bond for Design-Build Projects
- Subcontractor's Payment Bond for Design-Build Projects
- General Contractor's Performance bond for Design-Build Projects
- General Contractor's Payment Bond for Design-Build Projects
- Building Information Modeling Exhibit
- Insurance Exhibits Complete Set (includes the specific insurance exhibits listed below)
- Insurance Exhibit - Design-Builder's Insurance Requirements
- Insurance Exhibit - Owner's Insurance Requirements
- Insurance Exhibit - Design Consultant's Insurance Requirements
- Insurance Exhibit - Design-Build Subcontractor's Insurance Requirements
- Insurance Exhibit - General Contractor's and Subcontractor's Insurance Requirements
- Sustainable Project Goals Exhibit

Spearin Doctrine

The Applicability of the Spearin Doctrine to the Water/Wastewater Sector: Do Owners Warrant Plans and Specifications?

The federal courts have created a doctrine whereby an owner impliedly warrants the information, plans and specifications which an owner provides to a general contractor. This doctrine, entitled the Spearin doctrine, arises from the case of *United States v. Spearin*, 248 U.S. 132 (1918), and maintains that a contractor will not be liable to the owner for loss or damage which results solely from insufficiencies or defects in such information, plans and specifications.

By example, in the Spearin case, the contractor contracted to build a dry-dock in the Brooklyn Navy Yard. In order to build the dry-dock in the site selected for it, the contractor had to relocate a portion of a sewer which ran through the specified site. The owner, which happened to be the United States Government, provided the plans and specifications containing the prescribed requirements for the section of sewer to be relocated. Subsequently, the contractor completed the relocation of this section of sewer pursuant to the prescribed requirements of the plans and specifications, and the owner approved and accepted the work.

Nearly one year after the relocation of the sewer, a dam in a connecting sewer caused the relocated sewer to flood and burst, thereby flooding the area excavated for the dry-dock. This dam was not shown on the owner's plans and specifications. The Court held that the owner created an implied warranty that, if the contractor complied with the plans and specifications, the relocated sewer would be adequate. The Court further held that the general clauses requiring the contractor to examine the site and the plans and to maintain responsibility for the work until completion did not overcome the implied warranty.

Courts, both federal and state, have since further refined the Spearin doctrine to encompass two specific implied warranties. The first implied warranty is that the plans and specifications are accurate and the second is that they are suitable for their intended use. An owner breaches the first warranty when the actual condition of the site is not as the owner has stated (e.g. if there is a dam in a sewer which is not on the plans and specifications). An owner breaches the second warranty when a contractor accurately follows the plans and specifications to completion, yet, even so, fails to produce a finished project suitable for its intended purpose or satisfactory to the owner. An example might be a contractor who builds a building in strict accord with the specifications and plans provided which is then, when finished, structurally unsound.

In both of the above-listed situations, a contractor may hold the owner liable for the added expense required to complete the project due to the inadequate plans and specifications. The contractor, however, must still show good faith. If the contractor has notice that the plans and specifications are defective, it must notify the owner promptly in order to preserve its cause of action. It should also be noted that courts have determined the Spearin doctrine to apply to private as well as public contracts.

One should not assume, however, that the Spearin doctrine applies in every state. While it is true that the Spearin doctrine is accepted by a majority of jurisdictions, any party undertaking a major construction project should take steps to investigate the issue of owner warranty of plans and specifications in its jurisdiction.

In Massachusetts, for example, two cases with opposite holdings have called the application of the Spearin doctrine into doubt. These cases are *N.J. Magnan Company v. Robert J. Fuller*, 222 Mass. 530 (1916), and *Alpert v. Commonwealth*, 357 Mass. 306 (1970). In the N.J. Magnan case, which was decided two years prior to the Supreme Court's decision in Spearin, the Supreme Judicial Court of Massachusetts held that there was no implied warranty attached to the plans and specifications provided by the owner. In so doing, the court stated, "It is the duty of one who proposes to enter into a building contract to examine the contract, plans and specifications, and to determine whether it is possible to do the work before entering into the engagement . . . ."

The Supreme Judicial Court seemingly reversed its stance in Alpert. In the Alpert case, the Massachusetts Court cited to Spearin with approval and held that the owner had impliedly warranted the sufficiency of the plans and specifications, which it had provided to the contractor, for their intended purpose.

The inherent problem is that Alpert did not overrule N.J. Magnan and in fact makes no mention of it. While the Alpert case is more recent and would appear to have greater authority, there still lurks the presence of N.J. Magnan which creates doubt and clouds the issue. In light of this uncertainty, contractors should be wary about relying on the plans and specifications provided by owners and should take all feasible steps to inspect both the plans and specifications and the work site. Additionally, it would be wise for contractors to insist upon written contract clauses warrantying the plans and specifications. In doing so, a contractor might remove some of the risk created by inconsistent case law in Massachusetts.

See more at: http://corporate.findlaw.com/law-library/the-applicability-of-the-spearin-doctrine-do-owners-warrant.html#sthash.1rNigwex.dpuf

WATER DESIGN-BUILD COUNCIL

AN ASSOCIATION OF LEADING DESIGN BUILDERS

Procurement Guides for Collaborative-Delivery Projects

WDBC has long realized the industry's need for materials specifically directed to effectively and efficiently procure and select qualified contractors for collaborative-delivery projects. Thus, the goal of this initiative is to give public officials and decision makers user-friendly guides presenting the steps in the three most used procurement processes that they may adapt and use for their own projects. The guides are available online through WDBC's website (WaterDesignBuild.org).

Progressive Design-Build Procurement Guide

This guide concentrates on the four types of procurements used for progressive design-build projects and includes templates for an off-the-shelf best practice based one- or two-step procurement process.

- Single-Step Process: Request for Qualifications
- Single-Step Process: Request for Proposals
- Two-Step Process — Step One: Request for Qualifications
- Two-Step Process — Step Two: Request for Proposals

Construction Management at-Risk Procurement Guide

This guide provides owners with a framework to use in CMAR procurement. The information in the guide is based on the industry's best practices and on practitioners' experiences with successful projects. It includes guidance in developing a request for qualifications (RFQ) and a request for proposals (RFP).

Fixed-Price Design-Build Procurement Guide

This guide concentrates on the types of procurement used for fixed-price design-build projects and also includes templates for an off-the-shelf best practice that encompasses both designing and constructing the project, which is established when the contract is signed. It focuses on the steps after an owner has defined the project requirements and scope of work sufficiently for proposing firms to accurately predict the project cost early in the procurement process – together with the ability to integrate either a prescriptive- or performance-based procurement into the process.

WATER DESIGN-BUILD COUNCIL

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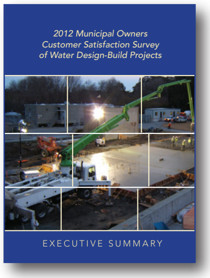
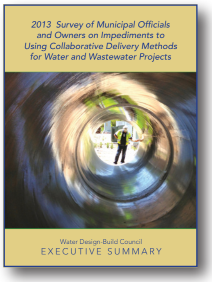
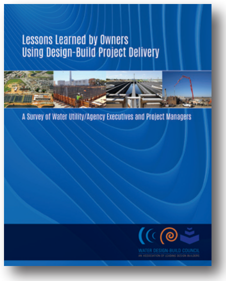
Industry Research on Design-Build Delivery



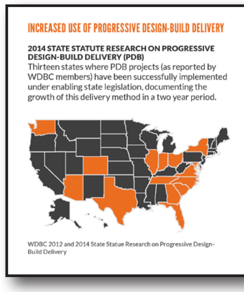
2012 Research Report — *Municipal Owners Customer Satisfaction Survey* highlights greater levels of data about users of design-build delivery with key findings reporting on why their satisfaction levels are high.



2013 Research Report — *Survey of Municipal Officials and Owners on Impediments to Using Collaborative Delivery Methods for Water and Wastewater Projects* documents that organizations' unwillingness to use collaborative delivery is attributed to lacking knowledge about the delivery methods, with the most critical impediments being a lack of education.



2015 Research Report — *Lessons Learned by Owners Using Design-Build Delivery*, an interview survey of utility/agency executive and managers, not only captures the experiences they gained in using collaborative delivery, but reinforces the value of education in preparing to use these delivery models and the need to begin the process early.



2012 and 2014 WDBC's Research on State Legislative Statutes on Progressive Design-Build reports on the changes that occurred over a two-year period with enabling legislation in selected states in allowing the use of progressive design-build delivery on water and wastewater projects. While the study reinforced the impact of legislative controls on the use of progressive design-build delivery, it also emphasized the role of education in removing those impediments.

Education and Training Modules

- Preparing to Procure and Manage Collaborative Delivery Projects
- Principles and Practices to Selecting a Design-Build Delivery Method
- Appropriating and Managing Risk
- Collaborative Delivery Procurement
- Design-Build and CMAR Project Management
- Managing a Design-Build Transition and Commissioning Process

Visit WaterDesignBuild.org for more details on WDBC 2016 Education and Training Program

Water and Wastewater Design-Build Handbook

Fourth Edition

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ISBN 978-0-692-70786-9

9 780692 707869