Capital Project Delivery

MANUAL OF WATER SUPPLY PRACTICES

M47

Second Edition

American Water Works Association

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Capital Project Delivery

AWWA MANUAL M47
Second Edition

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Preface

This manual introduces the terms and procedures used in water utility construction project administration in the United States. The intended audience is anyone involved in such projects, including engineers, contractors, suppliers, administrators, and decision-makers. The main emphasis of the manual, however, is presented from the water utility's, or owner's, point of view.

Because construction projects vary so much from project to project and country to country and because state and local regulations vary nearly as much, this manual cannot address every specific issue. Because of the variance, the manual cannot be considered a standard of practice. It should be used, rather, as a resource in planning, designing, and managing construction projects.

Contract documents have important legal consequences, and consultation with qualified professional services firms, such as attorneys and consultants, is encouraged before entering into a contract for the performance of construction, engineering services, construction management, and other services.

This publication, titled *Capital Project Delivery*, is the second edition of AWWA Manual 47, formerly known as the *Construction Contract Administration Manual*, published in 1996. The American Water Works Association (AWWA) and the Capital Project Delivery Committee would appreciate any comments on the manual. Contact the AWWA Volunteer and Technical Support Group at VTS@awwa.org, or write to the group at 6666 West Quincy Avenue, Denver, CO 80235-3098.

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Photographs in this manual are courtesy of Joe Reichenberger, Brian Steglitz (City of Ann Arbor, Mich.), Amy Kramer (Northern Kentucky Water District), and Kevin Linder (Aurora Water, Colo.).

Introduction

Capital projects are those construction projects that further the growth of a utility's infrastructure or upgrade or replace aging infrastructure. These capital projects involve a significant amount of monetary investment (capital) and, when completed, are expected to service the utility and its customers for decades. The term *capital project delivery* refers to the method of contracting for the construction of these projects. Depending on the delivery method, the term may also include the design or short-term or even long-term operation of the project. Figures I-1, I-2, I-3, and I-4 illustrate typical water utility construction projects.

Figure I-1 Large water transmission pipeline (courtesy of Beaumont Cherry Valley Water District, J. Reichenberger, P.E., District Engineer)

Figure I-2 Steel water tower (courtesy of B. Steglitz)

Figure I-3 Prestressed circular or cast-in-place rectangular reservoir (courtesy of Beaumont Cherry Valley Water District, J. Reichenberger, P.E., District Engineer)

Figure I-4 Headquarters/admin building (courtesy of A. Kramer)

In the past, the design-bid-build approach was the traditional project delivery method used by most large and small water utilities—particularly publicly owned utilities. However, within the last decade or so, other delivery methods such as design-build, design-build-operate, and others have evolved based on successful experiences in the private sector. As projects became more complex, owners sought the assistance of program managers (PM) and construction managers (CM) to assist them in project delivery.

Manufacturers are taking big strides in the development of technology for treating water. These are not subtle changes but major differences in construction and operation of these systems. Owners are faced with new problems on how to contract for this technology in such a rapidly changing world. The boards of directors, commissioners, and management of water utilities are quietly wondering what risks are being assumed. How do they protect themselves? What are utilities getting into?

The purpose of this manual is provide public and private water utilities with a menu of various project delivery methods, a roadmap to implementing the method, and analysis of applicability, the risks involved, the advantages and disadvantages. It provides utility staff and management with a foundation for discussion with other utilities, consultants, and construction contractors as to the applicability of a particular method to the utility's project.

This introductory chapter discusses the principal terms used in the manual, explains the major differences in project delivery methods for publicly owned versus privately owned utilities, and previews the chapters of this manual.

PRINCIPAL TERMS

The terminology used in contracts and construction varies from locale to locale. The terms used in this manual are not intended to be the only correct terms that can be used. For example, a project manager is sometimes called a resident manager, a project engineer, a construction manager, or a resident engineer. Depending on the project and locale, there may be differences in the meanings of the terms. The contract documents for a project should define the terms to be used on a specific project.

The term *owner* refers to the entity, usually a utility, that arranges the financing for the project, contracts with the other participants, and operates and maintains the project after it is completed.

The term *consultant* refers to a professional or a firm hired by the owner to perform planning, design, management, construction observation, and other services. In this manual, the consultant is also referred to as the *engineer* or *design engineer* (in reference to engineering-related services). Of course, a consultant may also perform services other than engineering, such as architectural design.

The term *contractor* refers to the firm or consortium that constructs the project. Other groups, such as the American Society of Civil Engineers (ASCE) and the American Water Works Association (in its standards), refer to the *contractor* as the *constructor*. This manual uses the terms interchangeably. The word *contractor* usually implies a general or prime contractor, i.e., the firm with prime responsibility for the construction of the project. Firms hired by the general contractor to provide construction services, usually in specialty areas, are *subcontractors*. The terms *vendor*, *equipment supplier*, or *equipment manufacturer* refer to the entity that designs, manufactures, delivers, and often provides installation assistance, startup, and training for equipment or materials furnished to the owner. These terms are normally used in the context of owner-procured or owner-prepurchased equipment. Sometimes the terms are also used to describe those entities that provide material and equipment to a general or subcontractor.

The term *contract administration* is used in this manual to refer to the owner's project management efforts thorough the entire project delivery process. Contract administration

occurs over the complete project from planning through postconstruction. The term *construction management* is more specific to the construction phase of the project.

Other terms are defined as needed in the following chapters.

PUBLICLY OWNED VERSUS PRIVATELY OWNED UTILITIES

There can be differences between publicly owned utilities and privately owned utilities when constructing projects. For example, a private owner may not be bound to competitive bidding as strictly as a public entity. Public utilities may be precluded from using some project delivery types as a result of policy, charter, or state or local law. For the purposes of discussion in this manual, the utility is assumed to be either publicly or privately owned unless strong differences exist. In that case, the differences will be discussed. The utility should discuss any of the "nontraditional" project delivery methods with its legal counsel beforehand.

PROJECT DELIVERY METHODS AND OVERVIEW

Table I-1 presents a summary of some of the project delivery methods available and typical projects for which they might be considered.

RECENT TRENDS

Although it is difficult to quantify increases in actual expenditures, the following trends are occurring:

- Design-build projects are becoming more prevalent in water treatment. Agencies that have gone with design-build for water treatment facilities include the city of Seattle, Wash., the city of Orlando, Fla., and the city of Detroit, Mich., among others.
- Agencies with large capital improvement programs to replace aging infrastructure or to accommodate growth in their service areas have retained program managers to set criteria for design and construction, select design consultants, perform design review, conduct the bidding process, select the contractor, and manage the construction and startup phases. Agencies that have used program managers include the Southern Nevada Water Authority, city of San Francisco Public Utilities Commission, city of San Diego, and others.
- Seawater desalination and other water resource projects are areas where private entities are being formed to provide complete design-build-own-operate services. Two recent notable projects in California include the Cadiz Groundwater Storage and Dry Year Supply Program and Poseidon Resources' Carlsbad Desalter.

CHAPTER PREVIEW

The manual is presented in three main sections intended to divide the topic of project delivery into distinct areas of discussion. However, some overlap is occasionally necessary to provide a complete discussion.

Section I contains three chapters and introduces conventional project delivery. Chapter 1 discusses the traditional (design-bid-build) construction project, including the project phases, participant responsibilities, and advantages and disadvantages. Chapter 2 introduces construction documents, which include bidding requirements, contracts, drawings, and specifications; the chapter also reviews standard contract documents developed by the Engineers Joint Contract Documents Committee (EJCDC) and others. Chapter 3 discusses the reasons for prequalifying contractors and the steps in selecting contractors.

Table 1-1 Summary of project delivery methods

Project Delivery Method	Brief Description	Types of Project
Design-bid-build	Traditional method wherein owner provides a complete design, openly invites bids, and issues a single construction contract to a constructor. Owner provides oversight of the constructor's workmanship and materials.	Applicable to any project, large or small.
Multiple prime contracts	Owner provides complete design, openly invites bids for more than one part of the project. Multiple construction contracts are on-going simultaneously—often on the same site. Owner provides oversight of each constructor's workmanship and materials.	Applicable to parts of projects that are easily separated (e.g., pipeline segments) or that require different skills and experience (e.g., pipelines versus treatment facilities, reservoirs, or buildings).
Design-build	Owner provides a partial design and design criteria, openly invites bids or proposals to complete the design and construct the facility, and issues a single contract to a design-construction entity. Owner frequently retains some control over the design to ensure conformance with the design criteria and provides some oversight of the constructor's workmanship and materials for conformance with established criteria.	Applicable to any type of project, but best suited for projects like reservoirs, water treatment facilities where the equipment is "packaged" and represents a major portion of the cost, or when there is need to complete a project in an abbreviated time frame. A membrane treatment plant is a good example.
Design-build-maintain	Essentially the same as design-build but requires the constructor to maintain the facility for a prescribed period of time.	Applicable to any type of project but particularly applicable to a complex project involving equipment and machinery such as a water treatment plant.
Turnkey	Essentially the same as design-build but with the design-build entity also providing additional services such as site selection and purchase, financing, or both.*	A water treatment facility—particularly a complex facility—involving new or innovative technology and where the owner does not have a site or the financial resources immediately available.
Design-build-own-operate-transfer	Essentially the same as a turnkey, except the constructor actually owns the facility and operates it for an extended period of time. At the end of the contract time period, the constructor transfers ownership to the utility. Usually payment is made based on the quantity of treated water, often with "take or pay" consequences.	A water treatment facility—particularly a complex facility—involving new or innovative technology. May be appropriate where owner does not have capital funds available.

* Design-Build Institute of America (DBIA) 2006. A variety of techniques may be used by owners in the process of delivering their capital projects. Some of the more common methods are presented in Table I-2 along with a brief description and typical applicable project types.

Increasingly, drinking water supply projects are constructed using nontraditional or alternative project delivery methods. Section II introduces the commonly used alternative approaches to construction projects and contract administration. These approaches range from construction management performed by the project owner (chapter 4) to design-build and turnkey projects (chapter 7) in which a private firm completes all the phases of the project. Other chapters in section II discuss hiring a construction management firm to provide contract administration (chapter 5), projects with multiple prime

Table 1-2 Project delivery variants and options

Option	Brief Description	Types of Project
Prequalifying and selecting contractors	Technical and financial qualification statements are requested from equipment suppliers, construction contractors, and design-build entities from which a short list of three or four entities are selected that may then bid for the project.	Very large complex projects requiring specialized expertise and experience, e.g., dams or projects involving new technology.
Equipment prepurchase	Owner prepurchases equipment and requires the constructor to take delivery of the equipment and install it or prenegotiates a price with a particular vendor or subcontractor and requires all bidders to use the equipment or subcontractor at the prenegotiated price. This alternative may result in significant cost savings to the owner because the contractor's markup on the purchase of the equipment is eliminated. But there is additional risk the owner must bear in terms of schedule and delivery.	For projects when an owner wants a particular brand of equipment to match existing equipment; or when particular manufacturer's equipment substantially impacts the detailed design; or when the owner needs to accelerate the project.
Construction management	Owner retains a firm to provide services during the design, construction, and commissioning to oversee and manage the design firm, oversee the bidding, and oversee the construction and startup. Usually limited to a single project.	Almost any project where owner does have the technical or staff resources available.
Program management	Similar to construction management except the consultant now manages the entire capital improvement program. Usually extends for many years. Program managers are typically precluded from doing any design or construction work on the projects.	Typical when owner is a large entity with a large number of capital projects in various stages of design and construction at a given time.
Construction management at risk	Similar to construction management except at some point in the design process, the construction management entity offers to construct the project for a guaranteed maximum cost. Construction manager then takes on the role of constructor.	Applicable to any project, but usually limited to a larger, more complex project.

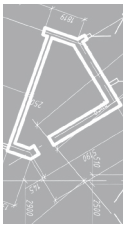
contractors (chapter 6), and projects with a guaranteed maximum price, i.e., construction management at risk (chapter 8).

Section III discusses general issues common to all project delivery methods, including budgeting and payment procedures (chapter 9), performance clauses that give the contractor incentives to complete the project on time (chapter 10), warranties that are guarantees of the contractor's and suppliers' materials and work (chapter 11), risk allocation (chapter 12), disputes and claims (chapter 13), communication (chapter 14), selecting consultants (chapter 15), and partnering (chapter 16). These general issues apply to all types of projects and contract administration.

At the end of this manual, the bibliography lists resources that can be consulted for more detail about the topics introduced in these chapters, and a substantive index is provided for the convenience of the reader.

REFERENCE

Design-Build Institute of America (DBIA). 2006. *Design-Build Definitions.* Washington, D.C.: DBIA.



SECTION I

Conventional Project Delivery

- Conventional Project Delivery: Design-Bid-Build
- Construction Documents: Overview and Application
- Prequalifying and Selecting Contractors

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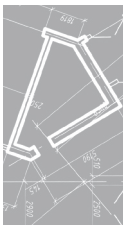


Chapter 1

Conventional Project Delivery: Design-Bid-Build Approach

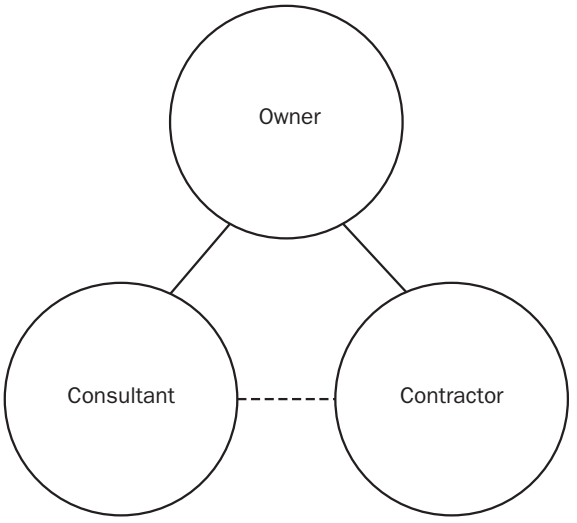
This chapter defines the traditional water utility construction project, project phases, participants and their responsibilities, selection of participants, forms of payment, and advantages and disadvantages of the traditional project.

In earlier times, more often than not, water utility staff themselves would plan, design, and construct the utility's projects. As projects became more complex, water utilities contracted with outside experts, particularly to design, finance, bid, and administer the construction contract. More recently, the consultant has been limited to planning, designing, bidding, and construction contract administration.

Traditional construction project organization can be illustrated by a triangle (Figure 1-1); the utility (owner) hires the design engineer, design consultant, or architect (consultant) along with the company that builds the project (contractor). In the triangle, the consultant and the contractor are connected with a dashed line, symbolizing that those two participants do not have contractual ties but may interact during construction if the consultant performs the contract administration. In this type of delivery system, the owner may retain an independent third-party construction manager to administer the construction contractor and provide on-site representation ("inspection") for the owner. In this case, the design engineer's responsibility during the construction is limited to shop drawing and submittal review, response to requests for information, and change-order preparation.

PROJECT PHASES

The following paragraphs introduce the main phases and activities of the traditional water utility construction project. The responsibilities of the participants during each phase are discussed in the following sections. Of course, water utility projects vary widely, from installing a valve (Figure 1-2) to constructing a treatment plant (Figure 1-3), and phases also vary according to the complexity of the project.



NOTE: Solid line indicates formal contract ties; dashed line means no formal ties.

Figure 1-1 Traditional project participants

Planning

A preliminary study defines what the project needs to accomplish, determines possible alternatives to meet the need, estimates costs, and determines the technical feasibility and financial requirements. Based on the preliminary study, a final report more accurately defines the project scope, suggests a preferred alternative, presents a refined budget, and identifies the steps to implement. The owner uses the preliminary study and final report to decide whether to proceed with the project. The final report also serves as the basis of the design. The selection of the design consultant and other design professionals is described at length in chapter 15.

Environmental Documentation and Entitlement

Projects that involve federal financing or that potentially impact wetlands or waters of the United States will require some environmental clearance from the US Army Corps of Engineers, US Fish and Wildlife Service, or other regulatory and permitting agency. A number of states have requirements for environmental clearance that could involve environmental assessments or environmental impact reports. Environmental clearance must be obtained before proceeding too far into the design. In most cases, design is not initiated until completion of the environmental entitlement. Unless the particular project is exempt from environmental clearance, owners need to consider the time and cost to complete this phase of the project. The duration varies depending on the project's complexity and the public's concern. For projects that are deemed to have significant impact or to be subject to public scrutiny, the owner will be well served to implement an extensive public outreach program. Such an effort can be performed by the owner's staff or an independent consultant.

Design

The major products of the design phase include construction drawings, specifications (technical requirements), and the bidding and contract documents (legal requirements).

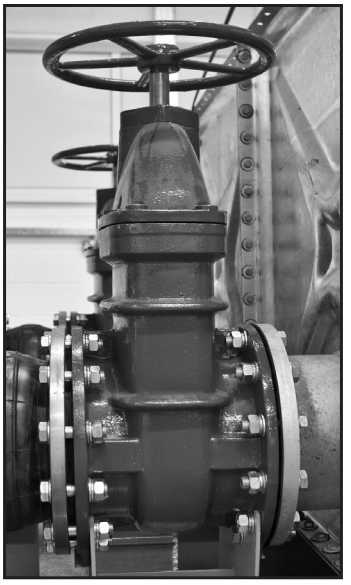


Figure 1-2 Water valve

Figure 1-3 Treatment plant

Other design-phase products typically include a final construction cost estimate and agency approvals of the design.

Based on the construction cost estimate and financing, the type of construction contract is usually determined in this phase. The main types of contracts in traditional projects are fixed price (unit bid or lump sum) and cost plus.

In a fixed-price, unit-bid contract, quantities for each element of the work are estimated by the design engineer and defined within the bid section of contract documents. During the bidding phase, bidders fill in the unit prices they will charge for each line item

(for example, 100 lin ft (30.5 m) of 6-in. (152-mm) pipe at $35 per foot). Some projects or elements of projects do not easily lend themselves to a measurable quantity definition. In those cases, areas or limits of work are defined and the contractor is requested to submit a lump sum bid or a lump sum for particular items of work, e.g., pressure regulating vault, complete; and air release valve assembly, complete. During construction, payment is made based on an agreed-on percent completion of those elements appearing within an approved monthly cost estimate breakdown, also referred to as the schedule of values.

In a cost-plus contract, payment is made for the actual cost of the work based on labor and equipment rates, material invoices, and profit and overhead markup percentages. The effort is tracked during performance of the work. Most prevalently, the cost-plus approach is used as part of a change-order process or on a project for which the limits of effort required cannot be reasonably defined and the contracting parties cannot agree on a lump sum value. In some cases, owners may want to select contractors for small projects or emergency work on the basis of a prequalified list, where the owner has already prenegotiated rates for labor, materials, overhead, small tools, and profit. This process reduces the time to "get a contractor on board" and assures the owner of competitive pricing.

Bidding

The bidding phase essentially involves the selection of the contractor. Chapter 3 discusses this topic at length. Generally, the availability of bid documents (plans and specifications) to prospective bidders is advertised in local newspapers as well as within known construction publications, such as the *Dodge Reports*. Copies of the plans and specifications are maintained in "plan rooms." A prebid conference may be held at which time questions from prospective bidders are answered. Bids are received and evaluated for compliance with funding capability, conformance with bidding requirements, and qualifications of the bidders. This phase also entails awarding a contract and entering into an agreement.

Construction

During the construction phase, the project is built according to the drawings, specifications, and contract provisions. Of course, projects rarely go completely according to the plans because of unforeseen conditions, and changes may be required. All three participants—owner, design consultant, and contractor—are usually involved in changes. Owners should budget for some changes, e.g., up to 5 percent of the bid price is reasonable, as plans and specifications are not expected to be error free and unknown subsurface conditions frequently require a change of plan.

During construction, there are many points of communication, written and spoken, and much documentation is prepared. The types of documentation used includes shop drawings, requests for information, responses to requests for information, payment requests, change orders, inspection reports, and material and operational test results. The components of the project are observed and either accepted or rejected. All components must be working correctly (as defined by the specification) before the project can be considered finished.

During the construction phase of the project, the owner, the design consultant, or an independent construction manager provides the contract administration services. Depending on the complexity of the project, the oversight can be full time or part time.

Postconstruction

In the postconstruction phase, utility staff may need instruction in the operations and maintenance (O&M) of the project components. A warranty period (refer to chapter 3) is usually in effect. Also, an important part of this phase of the project is the preparation of

the project record drawings ("as-builts") based on the construction manager's or resident engineer's and construction contractor's records.

PARTICIPANT RESPONSIBILITIES

The three project participants have relatively distinct responsibilities during each phase of the traditional construction project. Again, projects vary in complexity and the responsibilities vary accordingly. Each party's responsibilities should be clearly described in the contract documents.

Owner

The owner has responsibilities in all phases of the project, the most important of which are defining the need for the project, selecting the consultant and contractor, providing direction to the consultant, and paying the consultant and contractor in a timely manner according to the contracts. The contractor is usually selected through the bidding process as described above. Guidelines for selecting the consultant are presented in chapter 15. The owner is responsible for clearly defining and communicating the expected roles of all the participants.

Preliminary phase. Based on the utility's needs, the owner defines the scope of the project. The owner, sometimes together with the consultant, performs the preliminary study and prepares the final report. The owner acquires project approval and funding from the necessary authority, such as a water utility governing board.

Design phase. The owner enters into an agreement with the consultant to generate drawings, specifications, and bidding and contract documents. During the design phase, the owner and consultant meet periodically to review progress and resolve any questions that arise. The owner must make sure the project stays within its scope and budget and that the design meets expectations. The owner should provide necessary design approvals.

Bidding phase. The owner may submit the bid request to a list of prequalified contractors, advertise for bids, or both. Often the owner is bound by certain legal bidding requirements or bidding policies. Local newspapers, as well as construction bulletins such as *Dodge Reports*, can be used to advertise. The length of the advertisement period may be based on local, state, or federal regulations; project complexity may also determine the length. The typical bidding period is four weeks; but the period for simple, small projects could be less. Complex water treatment plants may require a six-week or more bid period.

The owner, often together with the consultant, conducts the bid opening, where those bidding are present and their bids are opened and read. The owner, usually with the consultant, evaluates the bids; if the low bidder meets the criteria established in the bidding documents, the low bidder is typically selected to construct the project.

Construction phase. The owner issues a notice of award to the approved bidder and sends the construction contract to the contractor to be signed. The owner also signs the agreement and issues a notice to proceed, which defines the start date and completion period. During construction, the owner documents progress and inspections either in person or through the design engineer or an independent third-party construction manager; attends established progress meetings; approves appropriate changes to the project (working with the design consultant if the changes involve the design); and issues payments to the contractor. When the project is completed and accepted, the owner issues a project completion statement, the date of which establishes the beginning of the warranty period. Often the notice of completion is recorded with the county recorder. The contract documents must define the terms of acceptance.

Postconstruction phase. During the latter stages of the project, as components become ready for their intended use, the owner's staff may need training in the operation of the components. The owner at this point becomes responsible for O&M of the project.

Consultant (Engineer)

In the traditional construction project, the consultant's main responsibility is to prepare the project plans, specifications, and contract documents. In recent years (particularly with more complex projects), the consultant's role has come to include tasks such as

- Performing preliminary studies
- Generating final reports
- Securing permits and environmental clearance
- Performing financial studies
- Conducting the bidding
- Providing construction contract administration
- Assisting with project startup
- Assisting with O&M
- Public outreach

Preliminary phase. The owner may hire the consultant to perform or assist with the preliminary study and final report. The consultant often estimates the construction costs and may present design and financing options. The consultant may assist the owner with obtaining regulatory agency approval as well as approval of the utility's governing board.

Design phase. The consultant's main responsibility is to generate the project drawings and specifications. The owner and consultant agree to various stages of the design, at which times the plans and specifications should be reviewed. The consultant may coordinate the design approval with both local and other regulatory agencies. The consultant usually furnishes the owner with an estimate of probable cost of the project at key milestones and cost upon completion of final design. The owner and the engineer should review the project cost estimates at each milestone to ensure the project stays within the owner's budget. Most of the time, the consultant prepares the bidding and construction contract documents for the bidding procedure.

Bidding phase. The consultant can assist the owner with the bidding process or conduct the process on behalf of the owner. Specific activities in the bidding process for which the consultant can assist the owner are

- Recommending publications in which the project should be advertised
- Prequalifying bidders (discussed in detail in chapter 3)
- Conducting or attending the prebid conference
- Responding to inquiries from bidders and preparation of addenda, which are changes to the bidding and contract documents during the bid process
- Conducting or attending the bid opening
- Tabulating the bidding results
- Evaluating the bids and recommending the winning contractor
- Preparing a notice of award to be presented by the owner to the contractor

Boards and commissions overseeing agencies should be made aware of the fact that the bid price awarded will not likely be the final total cost at completion of construction.

In writing the letter of recommendation of the low bidder, it is often recommended that the staff and directors be made aware of the fact that the project budget should include some amount for contingencies to cover unforeseen changes during construction. An allowance of up to 5 percent more than the lowest bid price is reasonable but varies by project size.

Construction phase. The consultant may or may not be retained to perform construction contract administration, and the consultant's responsibilities vary accordingly. The following list of responsibilities assumes the consultant is an active participant in the construction phase:

- Perform periodic observation of the constructed project to check for compliance with the intent of the design. The consultant can provide full- or part-time construction observation staff on-site.
- Evaluate construction progress and process progress payment requests for submittal to the owner.
- Provide information and clarification.
- Evaluate construction quality and identify deficiencies.
- Review shop drawings for compliance with the contract documents.
- Review test reports.
- Conduct and attend preconstruction and construction progress meetings.
- Witness and review tests.
- Report to owner any proposed changes to construction schedule, scope, and budget.
- Review and process change orders for submittal to owner for approval.
- Collect warranty information from the contractor and provide to owner.
- Transpose contractor documented-as-constructed information to project record drawings (also called *as-builts*).
- Verify that vendors of project components submit O&M manuals where required.
- For complex projects, such as a treatment plant, develop project O&M manuals or other documents and provide utility operator instruction and startup.
- Furnish certification of completeness to the owner and to applicable regulatory agencies.

Postconstruction. In the traditional construction project, the consultant's role usually ends at the completion of the construction phase. In a few instances, however, the consultant may provide services such as

- Assisting the owner with warranty issues
- Providing advice on O&M problems
- Evaluating and reporting on the project performance after a defined period of time
- Assisting the owner in resolving other outstanding issues, claims, and litigation

Contractor

Traditionally, the contractor's sole responsibility is to construct the project according to the plans and specifications. With nontraditional projects (discussed at length in section II), such as design-build projects, the contractor's role has been expanded. The following paragraphs focus on the traditional role of the contractor during each phase.

Preliminary and design phase. In the traditional construction project, the contractor is not involved in the preliminary and design phases.

Bidding phase. The contractor is responsible for preparing a bid according to the bidding instructions and may have to submit prequalification documents (refer to chapter 3). The contractor must follow the bidding directions upon receiving clarification of the plans and specification; such directions are intended to maintain fairness to all bidders.

Along with the bid, the contractor is normally required to submit additional information such as

- Bid bond or bid surety (the form varies from state to state)
- Questionnaire on ability to perform the project (e.g., past projects, safety plan and safety record, references)
- List of major suppliers and subcontractors
- Preliminary schedule

Construction phase. The successful bidder enters into a construction contract with the owner. Bound by the contract, plans, and specifications, the contractor is responsible for constructing the project within bid price and within the defined time frame. Construction activities are expected to begin upon receipt of the notice to proceed.

The contractor should follow the lines of communication and authority established in the contract. For example, the contractor should submit progress payment requests as scheduled, give required notice for inspections, attend progress meetings, and negotiate change orders on schedule changes with the owner or contract administrator.

When the project is substantially complete and ready for its intended use, the contractor notifies the owner to demonstrate that the project components have been started, tested, and are performing to the requirements of the contract documents.

If the contract so specifies, the contractor coordinates training the owner's staff, often using manufacturers' specialists. In addition, the contractor assembles and gives to the owner the vendors' O&M manuals.

Postconstruction. The contractor's postconstruction responsibilities can be any of the following depending on the contract documents:

- Maintain the bonds active for a defined period of time.
- Maintain completed products' insurance for a defined period of time.
- Return to the site to correct defective work not known at the time of construction completion.
- Coordinate the various manufacturers' return to the site for warranty work.
- In some cases, contractors are engaged to operate the project for a period of time before complete assumption by the owner's staff.

ADVANTAGES AND DISADVANTAGES

The traditional project has evolved to an extent that it offers some degree of flexibility; however, many new forms of project delivery are available. These alternatives are described in more detail in section II. The advantages and disadvantages of the traditional project are listed in the following sections.

Advantages of the Traditional Project Delivery

Advantages of the traditional project delivery are as follows:

- All participants are usually familiar with the processes, responsibilities, and expectations.
- Traditional project delivery has a long history of experience in the utility industry.
- Owner maintains direct control over the contractor and the design engineer.
- Design engineer works for the owner and so is more apt to optimize the design to meet the owner's needs.

Disadvantages of the Traditional Project Delivery

The disadvantages of the traditional project are as follows:

- Traditional project delivery requires owner's involvement to resolve disagreements between the contractor and the design engineer.
- The process requires a complete set of plans and specifications and the project work must be completely defined. Overall time frame from design to project completion takes longer than other alternative delivery systems.
- There is less opportunity to take advantage of the contractor's skill and ingenuity in construction.

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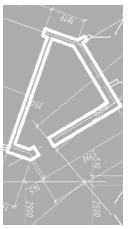

Chapter 2

Construction Documents: Overview and Application

This chapter discusses the general content of traditional construction documents that define project requirements. Historically construction contract documents were organized and assembled according to the traditions of the owner or consulting firm. There was a general lack of uniformity. To address this, the Construction Specifications Institute (CSI) established a standard format for the organization of the construction contract documents to provide uniformity, minimize misunderstanding and confusion, and make the bidding and construction processes more efficient and less time-consuming. Most consulting organizations and agencies follow the CSI format.

THE CSI FORMAT FOR CONSTRUCTION DOCUMENTS

Because of its appeal, the CSI format for the organization of construction contract documents will be the focus of this section. Table 2-1 presents the CSI's format for the organization of the bidding and contract documents.

The documents listed in Table 2-1 are self-explanatory for the most part; however, a few warrant additional discussion.

General Conditions. These are the contractual-legal elements of the construction contract and define the role of the parties, method of payment, payment procedures, and procedures for making changes to the work, making claims for additional compensation or time, and so forth. As such, this General Conditions section should be limited to the legal issues. The General Conditions section is typically a standard document that has been thoroughly reviewed by the owner's legal counsel. It is typically not changed. Any changes that are necessary or that are required to meet specific job requirements are typically made through the Supplementary General Conditions.

Supplementary General Conditions. This section modifies provisions of the General Conditions or supplements (adds to) them. The Supplementary General Conditions section is typically tailored to each project.

Specifications. Each section of the specifications is subdivided into three parts: General, Products, and Execution. The General section provides information on the design constraints, conditions of use, and other information. The Products section refers to the

Table 2-1 CSI organization of the bidding and contract documents

Type of Document	Specific CSI Section Details
Bidding documents	Advertisement Information for Bidders Bid Form Bid Security Certificates and Affidavits Addenda
Conditions of contract	General Conditions Supplementary General Conditions Agreement Bonds
Specifications	Specifications were formerly 16 divisions, now over 30 major divisions with latest revision. Within each division there are sections (General, Products, and Execution). The sections can be very narrow scope, i.e., "butterfly valves," or broad scope, "valves." The use of sections is left to the owner and engineer.
Drawings	
Contract modifications	Change Orders

materials that will be incorporated into the project. The Execution section describes the workmanship and method to install the materials. By standardizing in this fashion, engineers, owners, and contractors have a much easier time finding the items of interest.

Division 1 of the Specifications entitled "General Requirements." This section contains job specific instructions on the progress and sequencing of the work, testing, startup, project office, submittals and shop drawings, project schedule, and so on. Virtually everything that is of a general nature, applicable to the entire project work, and not of a legal context is included in Division 1.

Some organizations are reluctant to give up their own terminology and have generated a hybrid of their own format and the CSI format. They might have General Conditions and General Provisions, for example. Such a hybrid is an unnecessary duplication and will lead to confusion and conflicts. This format should be avoided if at all possible.

STANDARD FORMS FOR THE BIDDING AND CONTRACT DOCUMENTS

Various organizations have developed standard construction documents. The main purpose in developing such standard documents is to provide consistency in terminology, organization, and procedures. The use of such documents should result in higher quality, quicker completion, and fewer disputes in design and construction. (NOTE: In the following discussion, the design consultant is referred to as the *engineer* to be consistent with the documents being described.) Organizations which have developed standard forms include:

- American Institute of Architects (AIA)
- Engineers Joint Contract Documents Committee (EJCDC)
- Design-Build Institute of America (DBIA) for design-build documents (refer to chapter 7)

In addition, the larger public agencies and consulting engineering organizations have developed contract documents and other forms for use on their projects.

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

The Engineers Joint Contract Documents Committee is a national (US) committee. The committee began in 1963 with the formation of a Contract Documents Committee by the Professional Engineers in Private Practice (PEPP), a practice division of the National Society of Professional Engineers (NSPE). The Contract Documents Committee of the American Consulting Engineers Council (ACEC) joined with NSPE-PEPP in 1975. A similar committee of the American Society of Civil Engineers joined in 1978. In 1981, the Construction Specifications Institute joined, but in 1992 changed its status from member to observer. The overall committee adopted EJCDC as its name.

The committee retains outside legal counsel and in recent years has sought the counsel of other groups in the construction community by establishing liaisons with the American Water Works Association, the American Council of Independent Laboratories, the American Institute of Architects, the Associated General Contractors of America (AGC), and the Association of Engineering Firms Practicing in the Geosciences of Soils and Foundation Engineers.

Through its publications, seminars, and other educational programs, the EJCDC also educates owners, members of the design profession, the construction industry, and attorneys, as well as the interested public, on the importance of understanding the proper roles and responsibilities of the contracting parties and on the wording and coordination of engineering services, bidding, procurement, and construction documents. The standard language and format of EJCDC documents are well known to contractors and can result in more competitive bidding because of fewer ambiguities. The reader is encouraged to contact the EJCDC.

The EJCDC's documents must be purchased for use. There is a licensing agreement with the purchase. Once purchased, the user (agency or consultant) has unlimited use of the documents on the agency's or consultant's projects. The documents can be purchased from the American Society of Civil Engineers, from the Associated General Contractors of America, or from the National Society of Professional Engineers.

Purpose of EJCDC Documents

The aim of the EJCDC standard documents is to define clearly the functions and responsibilities of the participants in designing and constructing a project. When all participants understand their roles and the roles of the others, the chances for misunderstandings and disputes will be greatly reduced.

The EJCDC standard documents reflect the experience and knowledge of owners, engineers, lawyers, and contractors involved in utility and other types of construction throughout the United States. The documents are adaptable to water utilities, large or small, and have been written so that the requirements of a particular owner or project location can be added to the standard text. The standard documents are constantly being updated to reflect changes in project administration.

The EJCDC documents can be divided into four broad categories.

1. Engineering consulting services
2. Construction
3. Procurement (purchasing goods and services)
4. Commentaries and updates that provide background information and comparisons of different EJCDC documents

Engineering consulting services documents. EJCDC engineering services documents help define standards of engineering practice in the United States. Water utilities and engineering consultants use the documents to arrive at acceptable consultant service agreements. Of course, as with any standard document, each specific project must be evaluated for any requirements that might necessitate modifying the documents. Procedures for modifying the documents are discussed later in this chapter.

Construction documents. EJCDC construction documents help define the agreement between the owner and the contractor from bidding, to the contract, to payment requests, to change orders, and to the certificate of substantial completion. Again, each specific project must be evaluated for any requirements that might call for modification of the standard documents. Procedures for modifying the documents are discussed later in this chapter, as are examples of the potential problems and benefits of standard documents.

Procurement documents. EJCDC procurement documents help define the agreement between the owner and suppliers of goods and services. Again, each specific situation must be evaluated for any requirements that might call for modification of the standard documents. Procedures for modifying the documents are discussed later in this chapter, as are examples of the potential problems and benefits of standard documents.

Commentaries and updates. EJCDC commentaries and updates are descriptions and comparisons of the documents listed in the previous sections. Frequently, several documents are referenced in a single commentary.

Modification of EJCDC Documents

Each construction project is unique, and EJCDC standard documents cannot cover all situations. Some of the common areas where projects tend to differ are

- Specific owner requirements
- Local statutory requirements
- Type of service to be performed
- Type and complexity of the project
- Conditions under which the work is to be performed
- Relationships between the parties

Extreme care should be used when modifying or supplementing the standard forms because their provisions are interrelated. Modifications of the language of the standard forms and supplemental provisions should always be made to cover in full the intent of the parties. For example, a change in one place or an addition in another may create an ambiguity or produce an unintended result in the legal obligations of the parties. To reduce such problems, EJCDC documents cross-reference related documents and provide warnings to modify the documents correctly.

How EJCDC Documents Can Reduce Common Problems: Some Examples

The following examples show how using the EJCDC documents can reduce common problems in construction projects.

Specifying contractor–subcontractor relationships. Potential conflict in construction projects can occur when the owner or engineer attempts to become involved in the relationships between the contractor and subcontractors. The EJCDC documents are based on the principle that the owner and engineer will deal only with the contractor, not directly with a subcontractor or supplier. The documents provide that the contractor is

fully responsible for the acts and omissions of the subcontractors and that nothing contained in the documents creates any contractual relationship between any subcontractor and the owner or engineer.

There are two basic reasons for this approach. One is the strong belief that both the owner and the engineer should avoid undermining a contractor's authority to deal in a businesslike manner with its subcontractors. The other is to avoid discouraging the contractor from fulfilling any of several primary responsibilities: supervising, directing, and inspecting the work and coordinating the activities of subcontractors and suppliers. Several court decisions have held that when owners or engineers undertake the responsibility of supervising and coordinating a contractor's work, they have a duty to perform that function with skill and care and are liable for the results of that action.

On many projects, however, the owner and the engineer desire to retain a degree of control over the contractor's selection of subcontractors. EJCDC documents provide two opportunities for the owner and the engineer to exercise judgment about the capabilities and qualifications of prospective subcontractors and suppliers.

The documents may require that after receipt of bids, the apparent successful bidder obtain the owner's and engineer's acceptance of those subcontractors specifically identified in the documents as being of special importance for the successful completion of the project. If the apparent successful bidder cannot obtain acceptance of a subcontractor nominee before the notice of award is given, that bidder may either furnish an acceptable substitute without an increase in the bid price or withdraw the bid without forfeiting the bid security. If the owner or engineer objects to a subcontractor or supplier after the contract is awarded, the contractor is allowed an appropriate increase in the contract price to reflect any required substitution. The EJCDC believes that it is good practice to resolve the acceptability of subcontractors and suppliers before the contract is awarded and that the allocation of expenses resulting from rejection and substitution before or after award of the contract should be fair and reasonable to all parties.

Clarifying changes to contract price and time. A perfect set of plans and specifications is unlikely because changes are frequently needed either due to unforeseen conditions or due to the desires of the owner. Therefore, the owner should establish a contingency fund to cover some unexpected changes.

A lack of clarity on the issue of changes in the work is seldom the source of conflict. Most contract documents clearly require that if changes are needed that affect cost or time, they can be effected only by a written modification to the contract. The vehicle for such modification is a formal change order reviewed and recommended by the engineer and signed by the owner and contractor.

Serious problems do arise, however, from the way in which change-order procedures are followed during construction. Frequently, conditions arise that make the routine processing of a change order impractical. The stakes are high for everyone involved. The pressures of time and cost are often enormous, and no one needs the added pressures of disruption and delay that changes generate.

To provide an improved and workable procedure for handling the change-order process, the EJCDC developed the concept of the work change directive. Earlier editions of the EJCDC standard documents provided that changes in contract work, contract price, or contract time could be made only by a change order recommended by the engineer and signed by both the owner and contractor. However, the EJCDC recognized that it is often difficult, if not impossible, for a contractor to estimate, or forward-price, the full impact of contract changes. This difficulty is a primary reason for contractors delaying the execution of change orders—or in some cases even refusing to execute them. To specifically address this problem, the EJCDC developed the concept of the work change directive to permit the contractor to proceed without delay before price and time are finally determined.

When a work change directive form is issued, the contractor must perform the work as recommended by the engineer and as authorized by the owner. This form provides for an estimate of the additional cost and time, which the contractor cannot exceed without prior authorization. But because the contractor is not required to sign the work change directive form, the contractor's right to request additional relief, if required, is reserved. When the owner, contractor, and engineer agree on the total effect of the change in the work, a change order properly signed by all parties is issued. Those who have used a work change directive report that it has significantly reduced conflicts during construction.

Another area of conflict in the change-order procedure is the basis for pricing changes in the work. Most standard documents provide that the value of the work covered by a change order will be determined in the following order: (1) by the application of unit prices previously bid, (2) by a mutually agreed–upon lump sum, or (3) on the basis of cost of the work plus a fee for overhead and profit. Because of the need to justify the cost of changes to higher authority or to regulatory or grant agencies, many owners require that changes be performed on the basis of the cost of the work. However, although many owners' documents state the allowances that can be used for overhead and profit, the documents frequently are silent, or sketchy at best, on what charges do or do not constitute "cost of the work" and to what "costs" the allowances or overhead and profit apply.

Clear and unambiguous definitions of these terms can prevent unnecessary conflict. The EJCDC documents were developed for use with contracts based on a unit price, lump sum, or cost plus fixed fee. As such, the documents contain comprehensive definitions of "cost of the work" and contain guidelines on applying allowances for overhead and profit. The definitions are useful in that they provide a road map for the forward-pricing of a change order when changes are to be performed on the basis of a mutually agreed–upon lump sum.

Lessening delay and acceleration problems. Another way conflicts can be readily minimized is to avoid using unenforceable clauses in documents. Such clauses make contract administration more complex and may prompt the owner to resist settling legitimate claims.

Damages for delay are a specific example of such clauses. Delay in construction projects is common. Contractors are almost invariably subject to the proposition that "time is money." Delay in performing the work or acceleration to overcome the delay frequently results in cost increases for the contractor that far exceed the direct cost of the change or of the changed condition that caused the delay. For these reasons, delay damages have become a major factor in many litigated or arbitrated construction claims. Careful evaluation of the project schedule is the basis for determining responsibility and extent of an excusable delay. There may be a concurrent delay over which the contractor has control, in which case damages are adjusted accordingly.

When the contractor causes the delay, the contract documents are usually clear and stipulate an amount in the form of liquidated damages to compensate the owner. But what about other types of delays, such as those caused by the owner or by circumstances beyond the contractor's control? For example, damage from Hurricane Katrina, as shown in Figures 2-1 and 2-2. When the contract documents do not address delays beyond the contractor's control, the courts usually hold that the contractor is entitled to recover damages.

Historically, many contract documents have contained "no damage for delay" clauses that preclude monetary adjustment and attempt to limit the contractor's recovery to an extension of time. Interpreted literally, these clauses may create an unreasonable risk to the contractor. As a consequence, many courts have interpreted these clauses narrowly, frequently finding that the contractor should be compensated for a delay in situations in which the clause's literal reading would have barred recovery. The courts' reluctance to enforce "no damage for delay" clauses arises from the inequity that such clauses engender.

Figure 2-1 Damage from Hurricane Katrina

Figure 2-2 Repairs after Hurricane Katrina

The EJCDC believes the prudent course of action is to provide in the contract documents for monetary adjustment when a delay occurs. The documents provide that (1) the contractor may be entitled to delay damages when the owner causes the delay and (2) the owner is entitled to delay damages (in the forms of liquidated damages) when the contractor causes the delay. Additionally, provisions are made for an extension of time following delays not caused by either party.

Allowing for unanticipated conditions. All contractors that perform work under fixed-price contracts determine their bids on the basis of certain fundamental assumptions concerning the conditions they will encounter and the effect of those conditions on price and time. Unanticipated conditions such as concealed subsurface or concealed physical conditions in or around existing structures can greatly disrupt project scheduling and otherwise increase the cost of performing the work.

The owner has an affirmative duty to disclose to a contractor information about conditions that will affect cost, progress, or performance of the work. This information usually includes reports of exploration and tests of subsurface conditions that the engineer has used to prepare the contract documents. If the work is to be performed in or around

existing structures, the information usually includes the owner's record drawings of those structures.

In an attempt to discourage contractors from inflating their bid prices to cover the contingency of unanticipated conditions, most contract documents include a "changed conditions" or "differing site conditions" clause that allows price or time or both to be adjusted when such conditions are encountered. To reduce the risk assumed under such clauses, however, these documents also include disclaimers concerning the accuracy or adequacy of the information provided and a related "site investigation" clause that requires contractors to make, at their own expense, all such investigations and tests as they determine necessary to prepare their bids.

Reliance on the "changed conditions" clauses and associated disclaimers, particularly with respect to subsurface conditions, has not had the desired effect. Contractors continue to include significant contingencies in their bids to provide for unanticipated conditions. Additionally, contractors' lawyers have been successful in the courts in showing the inequity of a design-construction system that puts virtually all of the responsibility for subsurface conditions on contractors and does not provide adequate time or funding for them to identify those conditions properly. Stronger wording of disclaimer has not been an effective method for changing these results. As a result, there is a trend to require the owner to bear the costs when information about the subsurface does not describe the actual conditions.

In recognition of this trend, the last two editions of the EJCDC standard construction documents take a somewhat different approach to the sharing of risks by the owner and contractor for unanticipated subsurface or physical conditions. As previously discussed, the documents provide for furnishing the contractor with all information on subsurface and physical conditions used by the engineer in preparing the contract documents. The significant change is in the disclaimer for the furnished information. The documents now provide that the contractor is entitled to rely on the technical data contained in the furnished information but not on nontechnical data, interpretations, or opinions. With regard to subsurface conditions, the technical data would include the boring method, location of borings, identification of materials encountered, level of subsurface water, laboratory test methods and results, and similar factual data, all as of the date(s) made.

The EJCDC believes this more equitable basis for sharing the risks for unanticipated subsurface or physical conditions will encourage contractors to decrease the contingency amounts in their bids and will reduce conflict by providing a better basis for determining an unanticipated or changed condition.

DESIGN-BUILD INSTITUTE OF AMERICA

The DBIA has standard documents and forms specifically for design-build projects (see chapter 7). In addition, the organization has a number of specialty publications related to project delivery systems and design-build.

STANDARD SPECIFICATIONS

Many agencies and organizations rely on standard specifications for their routine work. These standard specifications often include "contract type" provisions and, as such, can be used with minimal modification. However, use of the standard specifications requires a thorough knowledge of the contents, and, if the contents are not applicable for a project, supplementary general conditions or "special provisions" are needed to modify the standard. Failure to do this will result in confusion and claims.

One of the most common standard specifications used in many locations in the United States is the Standard Specifications for Public Works Construction (SSPWC), or "Greenbook," available from the Building News Institute. Organizations and groups that

participated in the development of the "Greenbook" and that continue to update it include the American Public Works Association, the Associated General Contractors of California, the Engineering Contractors Association, and the Southern California Contractors Association. (NOTE: although the "Greenbook" originated in Southern California, it now has nationwide appeal.)

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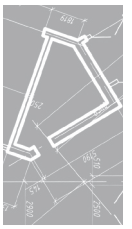

Chapter 3

Prequalifying and Selecting Contractors

This chapter focuses on selecting qualified contractors for construction projects. Generally called the competitive bidding phase of a project, specific contractor selection procedures vary among states, entities, and projects. This chapter introduces the principal steps in a typical bidding process, including the steps in prequalifying contractors.

Prequalification is the selection of contractors that will be permitted to bid on a given project. Not every project involves prequalification of contractors; indeed, regulations may not allow some entities to use prequalification.

The chapter begins with a discussion of prequalification, including its advantages and disadvantages. The remainder of the chapter presents the process of competitive bidding.

PREQUALIFICATION

Whether the contractor will be selected through competitive bidding with open advertising or through a limited bidding of a list of contractors, the contractor that eventually is awarded the project must be able to perform the work competently and effectively. The owner must make sure that the awarded bidder is qualified. The difference with prequalification is that only those contractors considered to be qualified are permitted to bid.

The following discussion presents the general issues, advantages, and disadvantages of prequalification, as well as the steps of the process.

General Issues

The general issues involved in prequalification are discussed in the following paragraphs:

Goals. The important goals of prequalification are

- To increase the probability of a successful project by selecting a contractor that has the appropriate experience, adequate capacity, a strong financial position, a written safety program, a safe work history, a sound environmental program, proper staff and equipment, quality management, and that has been proven cooperative.

- To reduce the possibility of delays, cost overruns, and associated lawsuits.
- To obtain equipment or materials that are compatible, have a proven record of performance, and are from a manufacturer that will provide necessary service.

Regulations. For most general construction work, public entities are bound by traditional advertised bidding procedures. Often the only contractor qualifications required are valid licenses to perform the work and financial capability to enter into a contract by providing bid and performance bonds (ASCE 1990 updated 2000). Privately owned entities may be able to skip the competitive bid process and contract with firms with which they want to work. For projects that are more specialized or may have unusual characteristics, such as a tunnel (Figure 3-1) or an environmentally sensitive area (Figure 3-2), the regulations under which public entities operate may allow for prequalification.

Local laws and regulations might also impose specific criteria for prequalification such as requirements for disadvantaged business participation, use of union-made products, disqualification of products made in specific foreign countries, and requirements for US-made products or components. Because of the variations in regulations, the owner or engineer should verify that prequalification is allowed (or possibly required).

Disqualification of a prequalified bidder. When a firm has been prequalified, it may be very difficult to disqualify that firm after bids are received and opened. Prequalification documents should include language such as: (1) all bidders must meet the qualification requirements detailed in the bidding documents, (2) prequalified bidders could be disqualified if those requirements are not met, and (3) the contractor's prequalification information is required to be submitted and approved prior to the submission of the contractor's bid for the project is submitted.

Examples of other situations benefitting from prequalification. There are other contracting situations besides the selection of prime contractors that might benefit from prequalification. Some common examples are

Figure 3-1 Moffat Tunnel/Winter Park, Colo.

Figure 3-2 Environmentally sensitive area in Mojave desert

Figure 3-3 Pipeline repair

- Establishing a standing list of firms eligible for certain kinds of projects (such as pipeline repair, as shown in Figure 3-3), rather than just for a single project
- Establishing a list of subcontractors or materials suppliers, including specialty subcontractors (e.g., instrumentation, supervisory control and data acquisition [SCADA] systems, and laboratory equipment and supplies)
- Continuing consultant services
- Continuing services for construction projects of a routine nature (e.g., short pipeline installations, rehabilitations, or relocations; package lift stations;

and short force main construction) based on established or negotiated unit prices

- Establishing lists of materials suppliers (meters, valves, hydrants, and so on)

Standing lists of prequalified contractors, subcontractors, and suppliers are usually valid for a specific time period, such as a year or two. Before the time period ends, a call for firms to submit prequalification documents is issued. Contractors may be more amenable to this process if the list is compiled fairly, if it is updated routinely, if there is a substantial amount of work to be awarded, and if the work is distributed among eligible contractors.

Another similar practice by design consultants is the naming of acceptable manufacturers of specific equipment in contract documents. The list is based on the requirements of the project and the consultant's and owner's knowledge and experience with products and suppliers.

Advantages

The advantages and disadvantages of prequalification vary with every project and must be evaluated to determine whether prequalification is justified. The advantages of using prequalification for a particular project depend on such things as location, complexity, timing, local bidding climate, and owner's and design consultant's experience with that particular type of project.

Advantages include benefits to bidders and owner. The owner benefits from accomplishing the goals of prequalification stated previously in this chapter. The owner reduces the time required to review and evaluate bids from unqualified bidders. It is easier for the owner to disqualify a bidder before bids are received than after they are opened.

Bidders and owners benefit from elimination of unqualified competition that could skew the bidding process by submitting unqualified low bids. Owners may save time over a typical full contractor selection process by using a standing list of acceptable contractors.

Bidders benefit from advanced knowledge of project requirements that could disqualify them; thus, unqualified bidders avoid the expense of preparing a bid and save themselves from the possible embarrassment or aggravation of public disqualification. A bidder's thorough, objective review of project requirements and its own qualifications could allow it to avoid the difficulties or losses that would result from contracting for work for which it is not qualified.

Continuing service agreements are typically used to eliminate or shorten the time-consuming selection process. The agreements are often used when a number of projects are anticipated and repetition of the normal selection process would be burdensome.

Owners may save on project costs by assuming the risk and eliminating or reducing the need for surety bonds from prequalified contractors.

Disadvantages

Most disadvantages associated with prequalification concern criteria that do not accurately evaluate a contractor's ability to complete the work successfully. For example, an owner that may have had a bad experience with a contractor that used rental equipment may wish to eliminate contractors that use rental equipment.

Prequalification may be viewed as a subversion of the general competitive bidding procedures. Prospective bidders may be disqualified based on some criteria that could be arbitrary, contrived, or based on a purely speculative concern for avoiding potential project difficulties. In these cases, the owner may be perceived as favoring a few contractors.

Prequalification may increase project costs by eliminating competition among bidders or by eliminating bidders that might have an innovative and cost-saving approach to executing the work. Disqualified bidders may be stifled in their growth if they are eliminated from projects in which they do not have experience even though they may be able to perform adequately.

Other examples of disadvantages to potential bidders would be cases where a bidder is eliminated because of poor performance on a previous project that is not representative of the bidder's current staff and ability. For example, a bidder might be disqualified because of previous poor performance by subcontractors, circumstances beyond the bidder's control, or ill-advised actions of the owner.

Prequalification Procedure

The following paragraphs identify the steps the owner (or consultant or both) should take to prequalify prospective bidders for a project. These steps are presented in approximate order of completion, although some may occur concurrently. Usually the project design is complete or nearly so when the process begins.

Determine advantages and disadvantages. Review the project design and conditions to determine whether prequalification is desirable for the project or for certain of its components. Weigh advantages and disadvantages as described earlier in this chapter. If the advantages clearly outweigh the disadvantages, then proceed with prequalification.

Identify critical characteristics. Identify the critical characteristics of potential bidders as required for the project. Set minimum acceptable criteria below which potential bidders would be disqualified. Depending on the project, the types of information to be submitted by the contractor include

- Performance and experience references
- Experience with similar work
- Types of materials or equipment produced
- Financial status (ownership)
- Equipment owned
- Personnel on staff
- Utilization of a written safety program
- Safety history including experience modification rate (EMR) and Occupational Safety and Health Administration (OSHA) forms.
- Pending litigation
- Bonding capacity

Minority business enterprise (MBE) status or woman-owned business enterprise (WBE) status or a description of a corporate commitment to use MBE/WBE firms. Note that there may be potential problems with requesting certain kinds of information (financial data, pending lawsuits) that by law are confidential. An attorney should review the types of information requested. Sometimes alternative information could be acceptable; for example, rather than providing a financial statement, a letter from a bonding agency might be acceptable. (NOTE: The contractor may also desire to learn the financial status of the owner.)

Prepare and send the statement-of-qualification form. Standard forms can reduce the time and expense of preparing prequalification forms and the time reviewing responses. One such form is Associated General Contractors of America Document No. 220, *Construction Contractor's Qualification Statement for Engineered Construction.*

The form should be evaluated to verify that it fits project conditions and owner requirements. Whichever form is used, it should clearly and precisely state which information is required; this will minimize the need for clarification or additional data.

The next step is to announce, advertise, and publish requests for qualifications (RFQs) from prospective bidders and send RFQs directly to known prospective bidders. These RFQs must include detailed instructions and explain precisely the minimum qualification requirements. In addition, RFQs specify when prequalification decisions will be made and whether disqualified firms will be notified of the basis for decisions. If appeals of prequalification decisions are allowed, the associated procedures should be detailed.

Projects may require subcontractor prequalification as well. The RFQ should be sent out far enough in advance so that prospective bidders do not expend time and effort contacting subcontractors that are not prequalified.

Evaluate the qualification statements. The owner or engineer usually establishes a selection team of three to seven members to evaluate the statements of qualifications. The responsibilities and authority of the selection team—that is, whether the team recommends qualified applicants to the decision maker or makes final decisions—should be clear. Team members must understand selection criteria. When qualified bidders are selected, the list should be sent to all applicants and an explanation for disqualifications sent to all disqualified applicants.

COMPETITIVE BIDDING PROCESS

The intent of the competitive bidding process is to select a qualified contractor at the most competitive price, which usually is the lowest bid. For this process to work, the owner must prepare clear, complete, and detailed plans and specifications and also clearly state the necessary qualifications of the contractor. Bidding instructions and requirements must also be clear.

The remainder of this chapter presents the main steps and documents used in the competitive bidding process. This section assumes the project is publicly funded; privately funded projects may use the procedure as well, although they may not be bound to do so by law.

Documents

Bidding documents are strictly used for advertising the project and giving instructions to the bidders. Restatement or explanation of contract or technical provisions must be avoided (Smith 1987). Standard Engineers Joint Contract Documents Committee bidding documents were listed and briefly described in chapter 2. Typical bidding documents are described in the following paragraphs.

Advertisement and invitation to bid. The advertisement and invitation to bid contain the owner's name, a brief description of the project, the bidding schedule, and an explanation of where to obtain the bidding documents. The advertisement and invitation are called the legal notice and are sent to contractors and placed in appropriate newspapers and periodicals. If a monetary deposit is required for the bidding documents (which includes a complete set of plans and specifications), the amount should be specified. Plans may also be available for viewing, but not removing or copying, in the owner's or consultant's office or other agency's plan room.

Instructions to bidders. The instructions to bidders detail the steps necessary to submit a bid and vary from project to project. Instructions generally include documents that must be completed, information that must be given, deadline for bid submittals, bid-opening procedures, and contract-awarding procedures. If a prebid conference is scheduled, the date and time should be included in the instructions and it should be specified

whether this meeting is to be mandatory or not. Instructions should also suggest strongly that bidders visit the project site.

Bid form. The bid form lists the line items of the project and the basis for the bid (e.g., cubic yards, lineal feet, lump sum). The basis should be standard measurements used in the industry. The form also has spaces to list totals for each item and the grand total of the bid.

Bidder qualification. This information is required by the owner to ensure that bidders are qualified and able to complete the project. A list of subcontractors and their qualifications may also be required. Typical qualification information was discussed previously in this chapter. It is suggested that a requirement to return completed bids on this form be enforced for ease of tabulating results in a consistent manner.

Bid security and bonds. The bonding amount required is usually 5 percent of the bid, although it may be higher. A bid bond form is usually included in the bidding documents, although most bond agencies use their own forms.

Addenda. During the course of bidding, bidders may raise issues that need clarification. If one contractor receives such clarification or if errors are found that need to be corrected, all bidders must receive the clarifications or corrections. Official addenda are sent to bidders, and the bidders must acknowledge receipt, usually by signing the addenda as received and submitting them with the bid.

Bid Opening, Evaluation, and Award

The following procedures are performed by the owner or consultant on behalf of the owner.

Bid opening. The time to open bids must strictly be observed; late bids should be treated as if they were never received (Smith 1987). Normally bids are randomly selected and opened and the grand total read aloud. The receipt of addenda and other required forms are often announced at the opening. A bid tabulation form listing bidders is filled out with the prices; bidders can be given a copy of the blank form to fill out as bids are read. An official bid tabulation should be sent to all bidders.

The process described above represents a public utility bid-opening procedure; privately held management companies operating municipally owned utilities or privately owned utilities may follow alternative bid-opening procedures.

Bid evaluation. Assuming the low bidder has complied with bidding instructions (especially that the bid was signed), the next step is to verify the bid. If it seems too low, considerably less than the next lowest bid, the bidder should be asked to verify the bid. If the bidder has made a verifiable mistake, the bid may be withdrawn. Forcing the bidder to perform at the quoted bid is rarely to the owner's advantage. If the low bid is valid, the bidder's qualifications are verified according to preestablished criteria. The owner or consultant may desire additional information or clarification from the contractor, but this should be limited to valid requests related to the project.

The owner normally reserves the right to reject all bids, but this typically happens only if all bids come in over the budget or there are substantive irregularities in several of the low bids. If, during the bidding process, serious errors in design are revealed, bidding should be stopped before completion and all bids returned. If only one bid is received, the owner should return the bid unopened or be prepared to accept the bid if it is within the budget and the bidder is qualified (Smith 1987). Negotiating with the low bidder for a reduced quote or revised project scope is a tricky issue and is done less often with public projects than with private projects; other bidders might have legal grounds to protest. In short, negotiating should be avoided, but if circumstances warrant negotiating, a construction contract attorney should be involved.

If the lowest bid is withdrawn or the bidder is found to be unqualified, the next lowest bid is evaluated and the bidder's qualifications reviewed. However, bids are valid for a specific time period, and if more time is needed, an extension must be approved by the bidder.

Contract award. The successful bidder is officially notified with a notice of award, and the contract documents are issued for signing. The contractor usually has a set period of time to execute the documents. When contract documents are signed and then countersigned by the owner, the contractor is sent a set of the signed contracts and a notice to proceed. The notice usually establishes the effective date of the beginning of the contract time.

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SECTION II

Alternative Project Delivery

- Owner Construction Management
- Third-Party Construction and Program Management
- Multiple Prime Contracts
- Design-Build and Turnkey Construction
- Construction Management at Risk

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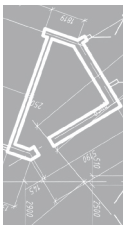

Chapter 4

Owner Construction Management

Some degree of management is required of each of the participants involved in the design and construction of any engineered project—the owner, the design consultant, and the contractor. This chapter examines owner construction management, which refers to an owner that assumes all the responsibilities except for the final design and construction of the project.

CHARACTERISTICS AND ACTIVITIES

With owner construction management, the owner has made a decision to be the principal member of the project team. This form of management may vary from utility to utility, depending on staff capabilities. For this discussion, the owner is assumed to be active in all phases of the project. Specific owner activities are discussed in the following paragraphs.

The owner guides the design consultant and makes certain that the completed project will serve the intended purpose. The owner is more involved in the final design and often performs many tasks such as soliciting bids on the work, awarding the contract, and interpreting all details to the contractor with a minimum of assistance from the design consultant. Owner construction management can facilitate the use of multiple prime contracts, as discussed in chapter 6.

After awarding contracts, the owner must assume additional responsibilities including

- Progress meeting facilitation
- Submittal reviews
- On-going schedule review and adjustment
- Construction inspection
- Materials testing

- Evaluating contract changes that may be required
- Negotiation for and documentation of change orders
- Reviewing contractor's submittals for labor expended and materials installed for progress payments

Throughout the construction period, safety on the jobsite must be a top priority. As contract administrator, the owner must make sure the contractor is following safety regulations, such as the scaffolding shown in Figure 4-1. Because of the owner's additional exposure under this form of management, the owner must be protected both contractually and by appropriate insurance coverage. An insurance consultant could be a wise investment.

The contract between the owner and contractor should have an established completion date and identify any interim schedule requirements. In order for the contractor to stay on schedule, the owner must perform its own responsibilities (such as submittal reviews, materials testing, and inspection) in a timely manner. Materials testing and inspection expectations should be clearly identified in the contract documents. As work is completed, the owner assembles record drawings from contractors, as well as operations and maintenance manuals from both contractors and equipment suppliers. These must be carefully filed and preserved for use in developing ongoing maintenance programs and general operating procedures required for the completed facility. The owner should request that O&M manuals be provided in both hard copy format and electronic format. Dual media are becoming commonplace for equipment suppliers. The owner may also need to negotiate maintenance contracts for complex equipment, for units such as elevators for which the safety of the public is a special consideration, or for equipment (such as heating, ventilating, and air conditioning [HVAC] equipment) where the owner's staff likely does not have expertise.

Figure 4-1 Contractors following safety procedures (courtesy Aurora Water)

Each construction management activity shares tasks in common: problem identification and alternative selection, cost estimation, project approval, preliminary design, final design, construction, closeout, and final asset entry. To control all of this activity, the owner must develop internal systems that permit the necessary communications among all groups, particularly construction management, engineering, finance, purchasing, and records. All of the systems must have access to information concerning the current status of the work during planning and throughout construction.

STAFF REQUIREMENTS AND RESPONSIBILITIES

When a utility decides to perform the construction management phase of a project, the availability and expertise of its staff must be considered. Even with relatively simple projects, construction management can take extensive staff time. Construction management itself is an art as well as a science, and a good practitioner is usually one who has much experience.

The owner usually performs an evaluation of staff availability and expertise during the planning phase of the project. A typical evaluation involves three steps.

1. Estimate the number of hours and type of expertise involved for each phase of the project.
2. Compare the results to the existing staff's availability and expertise.
3. Determine whether existing staffing is adequate, new staff (temporary or permanent) should be hired, or another method of contract administration should be used.

Table 4-1 shows an example of following these steps. In this case, the owner has adequate staff to cover all aspects of the project except for some engineering personnel needed after the preliminary approval stage.

No rules of thumb have evolved to help estimate the time involved in project management. However, experience at a utility in Michigan indicates that for projects between $50,000 and $5,000,000, project management costs for design may range from 0.5 to 3 percent of the total project cost and project management for construction services may range from 5 to 10 percent of the total project cost. The high end of these ranges is more typically associated with the lower valued projects because they are typically less efficient to manage, and there is a base level of project management tasks and responsibilities that are required regardless of the project size. These ranges should be used only as rough guidance because the level of effort for project management services is dependent on many variables, including the expertise of the staff, scope of services provided, size of the utility, size and complexity of the project, and the experience and competency of the contractor. The best way to arrive at good estimates is to compare the current project to similar past projects. To help with the estimation, the following paragraphs describe the owner's staff responsibilities during the project phases.

Planning

Project planning begins with identifying a system problem, infrastructure need, or system improvement to be addressed by a future capital project. Planning is typically completed by the owner's engineering or administrative division. For larger municipalities, a planning department may exist to serve in this role. To be effective, planners should seek input from all the utility's divisions, including operations, engineering, administration and human resources, and finance, as well as from customers, when developing proposed project lists.

Table 4-1 Example of estimating project staff requirements

Activity	Administration and Planning			Purchase and Finance			Engineering			Maintenance and Operations		
	Tot	Stf	Req	Tot	Stf	Req	Tot	Stf	Req	Tot	Stf	Req
Concept-project development	400	400	0	200	200	0	200	200	0	100	100	0
Preliminary design	100	100	0	80	80	0	400	400	0	40	40	0
Scheduling	40	40	0	80	80	0	80	80	0	0	0	0
Cost estimating	40	40	0	80	80	0	80	80	0	40	40	0
Preliminary approval	80	80	0	40	40	0	80	80	0	0	0	0
Final design	100	100	0	80	80	0	600	200	400	40	40	0
Approvals and permits	80	80	0	0	0	0	120	80	40	0	0	0
Solicitation of bids	0	0	0	40	40	0	80	40	40	0	0	0
Award of contract	20	20	0	20	20	0	40	20	20	0	0	0
Construction activity	60	60	0	60	60	0	800	300	500	100	100	0
Closeout	40	40	0	40	40	0	200	100	100	40	40	0
Total	960	960	0	720	720	0	2,680	1,580	1,100	360	360	0

Tot = total time required per activity in hours.
Stf = staff time available in hours.
Req = required additional time (design engineer and/or new employees) in hours.

The individuals or team tasked with planning responsibilities will facilitate development of proposed capital project lists and a means to prioritize future projects. Projects that are determined to provide the most value to the system or mitigate a system deficiency should be implemented first.

Initial project planning should include identifying and evaluating alternatives, estimating costs and personnel requirements, and determining financial capability. This study may be completed by owner's staff or a consultant depending on the size of the project and expertise available within the owner's organization. Results of the preliminary study should help the utility decide if the owner can manage the project. The study will include a description of the project's scope and budget and will serve as the basis of design.

Design

A project management team is usually charged with selecting the design consultant (see chapter 15 for the selection procedures). Once selected, the management team must establish a procedure for working with the consultant, usually by establishing a particular staff member to serve as contact for the consultant.

The staff contact person is usually empowered to make decisions for the utility as far as the design is concerned, unless the question is beyond that individual's power or ability to answer. If such a question arises, the contact member finds the staff member who can provide the answer. The contact member is also responsible for setting up the necessary meetings between the consultant and the management team or with any other staff member. The staff contact usually facilitates in-house review and approval of plans and specifications.

During the final design phase, the owner may wish to contract for surveying, geotechnical assessment, and similar services required by the designer and required to permit an early start of actual construction. Utility permits can be obtained during this period so

that buried pipe installations can be completed early to maintain the overall program and schedule. The owner may also assign the responsibility for obtaining some of the required regulatory approvals for the project.

Usually the contract and bidding documents are prepared by the consultant. Chapter 2 discusses use of EJCDC documents; however, the owner may have standard contract documents such as general conditions and instructions to bidders it prefers to use. Likewise, the actual bidding, including a prebid meeting and site visit for prospective bidders, may also be conducted by the owner or the consultant, depending on the owner's preference. Previous chapters discuss bidding procedures in detail.

Construction Services

With owner construction management, the owner has several responsibilities during the construction phase. The owner must provide staff who have the time and qualifications to expedite, not hinder, construction. The main categories of responsibilities of the owner project manager are as follows:

- Perform required inspections.
- Perform (or subcontract) materials tests.
- Process progress payment requests.
- Provide contractor with plan and contract clarification (respond to requests for information [RFIs]).
- Review shop drawings and other submittals along with the designer.
- Conduct and attend preconstruction and construction progress meetings.
- Coordinate with owner's staff and customers as needed. Construction may involve shutting down of processes at a plant, shutting down a customer's service, temporarily shutting off fire protection, or may impact system operation in other ways. The project manager should facilitate all construction impacts with affected parties.
- Make sure that the owner's employees perform their tasks safely when onsite. Any possible unsafe working methods on the part of the contractor's crews or subcontractors should be reported to the contractor. (NOTE: Exactly how much the owner is responsible and liable for jobsite safety should be reviewed by legal and insurance experts.)
- Review contract changes and process change orders.
- Process contractor pay requests.
- Prepare (or review) record drawings (also called *as-builts*).
- Obtain or develop O&M manuals and procedures.
- Facilitate training of owner's staff by coordinating, scheduling, and staffing the appropriate number and timing of training sessions.
- Furnish certification of completeness to the contractor and applicable regulatory agencies.
- Develop punch list and prepare other required contract closeout documentation.

With owner construction management, special training for the owner's staff may be required, in particular for the construction observers or inspectors. Construction

Figure 4-2 Installation of water tank (courtesy Aurora Water)

inspectors must be aware that their primary responsibility is to see that the project is completed in compliance with the requirements of the contract documents. In other words, the owner's construction inspectors should not change the design in the field. Following clearly established procedures for change approval is important.

Construction inspectors should also be trained to keep a detailed daily diary of progress. Such diaries are often crucial in settling disputes, as well as in solving field problems. Photographs or video should be taken regularly. Good construction photographs show the site before work has begun as well as work in various stages and at different angles, such as the installation of a water tank in Figure 4-2. Useful photographs should also show the date and scale of objects in the picture, such as in Figure 4-3, where two workers in the picture provide scale to a plant expansion.

Items to be noted in daily progress diaries include

- Construction activities
- Staff on-site (owner and contractor)
- Equipment on-site
- Safety concerns
- Site conditions and weather
- Materials tests conducted

- Inspections summary
- Problems encountered, who was informed, and how problems were resolved
- Items that could impact the project cost, schedule, or both
- Pay items and quantities if it is a unit price contract
- Contractor downtime and reasons

With multiple prime contracts (see chapter 6) or special equipment contracts, the owner must coordinate delivery and installation with the other contractors. Coordination may be assigned to one of the contractors through the construction documents. These types of contracts are typically used by more experienced owners on larger projects. Multiple contracts can speed up work, give the owner more control over project quality, and reduce the overall project cost, but they also require more knowledge and ability.

As contracts and procurement agreements are completed, work must be inspected for final acceptance and contracts must be closed out. A punch list of construction items that need correction or changing is used to indicate items that may not be complete or that may require corrective work. With owner construction management, the owner's direct involvement in the work should reduce the number of punch list items.

Other project closeout tasks include completion of record drawings, compiling of O&M manuals, and training of the owner's staff. The owner construction manager must complete record drawings or receive them from the contractor and verify their accuracy. These drawings, together with O&M manuals on equipment units, must be filed and shared with operating divisions for use in developing O&M programs. Prior to final acceptance by the owner, the owner's staff should be trained on operation of all new equipment and processes. Multiple training sessions should be provided to accommodate different shifts and locations of staff to be trained.

Figure 4-3 Workers involved in plant expansion (courtesy Aurora Water)

Because each project should be viewed as a learning experience, project documentation should be stored. Numerical data can be entered in an electronic database for easy access and comparison. Data and other documentation can be used to plan, estimate costs, schedule, and manage future projects. Documentation should include

- Project description
- Planned and actual completion dates
- Unit costs for the work
- Cash flows broken down into materials, labor, contractor, and miscellaneous costs
- Owner's labor and materials costs organized by phases (study, design, construction services)
- Photo records and diaries

ADVANTAGES

Owner contract administration has several advantages, particularly if the owner has trained staff with the necessary time to devote to the project. The following paragraphs present important advantages and what the owner must do to maintain them.

Direct Communication

Rather than spreading out the responsibilities among several participants, especially to an outside contract administrator, the owner keeps the responsibilities in-house. Communication between owner and contractor is more direct without another participant acting as a go-between. The owner's staff is more familiar with all the utility's systems and can reduce the potential for problems.

For this advantage to work, the owner must maintain open and direct lines of communication within its own organization as well as between its staff and the staffs of the principal designer and contractor. Direct communication (see chapter 14) facilitates final design, construction, early completion, acceptance, and startup of the new facility or installation.

Smoother Process for Final Design and Approval

When the owner is more involved in the project from the start, particularly if its staff performs preliminary design, the owner has developed a stronger conceptual image of the project. With a strong concept, the owner can better communicate its goals and requirements for the project, which helps both the final design and construction.

When the owner is actively involved in the design process, the owner may be able to obtain permits to arrange subsurface explorations and analysis, site clearing and similar activities, and possibly excavation. The need for rights-of-way can also be determined, and legal and contractual activity can be expedited.

Timely processing of design, changes, and shop-drawing approvals is essential. It is important throughout the construction phase of the work, but it is especially important at the beginning because of the greater volume of information that must be approved to allow work on the contract to begin and the difficulties that can occur with inadequate planning. The active owner is in a better position to complete these reviews.

Improved Resolution of Construction Problems

Many problems that arise during construction are a result of differences in interpreting plans. The owner that has been active in the preconstruction and construction phases can more readily resolve such differences. If changes to the design are needed, the owner can work directly with the design consultant rather than working through the construction manager. If a cost increase is involved, the active owner can more readily decide its merits and means of funding.

Involvement of Operating Personnel

The active owner's personnel who will operate and maintain the facility can more easily be involved from the beginning. This involvement can have a number of advantages, including the following:

- Early development of the team concept by the owner's personnel can increase open communication.
- The availability of persons knowledgeable in the owner's requirements, operations, and fiscal limitations can ensure the intended detail in design, proper interpretation of the contract documents in plan review and approval, and timely solutions for day-to-day problems that arise during construction.
- Operations staff who have been involved in the work are in a better position to bring the new facility online in the shortest possible time, to keep unscheduled downtime in this critical period to absolute minimum, and to assist in training required additional workers.
- Operations staff actively involved during construction will ensure the finished product successfully meets the design intent, the utility's standards, and the needs of the operations staff for operation and maintenance.
- Operations staff actively involved during construction will increase the utility's understanding of all aspects and intricacies associated with the project. This understanding is important once the utility takes ownership of the project upon completion.

DISADVANTAGES

The main disadvantage of owner construction management is the staff time required. Most utilities cannot take staff away from normal day-to-day tasks. Similarly, project management requires special skills, experience, and resources that existing staff may not possess. If the owner's staff does not have adequate time available to meet the needs of the project, either their involvement in the project is reduced to a level that negates many of the advantages or the work they were originally hired to do will suffer.

The owner assumes more of the risk of the project when the owner serves as project manager. Furthermore, an outside project manager may have a more objective view of the project or may bring broader experiences that might allow more creative and efficient problem solving.

Chapter 5 discusses an option for an owner that does not have a staff with adequate time, expertise, or experience to perform contract administration, that is, the use of a construction management firm.

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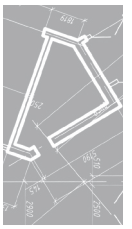


Chapter 5

Third-Party Construction and Program Management

Capital delivery projects such as those shown in Figures 5-1 and 5-2 have become increasingly complex. Some projects are simply large, but others may be multifaceted with several projects being managed and delivered simultaneously as a program. In other circumstances, the project owner's staff may not have enough time, expertise, or experience. In all these cases, the owner may hire a third-party program management (PM) firm, construction management (CM) firm, or PM/CM firm to perform contract administration. This chapter presents characteristics of a project managed by a PM/CM firm, advantages and disadvantages of using such a firm, project participants' responsibilities, and contract administration procedures.

CHARACTERISTICS

There is a variety of models by which a PM/CM project can be configured. These range from one extreme under which the owner essentially delegates all responsibility for delivery of the project to the PM/CM to a continuum of gradually increasing owner responsibility. These latter cases typically incorporate some element of an integrated team of owner and PM/CM personnel.

A project owner may contract a CM firm for its special expertise in the construction phase of a project or engage a PM firm to assist with all elements of the delivery, including project controls, predesign, environmental compliance and permitting support, design, and construction. A PM/CM quite often does not provide final design or construction services; the owner contracts directly with the design consultant and the construction contractor. The PM/CM firm does maintain a peer relationship with the design consultant and the construction contractor performing the work. There are also administrative ties among the design consultant, the construction contractor, and the construction manager. Again, however, the range of services provided by a PM/CM may vary significantly, depending upon the owner's preference for delegation of responsibilities. Literature developed and distributed by the industry trade groups (e.g., Project Management Institute, Design-Build Institute of America, and Construction Management Association of America) describes multiple variations of these models and is a reliable resource for in-depth descriptions and assessments of the variants.

Figure 5-1 Pump station

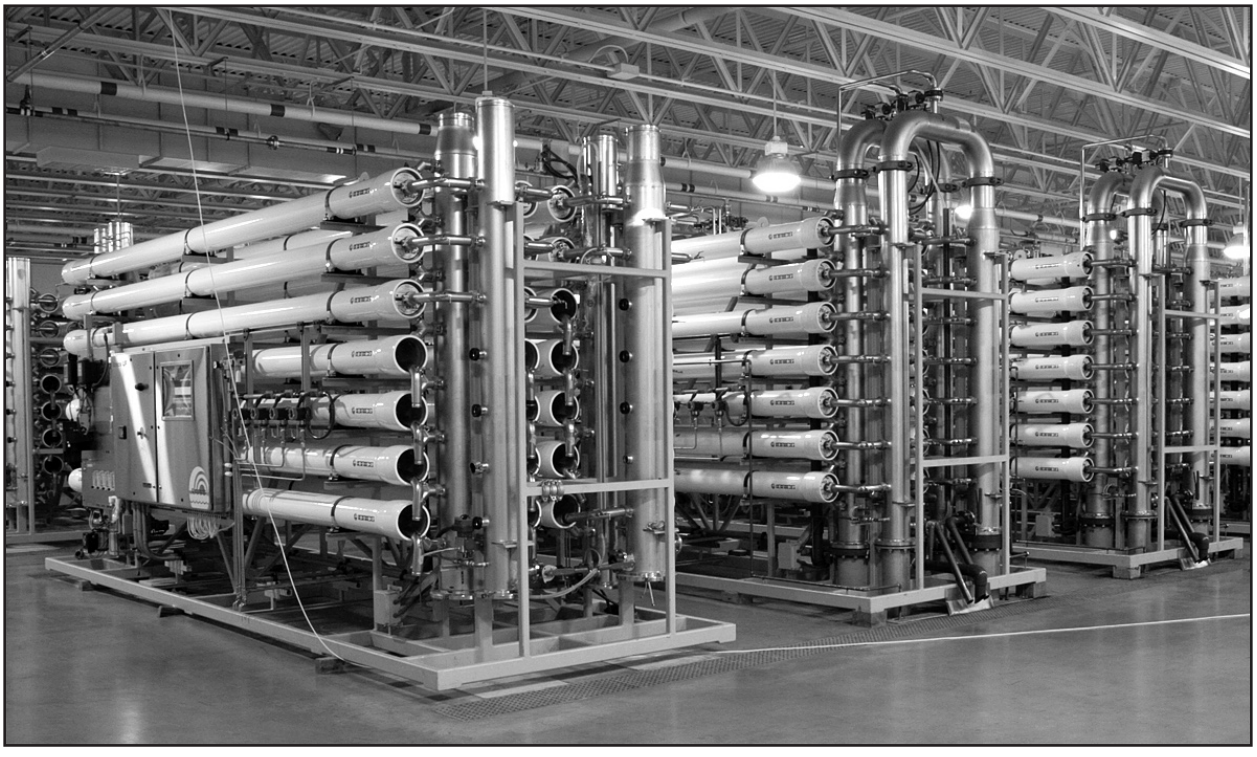


Figure 5-2 Membrane water treatment plant

Whereas a PM may have a wide range of responsibilities encompassing all aspects of the project, a CM's main responsibility is to perform contract administration during the construction phase of a project. The CM's responsibilities include observing construction, scheduling inspections, resolving field problems, and processing change orders and progress payments.

ADVANTAGES AND DISADVANTAGES

Proper capital project delivery requires a commitment of time and a high level of expertise and experience. Appropriate staffing and management can make the difference between a successful project and one less than successful.

The owner of a project must determine whether its staff has the time, expertise, and experience to provide proper project delivery management. In chapter 4, a simple method of making such a determination was discussed. If the owner determines that its staff does not have the time, expertise, or experience to perform project delivery management, the owner may hire the additional staff required or retain the services of a PM/CM firm.

Either of those two options requires funding, and the owner must look at the economics of the options. For example, if the owner hires new staff, the cost of benefits and other overhead must be included in the cost of the new staff to the project, and the owner must think about what happens to the staff after the project is completed. Will they become permanent employees? If so, permanent positions must be justified. If additional staff is hired on a temporary basis, it may be difficult to find qualified people.

Advantages

The main advantages of hiring a PM/CM firm are

- Expertise and quality of staff
- Cost savings
- Quality control
- Risk management

Expertise and quality of staff. As discussed earlier, PM/CM firms specialize in delivery of capital projects and maintain staffs that are focused in this area. Accordingly, PM/CM firms generally have a larger selection of personnel, with varying degrees of experience and specialty expertise, from which to staff a project or program.

Cost savings. Retaining the services of a PM/CM may be less expensive to the owner than using the owner's staff time required for contract administration or hiring additional staff. The cost of the PM/CM may also be considered part of the capitalized cost of a project or program and could be covered under the project financing mechanism, such as bonding. Staff time may or may not be so covered.

A PM/CM firm, through its expertise and experiences with the type of project to be constructed, is generally able to help control project costs. If the PM/CM is retained early in the project, it can add its expertise in the planning and design phases, when most of the decisions affecting major cost are made. In particular, the PM/CM can help with contract packaging and selection, project staging and sequencing, and financial modeling and rate setting.

Quality control. During design and construction, the PM/CM may be more objective than the owner. The PM/CM may have a wider range of experiences and can better anticipate and deal with potential problems than can the owner.

Risk management. By hiring a PM/CM, the owner transfers some of the project risk to that firm. The PM/CM can be held responsible for the project quality and cost consequences of its work as contract administrator.

Disadvantages

The PM/CM does add another participant to the construction process, which may require additional administration and coordination by the owner. A poorly performing PM/CM creates many problems for the owner, in which case owner contract administration would be preferable.

RESPONSIBILITIES AND PROCEDURES

The following discussion assumes that the PM/CM has been hired for contract administration during the construction phase, as is frequently the case. For a discussion of PM/CM responsibilities in other phases of a project, refer to chapter 8.

Owner

The owner must clearly establish the responsibilities of the design consultant, construction management firm, and contractor. Without a clear understanding, tasks will go undone and conflicts will inevitably occur.

The owner, having decided to hire a PM/CM, goes through the same procedure as with selecting a design consultant. Those procedures are discussed in chapter 15. The important thing for the owner to remember is to hire the PM/CM well before the construction is scheduled to begin. The PM/CM must have enough time to become familiar with the project, as well as to organize its staff. On complex projects, this lead time could be anywhere from several weeks to several months.

During the construction phase, the owner depends on the PM/CM for day-to-day contract administration of the project, especially the coordination and communication functions. The owner must provide the staff necessary to perform several duties, such as

- Resolving field problems
- Reviewing and approving changes
- Processing pay requests
- Attending construction progress meetings
- Observing startup and testing
- Providing staff for training

Program or Construction Management Firm

The program or construction management firm's specific responsibilities vary considerably from project to project. As always, these responsibilities must be clearly established and agreed to by all participants. For example, Figure 5-3 shows the inspection of scaffolding.

The important responsibilities that must be established include

- Field authority or line of authority for making decisions
- Inspections and materials testing
- Construction monitoring
- Environmental and safety protection
- Community relations

After being hired by the owner, the PM/CM must become thoroughly familiar with the project, including

- Drawings and specifications

Figure 5-3 Scaffold inspection

- Contract conditions
- Site conditions
- Owner's current systems, especially at connection points within and without the project

The PM/CM usually has a site representative (also called the resident manager or project manager) who is always at the project and who is responsible for contract administration, coordination, and communication. These responsibilities are largely the same as discussed in chapter 4 for owner contract administration. However, there are some differences as can be seen when the following list of PM/CM responsibilities is compared with the list in chapter 4, such as

- Perform required observations and inspections.
- Coordinate inspections to be performed by owner's staff.
- Perform (or subcontract) materials tests.
- Process progress payment requests from contractor (to be submitted to owner).
- Provide contractor with plan and contract clarification, if within the PM/CM's abilities; otherwise refer the question to the owner or design consultant.
- Conduct and attend construction progress meetings.
- Make sure that the PM/CM's employees perform their tasks safely when onsite. Report any possibly unsafe working methods on the part of the contractor's crews or subcontractors to the contractor. (NOTE: Exactly how much the PM/CM is responsible and liable for jobsite safety should be reviewed by legal and insurance experts.)
- Review contract changes and process change orders to be approved by owner.
- Prepare (or review contractor's) record drawings.

- Furnish certification of completeness to the contractor and applicable regulatory agencies.

The PM/CM's primary responsibility is to see that the project is completed as described and required in the contract documents. All design or other changes must be approved by the owner and design consultant.

As discussed in chapter 4, construction inspectors and observers should also be trained in keeping a detailed daily diary of the progress. Chapter 4 also includes a list of the events that should be recorded in the diary. The PM/CM usually retains diaries and other records, rather than giving them to the owner. In the event of a dispute, the PM/CM may be required to give a copy to the owner and other participants.

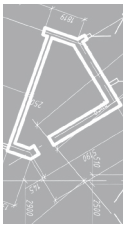
The PM/CM normally works with the owner to develop the punch list of final completion items. The PM/CM usually prepares the as-built drawings to be given to the owner.

Design Consultant

The design consultant usually does not perform construction management but does perform the other typical tasks required of the designer, including

- Shop-drawing review
- Design change review and approval
- Field problem resolution

The design consultant rarely has a site representative on a PM/CM-managed project. However, the designer should have a staff contact available at all times during construction.



Chapter 6

Multiple Prime Contracts

Multiple prime contracts (MPC) construction refers to a project that has more than one construction firm contracting directly with the owner. In some US states, MPC is required; such a situation is referred to as state-mandated MPC construction. The two principal categories of MPC are the state-mandated MPC and the construction management approach. This chapter discusses each of these categories and looks at the advantages and disadvantages of multiple prime contractors versus a single prime contractor.

MULTIPLE PRIME CONTRACTS PROJECT MANAGEMENT

Particularly with complex projects such as a treatment facility, one approach is to use multiple prime contractors. As with all projects, the owner must select an effective contracting approach to complete the project on time and on budget and to meet specifications. With MPC, the owner contracts specific portions of the project to specialty contractors, most often in the following categories or trades:

- General construction
- Electrical
- Heating, ventilation, and air conditioning (HVAC) or mechanical
- Plumbing

The MPC approach is better suited to medium- to large-scale projects, mainly because of the increased management costs for the owner. MPC is very attractive when the bidders for the project do not have the size, resources, and track record to prove their ability to handle the entire project successfully and independently. If such a case occurs, splitting the project into smaller pieces can be advantageous to the owner.

State-Mandated MPC

Separate prime trade contractors are required in New York and North Carolina, among other US states. In North Carolina, for example, state-mandated prime trade construction is required if the value of the work involved in a particular trade is in excess of $40,000. Some states also allow single prime bids, in which case the owner would be allowed to

accept either the low single prime bid or the low multiple prime group bid, whichever presents the lowest overall cost to the owner.

As mentioned earlier, the normal contract categories are general construction, electrical, HVAC, and plumbing. Even though the prime trade contractors directly contract with the owner, the general contractor usually coordinates all construction activities on a project. The general contractor needs to work closely with the prime contractors to ensure that all work is scheduled properly and installed and completed as specified, within cost and schedule constraints.

In addition, the owner typically hires a consultant or engineer to provide design and management services. In this case, the proper flow of information (though not necessarily authority) for an MPC project would be as shown in Figure 6-1. Figure 6-2 illustrates the flow of information if the project also has a construction manager.

The state-mandated MPC approach complies with laws and regulations that govern municipal procurement and awarding of contracts. All of the construction, materials, and equipment are awarded on the basis of competitive fixed-price bids. Other types of contracts discussed in this manual, such as design-build or guaranteed maximum price, may not comply with such laws. The following text presents an example of using MPC to satisfy such laws.

Example. The project was to build a water treatment plant with a 6-mgd (22,700 m^3/d) capacity producing clarified water (0.5 ntu) from a high-turbidity river water supply for the San Patricio Water District in Ingleside, Texas. The project included all treatment plant process components: buildings, aboveground and belowground piping, process control and instrumentation, pumping, electrical, water storage tanks, sludge-handling facilities, and all site improvements.

The time available from the beginning of final design to completion and operation of the plant was 34 weeks. A consulting engineer completed the preliminary design work. The engineer then joined the owner's staff—acting as owner's staff, acting as owner's representative, and coordinating the work of the multiple prime contractors. The MPC approach was selected because of the time limitations and the need for targeted process equipment selection. Equipment selection was critical because it controlled building dimensions, underground piping sizing and location, electrical requirements, and other factors.

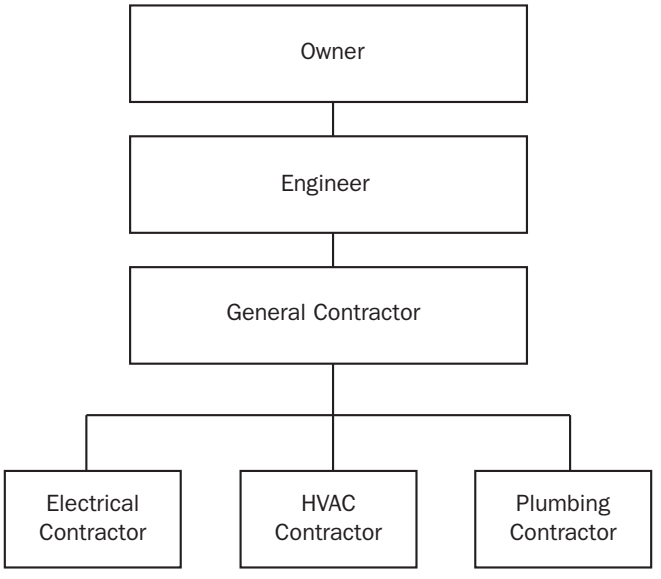


Figure 6-1 Typical flow of information for multiple prime contractors

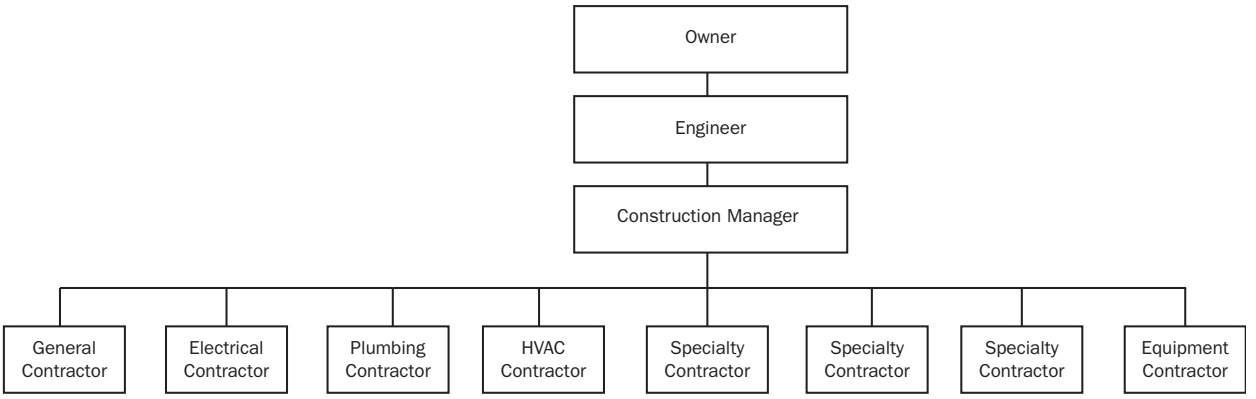


Figure 6-2 Typical flow of information for multiple prime contractors

Separate contracts were issued for

- Flocculation and settling process equipment
- Filtration equipment
- Pumps and motors
- Underground piping, site work, and building and process unit foundations
- Building, electrical, piping and process unit installation, and storage tanks

The owner and engineer were concerned about potential disagreements among contractors as to responsibilities. This concern did not turn out to be a problem, though, because the owner was involved on a direct and continuing basis. The advantage of including equipment manufacturers and construction personnel early in the process resulted in time and cost savings.

Construction Management MPC

The difference between construction management MPC (CM-MPC) and state-mandated MPC is that in the former case the owner has more flexibility on how to organize a project. In a project using the construction management approach, the project construction manager (CM) works with the owner and the design consultant or consultants to divide the project into a number of logical procurement and construction contracts for separate bidding. The CM may also be hired earlier in the project and may assist the owner in selecting the design consultant. Whichever is the case, the CM more closely manages the work of the trade contractors, particularly with respect to scheduling.

The following examples illustrate the CM-MPC approach.

Example 1: Oregon. A firm provided CM services on a $106 million plant project in early 1978. Originally scheduled as a five-year project, the time frame was extended to seven years to accommodate the owner's ability to finance the project. Design services were provided by seven separate firms. The project was subdivided into 33 contracts for construction and procurement of equipment and materials.

Only one significant claim was filed; it was settled for $37,000. Despite the funding-imposed delay in project execution, the project was completed in early 1985 at a total cost less than the original budget estimate. Demonstrated savings equaled the fee for CM services.

Example 2: Utah. A firm provided planning, design, and construction management services for a $110 million wastewater treatment facilities construction project. The project was divided into 17 construction and 8 equipment procurement contracts.

A benefit of subdividing this large project into smaller construction and equipment procurement contracts was a great flexibility in scheduling. Working with a number of contractors made it easier to meet the owner's changing needs. Rather than a single firm having to make major scheduling revisions as timing changes became necessary, contractors were able to adjust their individual schedules more easily. This approach enabled the CM to accommodate a number of funding delays, as well as one funding acceleration, without disrupting the overall program.

Example 3: Tennessee. A firm provided scheduling contract administration and inspection services for $94 million worth of facilities construction. The program was divided into 91 construction contracts. At the midpoint of the program, construction bids on 38 contracts, representing $30 million in construction value, were $10 million below the budget estimate, allowing the addition of 12 construction packages to the total program.

CHARACTERISTICS OF MPC PROJECTS

The following paragraphs examine the characteristics, advantages, and disadvantages of MPC projects compared to projects using a single general contractor. The characteristics are typical but may not apply to every project.

Total Contract Price

The total contract price is often lower with the MPC process. Single prime contractors incorporate the subcontractors' bids and apply additional markups for bonds, insurance, overhead, and profits. This increased cost could vary significantly from project to project; but generally the increased markups can be as much as 5 percent of the total contract price, which can be significant on large projects. Another possible reason for the lower price with MPC is the increased involvement of the design consultants and the owner with the contractors to improve communication and reduce misunderstandings. The MPC process allows earlier involvement of specialty contractors and equipment and material suppliers, which also tends to keep prices lower.

Separate and Smaller Contracts

Smaller contracts allow more contractors an opportunity to bid on the job. The result is a more competitive bidding climate and often a chance for more local contractors to become involved in the project. This not only can reduce project costs, but it also may enhance community relations.

Smaller contracts usually allow contractors to estimate project costs more precisely. The need for a large general contingency fund is reduced because individual contractors each have a clearly defined contingency. Contractors have more control, which may reduce the overall expense of contingencies.

The use of MPC is inherent to the fast-track process, in which construction can begin before design is complete. Typically, construction contracts for preliminary site work, foundation, and other underground work (Figure 6-3), plus procurement contracts for items of equipment requiring long lead time, are awarded early in the process, while design continues on superstructure, exterior finishes (Figure 6-4), final landscaping, and other parts. With proper scheduling and management, total project time and cost can be significantly reduced through the use of a multiple-contract fast-track approach.

Figure 6-3 Preliminary site work (courtesy Aurora Water)

Figure 6-4 Finished exterior

Bid Shopping

Bid shopping is a process in which the general contractor solicits lower quotations from the various subcontractors after its own bid is submitted to the project owner. The multiple prime contracting method prohibits postbid shopping by general contractors. Bid shopping can result in an "auction," which could drive the price of the subcontractors' work down to a point where they cannot financially perform. Although the project owner faces no

financial repercussions, the project sometimes suffers from reduced quality. Some states require that subcontractors' bids be listed if they are greater than a certain amount.

Prepurchased Equipment

The MPC approach may require significant up-front planning. In the early phases of the project, the project team can prioritize projects needs, for example, equipment items that have a long lead time. Such planning can reduce the duration of construction contract—and the cost of contractor overhead—resulting in an earlier completion of the entire project.

Early purchase of equipment can also assist the designers in preparing more complete plans because specific equipment dimensions, performance, electrical requirements, and other parameters are known. This knowledge helps the owner plan for operations and maintenance of the equipment (staffing, parts inventory, lubricants). It makes it easier for the owner to obtain assistance from the equipment supplier's staff; suppliers are more eager to contribute their energies, ideas, and time to a contractor that has made a commitment to purchase equipment.

With the CM and MPC approach, the early planning and subdividing of the project into various contracts promotes improved long-range planning.

Design Costs

Design costs tend to be lower with the single prime contractor method approach. Multiple prime contracts require the design engineer to define distinct separations of work to form a contractual basis with the multiple prime contractors. Additionally, the design engineer must create a separate bid and proposal form for each prime contractor.

However, it is important to note that MPC encourages increased involvement of the design consultants and owner. Furthermore, MPC promotes earlier involvement by specialty contractors and equipment and material suppliers, which may contribute to lowering costs.

The MPC approach often requires the design engineer to focus more on the details of the project in order to deal with each prime contractor. Such focus can result in plans that are more complete and have fewer errors. Any additional design costs are not usually significant relative to the overall cost of the project. However, additional costs might be more than compensated through reduced overall costs and by the value offered in the early involvement of contractors.

Contract Administration

Contract administration costs may increase if the multiple prime contracting method is used. Under the MPC approach, the owner and engineer must work with each contractor separately with regard to progress meetings, shop-drawing review, pay requests, change orders, claim and disputes, and general coordination.

Claims and Disputes

There tend to be fewer claims and disputes from a project under single prime contracting. Single prime contracting allows the owner to deal with a maximum of two other parties in the face of a contractual dispute—the engineer and the single prime contractor. Multiple prime contracts become very complicated when one contractor delays another or when any of the multiple prime contractors becomes insolvent.

If multiple contractors are used, it is less likely that large claims on a project will be generated. Although one or several contractors might need to make a claim, each claim

may be smaller than the claim made by a single prime contractor because each of the smaller contractors will have a smaller piece of the project.

Claim settlement or negotiation (chapter 13) is based on communication between the parties and their mutual desire to reach agreement on the claim. It is easier to reach this mutual agreement when small claims, rather than large claims, are presented for negotiation.

Quality Control

Quality control can be easier with the single prime method for several reasons.

- The general contractor becomes another responsible party in the shop-drawing review and coordination process.
- The general contractor is responsible for the quality control of all of the finished work product.
- The owner has one party to hold responsible for quality control.
- In the event of damaged work, it is not the owner's responsibility to prove which contractor damaged the work.

No price tag can be placed on quality. Needless to say, any method chosen must create a project of high quality in order to meet the owner's needs. Although higher quality may be easier to achieve under the single prime approach, it can still be achieved by using multiple contractors, although additional coordination and effort are required by the owner and engineer.

The concept of total quality management (TQM) can be used in construction to allow every supervisor and worker the opportunity to contribute more actively to the successful completion of the work. TQM stresses the importance of customer-supplier relationships. The CM approach is also based on effectively managing these relationships. TQM emphasizes the efforts of the team, rather than those of the individual (as does the CM approach). And, perhaps most important, both systems underscore the need for open communications and continuous improvement.

Communication and Coordination

Communication between the general contractor and respective subcontractors is often easier with the single prime contracting method. However, the direct line of communication between the owner, the engineer, and separate primes is improved in the multiple prime contractor process. More direct and focused coordination meetings are necessary under the multiple prime contractor process.

Most general contractors are accustomed to coordinating all work activities at the jobsite. General contractors are experienced in performing their own work activities as well as in coordinating a large number of suppliers and subcontractors. Therefore, overall project coordination tends to be better with the single prime contracting method.

Cash Flow Management

Multiple contracts can reduce cash flow constraints by allowing the owner to match the work placed under contract to the availability of funds. Given the high costs of borrowing money, this advantage can also reduce interest costs.

GENERAL QUALIFICATIONS AND PROCEDURES

For an MPC project to be successful, the owner, engineer, construction manager, and contractors should meet certain qualifications and follow certain procedures, as discussed in the following paragraphs.

Adequate Experience

The owner, engineer, and construction manager should be experienced in working under an MPC approach and must be adequately staffed. The owner, engineer, and CM in the multiple prime contract approach are taking on much of the scheduling, coordination, and control responsibilities that would normally be performed by a single prime contractor. To be performed well, these tasks require a great deal of experience. Failure to perform can lead to increased claims for interference and delay, extension of schedules, and an increased number of incidents among contractors when liability and responsibility lines become blurred. For projects with a cramped or tight project site or schedule, scheduling problems tend to increase.

Increased management costs may have to be justified to a utility's governing board. Costs should be shown to reduce overall contract price, reduce change orders and disputes, and reduce overall construction time.

MPC projects are particularly challenging for a general contractor (as opposed to a single prime contractor) because the general contractor has to determine a realistic and accurate schedule for the overall project. Obtaining scheduling information from other prime contractors may be difficult. The owner should schedule meetings to be attended by all prime contractors to be certain that each contractor realizes the need for full cooperation and to provide schedule information essential to the overall planning and execution of the work.

In all projects work must be scheduled logically to avoid having multiple contractors in the same work space and to avoid having to do work over. The electrical contractor, for example, might want to start installing duct banks as early as possible. These duct banks typically run all over the project site. If, however, the project is an entirely new one, it will be necessary for the electrical contractor to wait until the appropriate time to install duct banks. In this case, a number of preceding tasks must be completed before duct work begins. Site grading, sewer and drain installation, structural excavation, and structural backfill are some of these tasks. The owner or CM must be careful in working with contractors to ensure their schedules meet the needs of the overall project team. In both new and expansion projects, it is crucial to sequence contractor schedules carefully.

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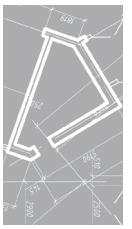

Chapter 7

Design-Build and Turnkey Construction

The term *design-build* refers to a construction method that uses a single entity for both the design and construction of a proposed facility. *Turnkey* is a term often used interchangeably with design-build; however, in the context of this chapter, *turnkey* implies that a single entity provides not only design and construction but also such additional services as financing, ownership, and/or operations and maintenance. Traditional services such as startup, operation and maintenance manuals, and staff training could be part of either design-build or turnkey.

Design-build has been used in the private sector for industrial facilities, petrochemical plants, and other projects for a century or more; in fact it has been used in public sector work for probably as long but under a slightly different form. When a developer constructs a new housing tract, often the water and wastewater utility lines are installed and paid for by the developer and then turned over (dedicated) to the local municipality or water agency for operation and continued maintenance. The facilities are designed by the developer or developer's engineer to owner standards, reviewed by the owner, and inspected. The construction is performed by the developer or a contractor retained by the developer. This is really design-build, although it may not be recognized as such. It is just in a different form.

For projects implemented by the public agencies themselves, there is on the one hand a natural resistance by some municipalities and public agencies to change from their traditional but very satisfactory design-bid-build approach. Legal and policy restrictions may also preclude alternative project delivery methods. On the other hand, modern water treatment plants are now frequently using processes that involve new "packaged" technologies (desalting, membranes, ultraviolet [UV], and so on) for which the treatment equipment is a major portion of the project. Because of the differences in the layout and design of these systems from manufacturer to manufacturer, public agencies are either forced to make a technology decision early and design to it or forced to rework designs to accommodate the actual equipment bid by the construction contractor. The latter path tends to drive the decision to a design-build approach. Also many agencies may have difficulty financing

urgently needed improvements and will be looking to innovative ways to finance and construct the project.

This chapter will describe the design-build approach as well as some turnkey approaches such as design-build-operate, design-build-finance-operate, and design-build-own-operate project delivery methods. While sounding similar, these alternative turnkey approaches offer some significantly different advantages and disadvantages over a straightforward design-build.

DESIGN-BUILD

The owner typically considers the design-build approach in response to one of the following conditions:

- Desiring single-point responsibility for design, construction, and performance
- Regulatory pressure to be operational by a specified date
- Desire to know the final cost prior to the start of major design and construction
- Convenience of proceeding with construction before completion and approval of final construction plans (fast-tracking)
- An unwillingness to design around a single supplier's equipment or process or incur redesign costs if a different supplier's equipment is eventually selected that does not closely match that used for the base design
- An opportunity to potentially save money

The design-build entity can be any of the following (Siegel 1995):

- A company that can perform design and construction in-house, in other words a company that has both construction and design engineering staff in its organization
- A joint venture between an engineer performing design services and a contractor performing construction
- A general contractor or specialty contractor that subcontracts design to an engineer
- An engineer who subcontracts construction to a contractor
- A developer or entrepreneur who subcontracts both design and construction

A design-build project is approached slightly differently from the conventional design-bid-build method described in chapter 1. Rather than provide the construction contractor with a complete set of plans and specifications, the owner will provide the design-build entity with a 10 to 30 percent design development package that will include performance specifications and specific design and material requirements. The purpose is to let the design-construct entity use its experience and ingenuity to complete the design and construction in the most cost-effective manner while still conforming to the project specifications. A question that often arises, however, is how are quality and life-cycle costs considered? This issue will be discussed later.

Before an agency begins a design-build project, it is important to check with the agency's legal counsel to determine if such a project delivery method is legal in conformance with agency policy and if there are any limitations on the procurement procedure, e.g., qualification-based selection (QBS) acceptable or competitive bid pricing required.

The Procurement Process

The procurement of a design-build team begins with the owner producing a procurement document that includes the *project criteria* and the *procurement criteria*. The *project criteria* document includes the project description, design and performance criteria and requirements, capacity and storage requirements, specific equipment requirements (type, acceptable manufacturers, redundancy), suggested layout, access for maintenance, principal construction materials, and so on. The *procurement criteria* document will include all of the procurement requirements, scope, proposal format, method of selection, schedule, minority business enterprise/woman-owned business enterprise goals, date due, preproposal/bid meetings, and so on—similar to the traditional approach.

As a rule, this procurement document represents a 10 to 30 percent design effort. If the design is carried beyond the 30 percent level or so, the design-build teams will not be able to offer as much in terms of cost savings based on their ingenuity. Conversely, if the document and criteria are not adequately defined, the owner will likely have some surprises at the end. The cost to prepare the document is a function of the level of detail. A caveat to consider is that the owner's preferences must be in the requirements or criteria or the owner cannot expect them to be included in the project. Preparation of the document takes time and experience. If the owner does not have the experience and staff availability in-house, an experienced consultant should be retained. This consultant should agree not to be a part of any of the design-build teams. The consultant should be retained to act as the owner's independent advisor (sometimes termed the *owner's engineer*) throughout the process to completion of the construction and startup.

The procurement can be undertaken in several ways—most commonly as a two-step or one-step process. The two-step process is a qualification-based selection process with the agency sending out requests for qualifications from prospective design-build teams. The agency, along with the independent consultant, reviews the submittals with an emphasis on the experience of the designers and the constructors, experience working together, satisfactory reference checks, insurance, financial strength, and concepts of the project design that is being recommended. Typically, the teams can provide a response to this RFQ in about four weeks. The agency should spend time reviewing the submittals carefully and selecting three to four firms that have the best qualifications and meet the needs of the agency the best. The agency should then send a request for proposal (RFP) for design-build of the project. The criteria document sent out with the RFQ can be updated based on what was presented; however, the agency should be sensitive to not divulge any thoughts and ideas of the individual proposers. Should there be anything that is definitely undesirable, then it should be stated. The RFP should state the form of the bid price, preliminary designs and layouts, estimated annual operating and maintenance costs, annual consumables for chemicals and power, submittal of equipment list with manufacturer, bonds, and other types of certifications that would be required in a conventional design-bid-build project. If the design-build team is to secure the permits and provide the environmental documentation, that should be so stated. The document should also indicate the method of evaluating the cost—construction cost only (not recommended) or life-cycle costs. If life-cycle costs are to be evaluated, the criteria should be stated—power cost, discount rate, escalation, period of evaluation, and so on. In the response to the RFP, the design-build teams will need time as they will have to do additional design and secures quotes from subcontractors and material suppliers. An allowance of at least two or three months should be given for this process. In some instances, owners will pay a stipend to each design-build team that prepares a proposal to partially cover the cost to prepare the bid. The agency should follow up and verify if the selected design-build teams will actually plan on submitting a bid. If not, the next team on the list should be sent an invitation to ensure there are at least three bids.

In the one-step procurement, the RFQ step is eliminated, and the owner goes directly out for firm bids or a guaranteed maximum price. Although an owner might be tempted to go directly to the one-step process initially, the two-step process has benefits in that the owner has some input on the qualifications and experience of the design-build team before receiving bids as there will be great pressure to take the low bid. The one-step procurement method is also far less attractive to the design-build bidders. Preparation of a design-build proposal requires much effort and cost for the bidder. Using the two-step approach, each bidder knows that its team has been qualified and is only competing against two or three other teams. This process reduces the risk of an unsuccessful tender and makes the required effort more worthwhile and the project more attractive. With the one-step procurement, some teams that might provide greater value may decline to bid if they see the field is too wide (often termed a *cattle call*).

The owner will need to evaluate the proposals along with the quality of the materials and equipment proposed to be incorporated into the project. To ensure quality, the project should be evaluated on a life-cycle basis using the criteria stated in the RFP. The evaluation may also include a sensitivity analysis that considers the importance of each selection criteria. When the evaluation is completed, the owner is ready to make a recommendation to the governing board for action.

Design and Construction Phases

Once the design-build contract is awarded, the design-build team will start to prepare a detailed design similar to that in the design-bid-build process. To facilitate the review of the design, weekly or at least biweekly meetings between the design-build team and the owner and independent consulting engineer should occur. Using this approach, owner preferences and design choices can be worked out on the spot and calculations reviewed efficiently. All final drawings and calculations should be stamped and sealed by the professional engineer who was in charge of preparing the drawings and calculations. The owner's independent consulting engineer should review all the drawings and calculations.

Of course, if there are any changes to the criteria, a change order will likely be presented. Equipment submittals (shop drawings) are typically required, and they should be reviewed for compliance with the project requirements and proposal. Shop drawings and submittals should be signed by the design-builder. O&M manuals, startup and commissioning checklists and procedures, and any other submittal typically requested in a conventional design-bid-build can be requested and reviewed.

Usually while the design development is occurring, the design-build team is looking to start work on some portions of the project—usually the clearing and grubbing, grading and excavation, basic foundations, and so on. These drawings will be prepared first and should be approved promptly so that work can begin. For the design-build team, the purpose of the design drawings is primarily to get the project constructed and there may be several versions of a particular drawing issued as the construction progresses. The owner should clearly specify that a consolidated set of the drawings is required at the end of the project for record drawing purposes. If environmental permits are required, this will slow down the start of construction. It is anticipated that the owner will have a resident engineer and inspector(s) on-site during the construction to monitor the installation and ensure that the construction conforms to the criteria and acceptable practice. This service is usually provided by the independent consulting engineer.

Commissioning and Startup

The commissioning and startup part of a design-build project is no different from that in the conventional design-bid-build. If the owner wishes to have the operating staff trained or

be involved with the construction oversight, this would be spelled out in the procurement documents. The design-build process does not limit the owner in any way.

Change Orders

One of the benefits of design-build is that usually there are fewer change orders. Typical changes that could occur on design-build projects include unforeseen site conditions and owner-specified value-added changes (owner betterment). Design errors and omissions are borne solely by the design-builder.

Permits

All of the permits to implement the project are typically included in the design-build contractor's scope of work, but some could be secured by the owner (or the independent consulting engineer under contract to the owner). Environmental compliance (environmental impact statement or its state equivalent document) could be obtained by the owner before the design-build contract procurement process begins. However, there is a possibility the project description used in the environmental compliance document may not exactly match what the design-build contractor will actually propose or construct. Such a discrepancy could lead to problems, although once an environmental document is approved, putting through an amendment to make minor changes should be noncontroversial as long as the changes to the design beyond the original approval are not substantial. However, in the city of Stockton, Calif., a lawsuit was filed by a local citizens' group, the Sierra Club, and the League of Women Voters claiming the city's privatization contract violated the state's environmental compliance laws (CCCOS 2005). The city's contract was basically an operations and maintenance contract for the city's water, wastewater, and stormwater utilities that included design-build of capital improvements to the wastewater treatment facility. The appellate court concurred with the citizens' group, and the city eventually rescinded the contract. It is important to emphasize this case was not about design-build but was rather about the issue of privatization of the utility system itself and whether the contract complied with the state's environmental laws. But Stockton's experience does point out the importance of an owner carefully identifying and following all of the legal requirements.

Types of Payment Terms

The traditional payment method with public works projects is lump sum with payment based on estimated completion. A contractor provides a schedule of values for payment purposes. This method would be applicable for design-build projects as well. If the costs cannot be adequately defined at the time of project initiation, the payment could be on the basis of cost plus a fixed fee with the design-builder's "books" open. Cost-plus-fee contracts allow the owner to pay the actual cost to design and construct. The owner and design-build contractor negotiate a fixed fee added to this cost. The fixed fee can be a lump sum amount, percentage of the estimated total cost, or guaranteed maximum price. Cost-plus contracts require the owner to manage the projects closely so costs are justified and do not exceed the budget.

It is also possible to include cost sharing between the owner and the design-builder for projects that ultimately cost less than the guaranteed maximum price. Similarly there could be liquidated damages for operation and maintenance costs that exceed bid values. There is ample flexibility.

Types of Projects

Design-build may be used on almost any type of project—large or small. Water utilities throughout the United States have used this approach very successfully. In general, design-build is best suited for those projects that are straightforward (e.g., storage reservoirs) and those that are based on a proprietary process. Examples include membrane treatment facilities and UV and ozone disinfection systems. For instance, Valdosta, Ga., used design-build for expansion of a water treatment facility from 15 mgd (55,700 m^3/d) to 22.5 mgd (85,200 m^3/d) that incorporated ozonation and air stripping for hydrogen sulfide removal. Examples of the successful use of design-build for smaller facilities also abound. The city of Norco, Calif., used design-build to construct a 1.5-mgd (5,678 m^3/d) (approximately) iron, manganese, and hydrogen sulfide treatment facility for groundwater. The West Basin Municipal Water District has used the design-build approach to construct a 3.5-mgd (13,250 m^3/d) advanced water recycling facility in Carson, Calif. The city of Corona, Calif., used design-build for the construction of the 10-mgd (37,850 m^3/d) Temescal desalter for groundwater treatment. Other projects are elevated steel reservoirs (Figure 7-1), and ground storage reservoirs (Figure 7-2). Design-build is less well-suited to complex plant retrofits where there are more unknowns and more logistical factors and interfacing with an existing operating facility is required. It is also less well-suited where the owner wants to be more "hands-on" through the project.

Limitations

Not all states allow public agencies to use the design-build approach. In 2006, 5 states out of the 50 prohibited design-build (AIA 2006). A privately owned utility is usually not as constrained by bid laws.

Figure 7-1 Elevated steel reservoir

Figure 7-2 Ground storage reservoir

Advantages and Disadvantages

A summary of the advantages and disadvantages of the design-build project delivery system is presented in Table 7-1.

To start the design-build process, the design level should be in the range of 10 percent to 30 percent. Frequently a preliminary design report is all that is needed along with a carefully prepared procurement document. This will allow early initiation of the project and save the owner duplication of the design costs. The process leaves the selection of the equipment up to the design-builder so long as it meets the performance and procurement requirements unless the owner has specific equipment standards (e.g., to be consistent with other facilities). Leaving the equipment selection up to the design-builder transfers the performance risk onto the design-builder. However, the requirements must be carefully specified by the owner or the owner's independent consulting engineer to ensure equipment with suitable quality and available support is supplied.

The Federal Highway Administration (FHWA) prepared a comprehensive national study to evaluate the effectiveness of design-build contracting and made a report to Congress (FHWA 2006). The study looked at the quality, cost, and schedule among other things. On average, the managers of the design-build projects surveyed (there were over 60 responses) estimated the process reduced the overall project duration by 14 percent and reduced total cost by 3 percent. The same level of quality was maintained in both conventional or design-build delivery methods. These results were for highway projects, however, not water infrastructure projects. A review of a number of design-build water infrastructure case studies in the literature indicates that the FHWA values are conservative.

A study by Sanvido and Konchar reported by the city of Phoenix (Phoenix 1999) indicated that design-build was 12 percent faster than traditional design-bid-build and 7 percent faster than construction manager at risk. The work by Sanvido and Konchar was for a building not a water facility, however. The city's study concluded that for the 80-mgd (302,830 m^3/d) [320-mgd (1,210 m^3/d) ultimate capacity] Lake Pleasant Water Treatment

Table 7-1 Advantages and disadvantages of design-build project delivery system

Advantages	Disadvantages
Single point of contact and single source responsibility for design, construction, and performance.	May be limited by state law.
Final cost is known before project starts.	Procurement must be carefully planned and undertaken.
No change orders for error and omissions; change orders only for unforeseen conditions and owner betterment.	Bid evaluation is more time-consuming and more complex.
Ability to fast-track and compress delivery schedule.	Quality can only be ensured by significant involvement of the owner or owner's independent consulting engineer in the procurement, evaluation, design, and construction. The design engineer's primary duty is to the contractor and not to the owner and thus there is a tendency to try to minimize construction costs wherever possible, possibly at the expense of quality or operability.
The contractor's experience and ideas are brought to the design.	Design-build does not eliminate the cost for design reviews or inspection.
Overall cost reduction.	Life-cycle cost savings may be difficult to substantiate.
Level of design completion for initiation is reduced.	Record drawings may be complex or lacking if the design is issued incrementally to fast-track construction or only to meet the contractor's needs. This problem can be addressed through proper specification.
Avoids redesign for changes in equipment supplier that often occur in conventional procurements.	
Guaranteed performance.	

Plant, a schedule using alternative delivery methods like design-build would save 6 months in a schedule that would take 50 months in a design-bid-build delivery system for the treatment plant and 4 months savings for the pipeline portion of the project. The cost savings ranged from 9 percent to 16 percent over conventional design-bid-build.

TURNKEY CONSTRUCTION

Turnkey construction, as defined in this manual, is design-build with add-ons. These add-ons may include any or all of the following: financing, operation, or operating and maintenance. Some of the more common variants are

- Design-build-operate (DBO)
- Design-build-finance-operate (DBFO), or design-build-operate and maintain-finance
- Design-build-own-operate-transfer (DBOOT)

All of these alternatives listed include design-build, so the procurement procedure and most of the advantages and disadvantages presented above for design-build are applicable to these turnkey methods and will not be repeated. Any significant differences are described below. It should be noted that the term *operate* could also include maintenance of the equipment and facilities as part of the fee either as a lump sum or a cost reimbursable. An alternative could have the maintenance and repair of equipment made the responsibility of the owner. But the owner should understand that any violations of performance standards that are attributable to the owner's lack of timely maintenance or replacement become the owner's responsibility. For that reason alone, it is recommended that the DBO contractor have the maintenance and repair responsibilities within the contractor's scope.

Design-Build-Operate (DBO)

Under the DBO form of delivery system, the design-build contractor is also responsible for operating the facility for a specified period of time, which could vary from 1 year to 20 years or more. Where the period of time extends for several years, cost escalators are

built into the contract. The bid proposal could include an annual cost for the operation and maintenance, or it could be structured to be a fixed annual cost plus a variable cost for each acre-foot or every million gallons produced. Under an agreement to operate for a specified period, the design-builder has an incentive to use equipment that is high quality and has an excellent track record for reliability and durability. The advantage with this delivery method is the design-build entity now has full responsibility for the design, construction, and continued performance of the equipment and the project. For a DBO contract with a 10-to-20-year-or-more operating contract, the operation and maintenance costs are very significant and, in some cases, exceed the construction costs. As such, the design-build-operate entity will likely use higher quality materials and focus on designing the facility to minimize operation and maintenance costs over the contract period rather than focusing on minimizing the construction costs as is the tendency with design-build. There may be a tendency for the DBO entity to try to minimize the "residual" value of the infrastructure at the end of the contract period by deferring maintenance. The owner will therefore still need to closely monitor the quality of the design and construction and then, later on, the performance of the facility when the time is close to the end of the contract period as there is a tendency to "let things slip" since the design-build entity will be imminently out of the contract. Contract provisions should include periodic testing by the owner of equipment efficiency, quality of maintenance, and so on. A number of recent projects that have used this form of project delivery are described below.

City of Seattle Public Utilities. The City of Seattle Public Utilities (city) used the DBO approach for the 120-mgd (454,250 m^3/d) Tolt Water Treatment Facility. The city did the predesign report and the environmental permitting and was planning on proceeding with the traditional design-bid-build at a cost (1998 present worth) of $100 million for construction and $56 million for 25 years of operation and maintenance. The city decided to move forward with DBO providing the result was at least a 15 percent cost savings. The contract provisions required a 21 percent minority business enterprise goal with 8 percent of that to woman-owned businesses. The city put out two proposal schedules: Proposal A to meet current and reasonably anticipated regulations (considered the base for comparison with design-bid-build) and Proposal B to meet current regulations but take a very conservative look at the future (at that time) of the Enhanced Surface Water Treatment Rule and other long-term enhancements including possible ozonation. The best and final costs for Proposal A ranged from $83 to $108 million and for Proposal B ranged from $103 to $124 million. All costs were net present worth 1998 dollars (Seattle 2008). The results clearly demonstrated the cost savings for the DBO delivery method. Construction started in 1998 and was completed in 2000 (Seattle 2008).

The city used a DBO project delivery on a second water treatment plant—the 180-mgd (681,375 m^3/d) Cedar Treatment Plant. The plant incorporated "green sustainable design." The design-build-operate contractor estimated that the city saved 30 percent, or $50 million, over the conventional design-bid-build method (CH2M Hill undated).

San Diego County Water Authority. The San Diego County Water Authority used design-build-operate for the 100-mgd (378,540 m^3/d) Twin Oaks Water Treatment Plant in San Diego County. This plant is the world's largest submerged membrane water treatment facility. The authority believes the delivery method allowed the project to be completed one year ahead of schedule. The project was completed in 2008 (SDCWA undated).

Design-Build-Finance-Operate (DBFO)

In design-build-finance-operate, the design-build contractor provides financing in addition to the design, construction, and operation. The design-build team will include a financing organization in addition to a design engineer, a construction contractor, and operating staff. This type of project would be attractive to an agency that might be at or near

its bonding capacity or desires to reserve its bonding capacity for another type of urgent project. Usually public agencies are able to borrow money at less cost than a private entity; however, in many cases financing by the private entity can have tax advantages.

The city of Santa Paula, Calif., a community of about 30,000 people in Ventura County about 75 mi (120 km) north of Los Angeles, needed to upgrade its wastewater treatment plant to meet new regulations under a consent order from the Regional Water Quality Control Board. The city was facing $8 million in fines. The city went out to bid using a DBOF approach and received four bids; two entities eventually withdrew. In April 2008 the DBOF contractor was selected by the city council and the work began. Groundbreaking occurred on July 7, 2008. As of December 2008, 75 percent of the tank walls (over 4,000 yd^3 (3,058 m^3) of reinforced concrete had been poured. The project is scheduled for completion by the end of 2010. The operations agreement is for 30 years.

The capital cost of the project is $58 million for a 3.4-mgd (12,780 m^3/d) membrane bioreactor treatment facility with annual O&M of $2.5 million [for 2.5-mgd (9,464 m^3/d) flow rate]. The net present value of the project is about $150 million. After the 30-year period, the design-build entity will continue to own the facility. The city could elect to purchase it at that time or continue with an O&M contract. In the final agreement, the design-build entity agreed to pay any of the fines imposed by the Regional Water Quality Control Board for not completing on time, assuming the reason for noncompliance was due to the design-builder.

Design-Build-Own-Operate-Transfer (DBOOT)

The DBOOT delivery method is very similar to DBOF described previously, but after the contract period the ownership is transferred back to the agency. Typically the facility is fully amortized over the period and the cost for transfer is symbolic.

STANDARD DOCUMENTS

The Associated General Contractors of America organization has standard construction documents related to the design-build process. The following AGC documents are available as a reference for those who are considering design-build or turnkey. State or local contracting requirements should be reviewed before using these documents.

- Preliminary Design-Build Agreement (400). Includes a discussion of reimbursement of design expenses in the event the proposed project does not go forward.
- Design-Build Guidelines for Building Construction (405). Explains the advantages of design-build contracting and how to select a design-build contractor.
- Standard Form of Design-Build Agreement and General Conditions Between Owner and Contractor (Provides a Guaranteed Maximum Price) (410). Includes the terms of a formal agreement for design-build services for a guaranteed maximum price.
- Standard Form of Design-Build Agreement and General Conditions Between Owner and Contractor (Where the Basis of Compensation Is Lump Sum) (415). Similar to the AGG 410 but based on lump sum compensation.
- Standard Form of Agreement Between Contractor and Architect (420). For use by contractors engaged in the design-build method of contracting when contracting with an architect to provide design services.
- Conditions Between Contractor and Subcontractor for Design-Build (430). A companion to AGG 450 and AGC 450-1 (listed below).

D-001 Guide to Use of EJCDC Design/Build Documents (2002)	
This commentary on the use of the design/build family of documents is an essential guide to achieving the contracting goals of these documents. It includes guidance on preparing RFP, proposal language, proper use of the documents, and the preparing supplementary conditions.	
D-700	Standard General Conditions of the Contract Between Owner & Design/Builder (2002). Use this document to allocate the basic duties and responsibilities between the owner and design/builder.
D-750	Standard General Conditions of the Subcontract Between Design/Builder & Subcontractor (2002). Use this document to set out the general conditions of the subagreement between the design/builder and a subcontractor providing construction services.
D-500	Standard Form of Agreement Between Owner & Owner's Consultant for Design Professional Services on Design/Build Projects (2002). Use this agreement to set the duties and responsibilities of an engineer who provides services directly to the owner, such as study and report phase services, preparation of the request for proposal, review of design/builder's drawings and specifications, and construction administration services.
D-505	Standard Form of Subagreement Between Design/Builder & Engineer for Design Professional Services (2002). Design/builders use this document to retain an engineer to provide design profession services.
D-510	Standard Form of Agreement Between Owner & Design/Builder for Preliminary Services (2002). Use this agreement to set the basic duties and responsibilities between the owner and design/builder for preliminary services. Covering all phases including study and report, technical exhibit, and proposal. It includes standards of performance, use of documents, electronic media, study and design phase insurance, dispute resolution, and more.
D-520	Standard Form of Agreement Between Owner & Design/Builder, Stipulated Price (2002). Use this agreement between owner and design/builder when compensation is based on lump sum payment, unit price, or both. This agreement also covers contract times, design/builders' representations, and other provisions.
D-521	Suggested Form of Subagreement Between Design/Builder & Subcontractor, Stipulated Price (2002). Design/builders use this document for agreements with subcontractors where compensation is based on lump sum payment, unit price, or both.
D-525	Suggested Form of Agreement Between Owner & Design/Builder on the Basis of Cost-Plus (2002). Similar in format and outline to D-520, this document applies to agreements between owners and design/builders based on cost of the work plus a fee, with a provision for a guaranteed maximum price.
D-526	Suggested Form of Subagreement Between Design/Builder & Subcontractor, Cost Plus (2002). Similar in format and outline to D-521, this document provides for compensation based on the cost of the work plus a fee, with a provision for a guaranteed maximum price.
D-610	Design/Build Contract Performance Bond (2002). Use this document to ensure the availability of funds to complete design/build contract.
D-615	Design/Build Contract Payment Bond (2002). Use this document to ensure the availability of funds to pay for labor, materials, and equipment used in design/build projects.

- Change Order/Contract Fee Adjustment (440). For use by contractors in handling change orders on design-build projects or on any project in which a fee is involved.
- Standard Design-Build Subcontract Agreement With Subcontractor Not Providing Design (450). To be used with AGC 430 when the subcontractor does not perform design functions.
- Standard Design-Build Subcontract Agreement With Subcontractor Providing Design (450-1). To be used with AGC 430 when the subcontractor provides design services.
- Contractor's Reference Manual for Design-Build (490). This compilation of material includes contract documents relating to the design-build method of project delivery, as well as various guideline publications providing helpful information to owners and contractors. Included among the contract documents are AGC 400, 410, 415, 420, 430, 450, and 450-1. The guideline publications included are Design-Build Guidelines for Building Construction; Owner's Guide to Building Construction Contracting Methods; Guide to Owner's Responsibility for Construction Projects; Guidelines for the Contractor/Developer; and Guidelines for Obtaining Owner Financial Information.

The Engineers Joint Contracts Document Committee has developed standard construction documents for design-build projects, similar to the documents discussed in chapter 2.

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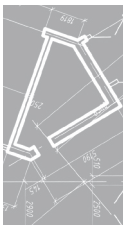


Chapter 8

Construction Management at Risk

With guaranteed maximum price construction management (GMPCM, also termed *construction management at risk*), the owner hires a construction management firm (CM) to perform contract administration. That firm guarantees a maximum price for the complete project. The owner and CM agree on the price before the construction phase of the project begins. Any cost overruns not due to unforeseen circumstances are borne by the construction management firm.

This chapter discusses the characteristics of a GMPCM project and the differences from other types of construction management, particularly CM-managed projects, as discussed in chapter 6. The responsibilities of the participants in a GMPCM project are also presented.

CHARACTERISTICS

Guaranteed maximum price construction management differs considerably from the more traditional CM role (discussed in chapter 6), where the construction manager is an agent of the owner and does not provide design or construction services. In GMPCM, the owner instead retains the CM for its expertise in construction planning, coordination, contracting, and contract administration. With a GMPCM project, the CM assumes additional risk and usually has more direct involvement in the actual construction of the project. The CM must properly estimate the construction cost for the project based on the plans and specifications prepared by the design consultant. Although the owner of a GMPCM project still contracts directly with the contractor, the CM usually desires a voice in selecting the contractors. During the construction phase, the CM must carefully schedule, coordinate, and control the construction process in order to keep costs within the guaranteed maximum price without compromising project quality.

The guaranteed maximum price does include contingencies or amounts for unforeseen circumstances. Changes in project size, materials, quality, site conditions, and schedule could result in renegotiating the guaranteed maximum price. Generally, the more

specific the plans and specifications are in terms of materials, quality, site conditions, and schedule, the fewer changes are needed. A CM arrangement can be changed to GMPCM when the project has been sufficiently defined so that a guaranteed maximum price can reasonably be provided. The CM must be willing and financially able to accept the additional risk.

Payment to the CM is usually either a lump sum or cost plus a fixed fee. The fee portion includes an amount for accepting the additional financial risk. Cost could include the construction manager's costs for labor, material, subcontracts, and incidentals, as allowed in the arrangement with the owner.

Variations

There are also some variations of a GMPCM project depending on what role the owner wants the construction manager to play (ASCE 1987). In one option, the construction manager can assume the role of "constructor" and construct a portion of the project with its own crews; the remaining work is constructed by other prime contractors that have separate contracts with the owner. Alternatively, the CM can perform some of the work and contract with other trades as a general contractor would. In another option, the CM does not perform the actual construction but acts as a general contractor that subcontracts directly with the prime trades. In all of these arrangements, the design consultant has a separate design services contract with the owner. An administrative or peer relationship exists between the design consultant and the construction manager.

Comparison of Design-Build to GMPCM

Despite a similarity to the GMPCM variations, the design-build approach is different from GMPCM. In the design-build arrangement, the design consultant is retained by or may be part of the design-build team's organization. The design-build team either designs and constructs the project entirely or directly contracts with the trades. Design-build is favored by owners that prefer a single point of responsibility for the project from design and construction to operation and performance.

Comparison of Traditional Contracting and GMPCM

With traditional contracting, the owner contracts with a design consultant to prepare the construction contract documents. The project is bid, and the contract is executed with the lowest qualified bidder. The only changes to project cost occur when there are unforeseen site conditions; changes in scope, schedule, quality, or type of materials; or design errors or omissions. Under the traditional contracting arrangement, the final project cost is not known until construction is complete and all claims and change orders are settled.

The principal difference between traditional contracting and GMPCM projects is the presence of a CM that uses its expertise in construction planning, coordination, and contracting to define the construction budget and guarantee that the price to the owner will not be exceeded. The CM works with the owner and design consultant to arrive at the price, which differs from a traditional bidding phase. Based on the guaranteed price, the owner can determine whether the project is economically feasible.

OBJECTIVES OF GMPCM

The owner of any project has three objectives: economical cost, conformance to expectations (quality), and on-time completion (schedule). Proper use of a CM in a GMPCM project can meet these objectives. The advantages and disadvantages of a GMPCM project can also be expressed in terms of these project objectives.

Figure 8-1 Water treatment plant

Figure 8-2 Pump station

In general, projects that can benefit from the GMPCM approach are complex (Figures 8-1 and 8-2). The owner may not have the staff experience or expertise to complete the project. A qualified CM can provide that expertise and experience with a guaranteed maximum price.

Cost

Controlling the project cost is one of the principal benefits of a GMPCM project. In any project, opportunities for controlling cost diminish with time as the project proceeds from the planning stage through design and into construction. In GMPCM, the CM is retained early in the project. The CM's expertise in construction, contracting, and estimating can influence decisions made by the design consultant to keep project costs to a minimum in a manner consistent with the owner's objectives for quality and functionality.

These economic decisions generally fall in the area of materials selection, contract packaging, staging, and sequencing. The owner must make sure that the CM and the design consultant communicate, generally through constructability reviews. Cost management is achieved through multiple cycles of estimating, budgeting, and comparing throughout the design process. Of course, the CM must not usurp any of the design consultant's responsibility as a consultant in this entire process.

Once the project has been defined and developed, the CM guarantees the project cost at completion and manages the construction prime contractors to keep that cost under the guaranteed maximum. This ability to control and guarantee the costs up front before construction starts almost always results in lower project costs than are achievable under the traditional approach, even when the CM's additional fee for risk is included. The owner spreads some of the financial risk to the CM. However, the owner does rely on the ability of the CM to perform economically for the additional cost of the CM to be justified.

Quality

Quality of the project is expressed in terms of conforming to the owner's requirements as expressed in the plans, specifications, and other contract documents before establishing the guaranteed maximum price. Conformance to project requirements is monitored by the owner and the design consultant. Depending on the project organization and the owner's preference, full-time on-site representation (construction observation) can be provided by the design consultant or performed by a third party.

As with the project cost risk, the owner spreads more of the quality risk to the CM. In return, however, the owner does surrender some control of the project to the CM.

Schedule

The greatest potential benefit for GMPCM is reduced project completion time through schedule control and management. Proper and realistic scheduling also ensures better cost control.

The overall project schedule can be further compressed using a fast-track approach that is common when the GMPCM arrangement is used. Under this approach, site work and foundation work (Figure 8-3) can start early, and equipment items requiring long lead times can be purchased early. Design, procurement, and construction activities can overlap much more than in the traditional approach under which these activities tend to be sequential.

With GMPCM projects for which the CM performs some of the construction work or is responsible for contracting the work, construction time may be reduced somewhat, primarily as a result of reducing time required for bidding, bid evaluation, and awarding the contract.

Figure 8-3 Site and foundation work

PARTICIPANT RESPONSIBILITIES BY PHASE OF PROJECT

Typical responsibilities of owner, design consultant, construction management firm, and contractor in each phase of a GMPCM project are discussed in the following paragraphs. Because of the wide range of GMPCM projects, responsibilities of the participants may vary.

Planning

With a GMPCM project, the CM may be hired to help the owner plan the project, often before a design consultant is chosen. The following discussion assumes the owner hires a CM at the beginning of the project.

Owner. When the owner has identified the need for a project, it next decides how the project should be managed. As explained previously, many options are available. The owner must evaluate advantages and disadvantages of each option, as well as any relevant regulatory constraints.

If the GMPCM approach is chosen, the owner then usually selects the construction management firm. Selection is based on the firm's expertise and experience with similar projects. Because the project has yet to be designed, no CM could give a reasonable guaranteed price at this point. As detailed in previous chapters, selection criteria are similar for selecting a design consultant, a CM, and possibly a contractor (if the CM will not actually perform all of the work). Financial resources and backing of the CM in a GMPCM project are important factors in the selection process.

During the planning phase, the owner works with the CM to arrive at an optimal solution to meet the owner's needs. The owner's responsibilities include providing access to staff and facilities as needed. The owner must clearly communicate its needs and keep

the project focused on those needs. The owner, which has hired the CM for its expertise and experience, should be receptive to the CM's solutions but must also make informed decisions.

The owner must clearly establish the responsibilities of the CM and design consultant. Compensation for the CM and design consultant is determined by a fee structure as described in other chapters. The CM usually has a fee for the planning and design phase separate from the guaranteed maximum price for project construction.

Construction management firm. The CM must endeavor to fully understand the owner's needs, funding capabilities, and operations and maintenance abilities once the project is completed. Only with this understanding can the CM help the owner and complete a successful project.

The general responsibilities of a CM in the planning phase can include

- Clarifying owner needs
- Identifying options to meet the needs
- Estimating costs and funding possibilities
- Helping the owner select the best option
- Preparing reports

The CM may or may not advise the owner in selecting the design consultant. However, because the CM and the design consultant must work together as a team, the owner often involves the CM in the selection process. The CM should assist the owner in choosing a design consultant qualified and experienced in both the right type of project and the GMPCM approach.

Design consultant. The design consultant is most often hired during the planning phase to help the owner and CM develop alternatives for design and to select the best option. Bringing the design consultant in during this phase is usually advantageous; it reduces the time needed for final design.

The design consultant in a GMPCM project generally has more narrowly defined responsibilities than with other types of projects. For example, the CM usually estimates costs of design alternatives and has a greater voice in selecting the best option.

Design and Bidding

With a traditional project, the owner and design consultant are the two main participants in the design and bidding phases. With GMPCM, the construction management firm also participates and may actually manage procedures.

Owner. During the design phase of a GMPCM project, the owner's responsibilities are largely the same as with other types of projects. The main difference with a GMPCM project is that two entities other than the owner—usually the design consultant and the CM—are involved in the design. As with all phases of a project, the owner must clearly define the responsibilities of each participant before beginning work. The owner best assists the CM and design consultant by being open, direct, and available for review, for approvals, and at other decision-making points in the process.

Construction management firm. The CM's main responsibility during design is to bring its construction management experience to the design process so that the best possible design is reached consistent with the owner's budget. The owner may give the CM responsibilities during the design phase that the owner usually performs, such as managing the design consultant's work or conducting bidding.

The CM must clearly understand its authority and responsibilities for design and bidding. The CM must perform with the interests of the owner foremost in mind. There is a

potential for disagreement between the CM and the design consultant because of different opinions on the design, and the CM is obliged to reduce that potential.

Whatever the specific GMPCM arrangement, the CM works closely with the consultant on design and must be available for review of the consultant's work on a timely basis. However, the CM should not manage the design consultant's work and staff.

Often with GMPCM projects, as soon as the design is final or even sooner if feasible, portions of the project such as site clearing or equipment ordering may begin. Of course, because the project is built at a guaranteed maximum price, that price will have to be agreed on before such work begins. Some risks exist in beginning the project before design is final, and the CM may build in additional contingencies in price to cover the unknown.

The CM and owner must also decide the extent of the CM's direct participation in construction work. This decision is usually based on the CM's expertise and experience. The CM usually handles the bidding phase of the project, using the plans, specifications, and contract conditions prepared by the design consultant.

Design consultant. Forms of the contract documents (drawings, specifications, contract conditions) prepared by the design consultant under the GMPCM approach are not much different from those prepared under the traditional approach. It is important to indicate that the GMPCM approach will be used, so that the general contractor or prime contractors understand and recognize the role and responsibility of the CM.

If the CM will construct all or part of the work by retaining prime contractors directly, the contract documents are "packaged" differently—generally by means of trade subcontracts. The design consultant must work closely with the CM to identify individual contracts to ensure there are no gaps in work. Any such gaps might slow work later in the project. Under the GMPCM arrangement, the CM would be liable financially in such a case.

During the design phase, after the guaranteed maximum price has been established, design consultants sometimes try to perfect or better the design, for example, by specifying slightly better-quality material or perhaps specifying that a concrete slab be another inch thick to be conservative. Unless the initial decision is incorrect, the CM usually resists these types of changes; obviously the guaranteed price must be based on a set final design. Project expenses can become higher than expected as a result of such changes in specifications, which will make it difficult for the CM to control the budget.

However, after the guaranteed maximum price has been established, if better materials or methods are discovered that will increase the project "value" or reduce long-term maintenance or operating costs, it is the duty of the design consultant to bring those discoveries to the CM's attention. The CM should then secure the owner's approval with an appropriate increase in the guaranteed maximum price for the project.

If the project is on a fast track, the design consultant might have to work with decisions made early in the project, perhaps even before the design consultant was hired. This situation often creates difficulties because the designer may have to work with less-than-perfect decisions or have the owner and CM agree to changes in these decisions. The owner and CM must weigh options, which usually come down to a choice between spending more money or taking more time.

Construction

As with other phases, the construction phase responsibilities in GMPCM projects vary according to contractual arrangements. In particular, the CM's duties vary from project to project. The following discussion presents typical responsibilities for each of the main participants. Major differences from traditional and other nontraditional projects are also presented.

Owner. The owner of a GMPCM project relies heavily on the CM to represent its interests during the construction phase. However, the owner is ultimately responsible for both quality and cost of the project and performs several duties, such as

- Resolving field problems
- Performing inspections as required
- Reviewing and approving changes
- Processing pay requests
- Attending construction progress meetings

Construction management firm. The construction management firm is broadly responsible for the quality and cost of the project. The CM may be more involved in actual construction of the project, depending on the role the owner wants the CM to play. Specific responsibilities vary considerably from project to project. As always, these responsibilities must be clearly established and agreed to by all participants.

Important responsibilities that must be established include

- Inspections and materials testing coordination
- Construction monitoring and management
- Shop-drawing review
- Field authority
- Design-change review
- Progress-payment approvals
- Permit and environmental compliance monitoring
- Community relations

The CM has a site representative (resident manager or project manager) who is always at the project and who is responsible for coordination, communication, and scheduling.

Design consultant. The design consultant in a GMPCM project usually does not perform construction management but does perform other typical tasks required of the designer including

- Shop-drawing review
- Design change
- Field problem resolution
- Inspection

The design consultant may not have a site representative on a GMPCM project; however, the designer should have a staff contact available.

Contractor. The general contractor of a GMPCM project may or may not be the construction management firm. If not, the contractor's responsibilities depend on which contracting approach is selected, as discussed in earlier chapters.

Postconstruction and Operations and Maintenance

The contract between owner and CM in a GMPCM project should clearly state the responsibilities of all participants in the postconstruction phase. A project is rarely considered complete when installation is finished. Startup, testing, training, and other tasks are very important to the success of the project. The CM must include in the guaranteed maximum price the costs of these tasks.

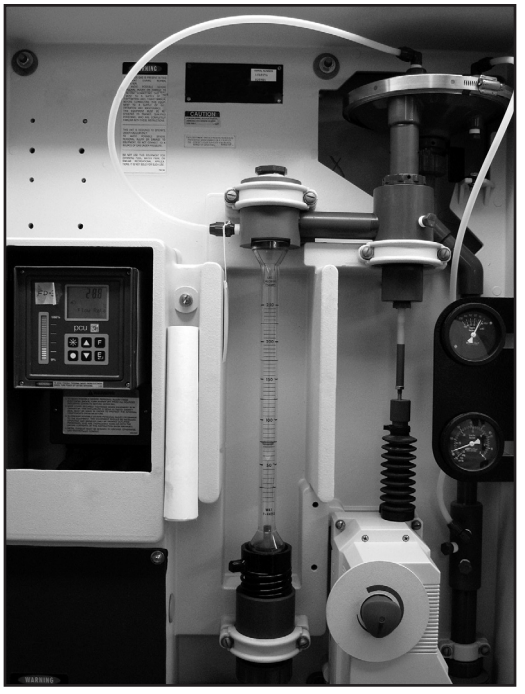


Figure 8-4 Chemical feed system, a gas chlorinator (*Opflow* 2010)

Owner. The owner typically makes staff available to participate in the testing and startup, prepares a punch list of unfinished tasks, and performs final inspections. The owner's staff is also trained in O&M procedures by the CM, the contractor, the equipment suppliers, and/or the design consultant.

Construction management firm. The CM usually coordinates startup and testing. For a typical treatment facility this can include

- Constructing flow bypass systems and recirculation systems for equipment testing
- Obtaining chemicals for testing chemical feed systems (Figure 8-4)
- Arranging for disposal of test fluids
- Testing alarms, variable-speed equipment, and mechanical, electrical, and instrumentation equipment

When equipment is thus checked, it must be started up and operated for a specified period of time before it can be considered acceptable. The owner and design consultant may periodically observe performance during this testing and validation period. Some design consultants specify this validation period to be as long as 30 full days.

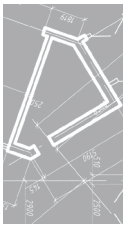
The owner has final approval before a facility is put into actual operation. The CM is usually responsible for assembling facility O&M manuals and equipment user manuals from suppliers.

Design consultant. The design consultant typically has fewer responsibilities during the postconstruction phase of a GMPCM project. The CM, as already discussed, handles coordination and scheduling. However, the designer typically observes testing and startup, may provide specialized training, and is called on when a question or problem arises. The designer may certify to the owner that the facility is performing to design specifications.

Contractors. Contractors, especially equipment suppliers, usually perform testing and startup procedures. They also perform adjustments as needed to meet performance requirements.

REFERENCE

American Society of Civil Engineers (ASCE), Committee on Construction Management. 1987. Qualification and Selection of Construction Managers with Suggested Guidelines for Selection Process. *Civil Engineering*, 113 (1).



SECTION III

Issues Common to All Delivery Methods

- Budgeting and Payment Procedures
- Performance Clauses
- Warranties
- Risk Allocation
- Disputes
- Communication
- Selecting Consultants
- Partnering

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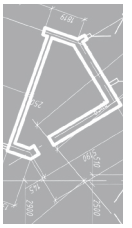


Chapter 9

Budgeting and Payment Procedures

The term *payment procedures* refers to the process of a project owner paying a contractor for work performed to date. Payments signify completion of certain portions of a project and imply acceptance of the work performed to that point.

The contract should define the specifics of the payment procedure that will be followed. The procedure should be presented in sufficient detail to eliminate ambiguities and misunderstandings by all participants in the project. In practice, the contractor, the consultant, and the owner often establish a payment schedule after the contract is awarded. However, specifying the basis of payment in bidding documents benefits all participants. The payment procedure is determined by the type of project, funding sources, length of project, complexity of the project, and the owner's existing framework for making payments.

Because progress payments are made as the work progresses, the quality of work as a function of the completed project cannot always be fully evaluated. In many cases overall project quality cannot be determined until the project is completed, started up, and tested. Payment methods and procedures can affect the risk assumed by the contractor in the progress of the work. Reducing the risk to the contractor will aid the contractor in its bid preparation and thereby reduce costs for unknown complications.

This chapter examines these issues in more detail. Included in the discussion are

- Project budgeting
- Payment methods
- Payment schedule
- Payment procedure work flow
- Forms
- Basis of payment
- Retainage

- Completion
- Project startup
- Late payments

PROJECT BUDGETING

Establishing a budget for a capital project can be challenging at the early stages of planning and design. Planning-stage cost estimates are generally based on historical and recent projects of similar scope and include high percentages for allowances that typically range from 30 to 50 percent. Allowances cover items that are expected but not yet known and measurable, as well as unknowns that were not anticipated in the project (i.e., true contingency). Cost models may be available from the federal government or the design firm to assist in preparing the initial budget. Projects with complex or unique features and newer technologies can be difficult to budget, however, because limited data exist. Renovation projects or improvements at existing sites may be harder to estimate than new construction because of conflicts with buried infrastructure, the possible need for deep foundations or excavation support systems for existing structures, and myriad other potential unknowns. It is also important to consider whether the cost estimate is in today's dollars or whether it needs to be escalated to the year when the project will actually be built. This decision should be communicated to project stakeholders to avoid confusion that could lead to a budget shortfall.

As the design progresses, the allowance amount can be reduced as project unknowns are eliminated and equipment and material quantities are determined. The volatility of material costs in recent years has made estimating construction costs difficult at best, even at the final design stage. Once the construction bids are in hand, it is recommended to carry forward a project contingency to handle potential change orders during construction. While the contingency amount may vary with the size of the project, an average-size project would typically have a contingency between 5 and 15 percent of the bid amount at the start of construction (see chapter 12 for further discussion on managing contingency).

Procedures for funding projects and tracking expenditures are specific to each owner. Project costs may be covered through existing funds or involve securing grants, loans, bonds, or a combination of these and other options. The duration and nature of the construction contract are important for knowing the rate at which the funds will be spent and over what period of time. It is important to continually monitor the budget and forecast the project's anticipated cost through completion.

PAYMENT METHODS

The most common payment methods are reviewed in the following paragraphs. Each method has different payment procedures that will be discussed in this chapter.

Lump Sum

In a lump sum contract, the contractor agrees to perform work for a set price. Such a contract may also be referred to as a fixed-price contract or stipulated-sum contract. This type of contract gives the owner control over the total cost of construction and shifts more of the risks of construction to the contractor. Lump sum contracts are especially applicable to smaller projects, to those completed in a few weeks, or to those with only one or two components.

With this type of contract the contractor assumes the risk of being able to perform all of the work for the amount specified. Because of this type of risk, a contractor may include

additional amounts or contingencies in the bid to compensate for any increased costs due to unknown conditions.

If a lump sum project takes several months to complete, the contract usually allows for progress payments based on percentage of the work completed. Typically a schedule of values defining the price for specified parts of the overall project (such as electrical or plumbing portions of a building construction project) is required from the contractor so that each portion of the overall project can be paid separately.

Unit Price

The unit price payment procedure requires the consultant to provide a quantity takeoff—an itemized list of bid items—as part of the contract documents. This quantity takeoff provides the contractor with the first step toward developing a bid. Additionally, unit prices assist in processing change orders should additions or deletions be made to the project during the construction period.

Under this approach, the risk to the contractor is reduced somewhat relative to a lump sum payment. The project cost to the owner may vary if the estimated unit quantities of work differ from the work actually performed by the contractor.

Cost Plus Fixed Fee

Cost-plus-fixed-fee contracts provide for (1) reimbursing the contractor for direct and indirect costs incurred in the project construction and (2) paying an additional fixed fee. The additional fee serves as the contractor's profit and is negotiated when the parties enter into the contract.

Municipal competitive bidding requirements usually restrict this method to privately owned construction. In construction of privately owned facilities, the owner might select the contractor because of good past performance. This allows the owner and the consultant to negotiate a fixed fee the contractor will receive in addition to construction costs.

This method might result in a lower project cost because the contractor's risk now becomes a *cost* to be reimbursed instead of an estimated cost that is part of a bid.

The contractor's risk is eliminated from the bidding process unless the project extends beyond the estimated total cost or completion time. However, the owner's cost will vary as the actual construction cost varies from the consultant's estimate.

Time and Material

Time-and-material contracts provide for (1) a fixed hourly rate for the number of hours the contractor spends performing the contract and (2) reimbursement for the contractor's material costs. The owner negotiates the labor rates to be applied to the construction work involved in completing the project. The contractor is reimbursed for cost of materials at a fixed markup and is paid for the labor at agreed rates. Privately owned utilities use this method more than public utilities. Quite often this is the payment method to a design consultant.

This method can provide the lowest project cost because the risk to the contractor is eliminated, since the labor and material costs plus profit are assured. However, there can also be a lack of incentive for the contractor to limit the construction costs. For this reason, labor and material contracts are often used only when no other type of contract is applicable. For example, municipalities often maintain time-and-material contracts for emergency repairs that must be initiated without plans or specifications being available.

Combination of Methods

Depending on the type of project, one of the following combinations of payment methods is often advantageous: (1) the unit price and cost-plus-fixed-fee methods of compensation or (2) the lump sum and unit price methods. For example, if unknown foundation problems occur in a concrete tank construction project, it might be advisable to use unit prices for excavation and concrete work, while using a lump sum for the instrumentation package. If more work than anticipated is required, a unit price exists for that extra work; and if less work is involved, the owner saves some money, since only the actual work completed is reimbursed. The contractor is also assured of receiving payment for the actual work involved.

PAYMENT SCHEDULE

The payment schedule—that is, how often the contractor submits a payment request—should be specified in the contract. Most payment schedules are based on a calendar month. It is possible to process payments in 60- or 90-day cycles, but the contractor might have to include interest costs into the project bid for the added time it must finance the work before reimbursement.

If outside funding is scheduled to be received from federal or state agencies, the owner should fully understand the scheduling of how these funds are to be dispersed. Questions to be resolved include

- Is the funding based on a reimbursement of the owner's costs after the contractor is paid by the owner? If so, what is the schedule for reimbursement—say, 30 days after the request is received from the owner or possibly on a quarterly basis?
- Is the funding to be received as a fixed amount on a fixed schedule?
- Are the contractor's payment requests to be submitted for review and approval by the funding agency before action by the owner?

When establishing the payment schedule, the owner should review its accounting procedures. For example, on what days are checks prepared by the owner's accounting department? Do checks then need to be submitted to a city council or board of directors for approval before payment?

Other contractual items to be specified include

- The exact day of the month for the contractor to submit the payment request so that the request can be processed efficiently
- To whom the payment request is given (for example, the construction management agency or the owner's project representative)
- The number of copies of the payment request
- The time for review and approval or revision of the contractor's payment request

The contractor and the owner's field representative may jointly develop quantities in the payment request, but the contractor should complete and sign the payment request form. Depending on the complexity of the project, the consultant's review time may increase as the project progresses. It is prudent to allow sufficient time in the work flow for complex payment request submittals to be reviewed. Often the city council or board members want all actions, such as a payment request, submitted at least five days before their meetings. If each monthly payment requires council or board action, the work flow should allow sufficient time.

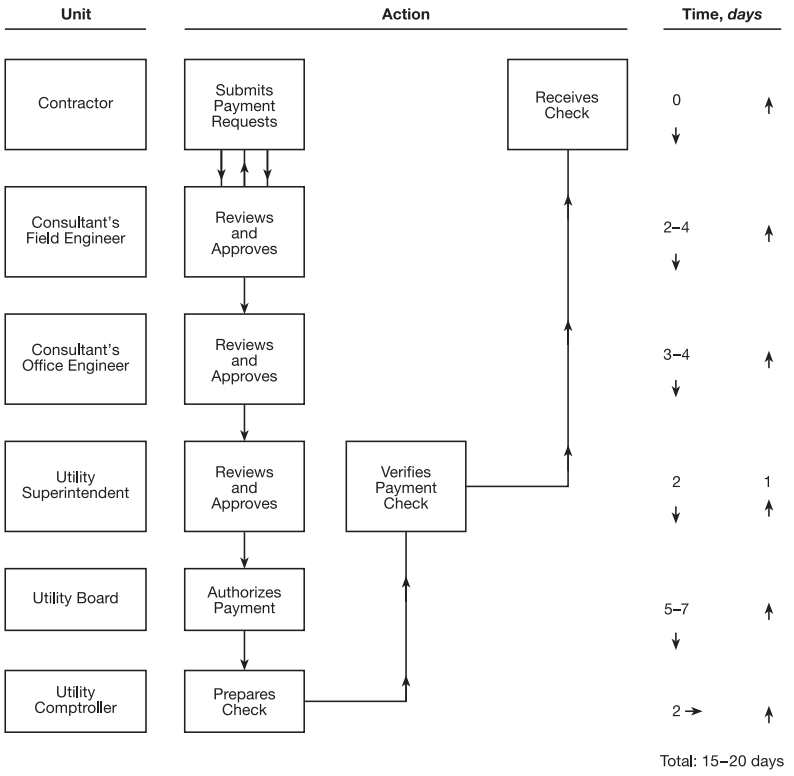


Figure 9-1 Sample payment procedure workflow

After payment procedures are developed and payment-processing time established, contractors have the right to expect that those procedures will be followed and that they may anticipate payment within the agreed period.

Figures 9-1 and 9-2 illustrate some sample payment procedure work flows.

IMPORTANT ELEMENTS IN PROJECT PAYMENTS

This section describes the important elements in project payments.

Payment Request Form

To simplify review and processing of the payment requests, either the owner or consultant should develop a payment request form for the contractor to use. The form is included in the contract documents. The owner might use the same payment form on all contracts to simplify review and processing. The form should include the following items at a minimum

- Date of request
- Schedule of values
- Change order list
- Total amount invoiced for project (by item in schedule of values)
- Amount previously invoiced
- Amount currently invoiced
- Approval line for construction engineer to sign

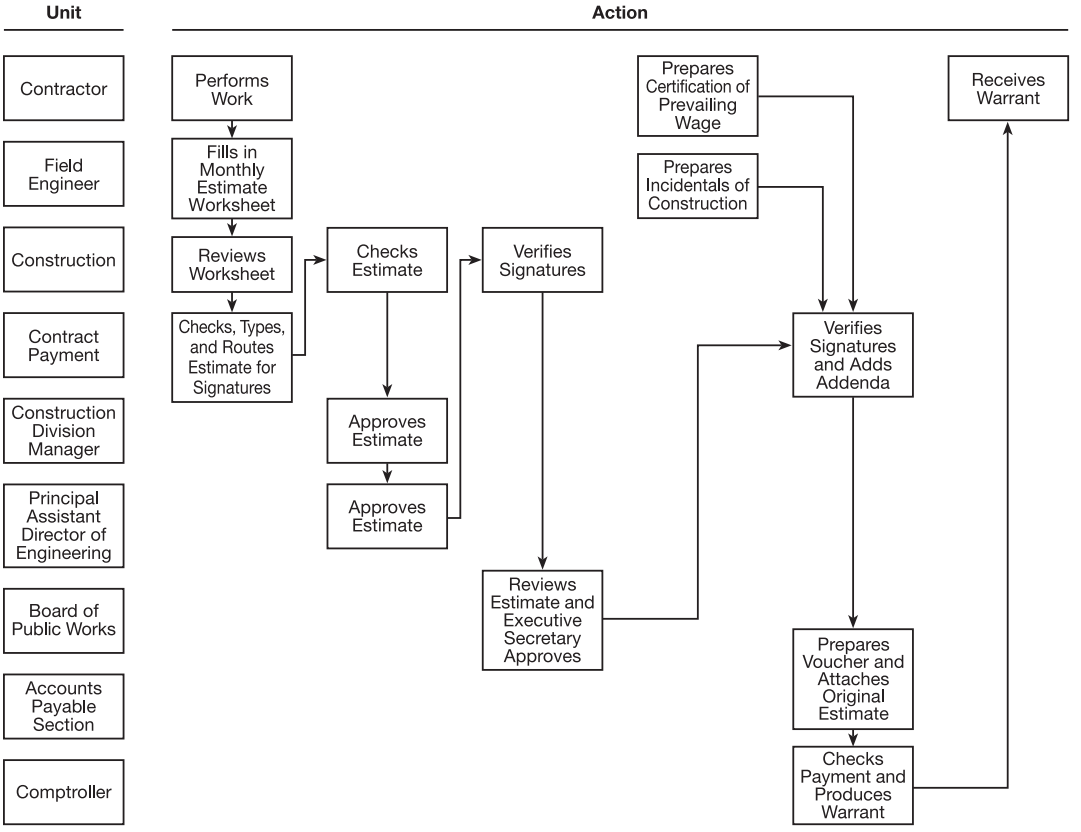


Figure 9-2 Sample contractor payment workflow

Payment procedures used in standard contract documents should be evaluated to make sure they fit the project and the owner's operating procedures. The owner should be aware that its own existing payment procedure may not fit the "standard" payment procedures of others.

Basis of Payment

To avoid conflict or confusion, the basis of payment to the contractor should be established. The main types of the basis of payment are described in following sections.

Completed work. An established unit price may be applied to estimated units of completed work such as cubic yards or lineal feet. Alternatively, a lump sum, such as for a piece of equipment or contractor move-in, or a percentage of a lump sum contract may be the basis of payment.

Materials on-site. If payment will be made for materials that are on-site but are not yet incorporated in the project, contract documents should define how and where materials are to be stored. Documentation that must accompany the payment request for material stored on-site, such as delivery receipts or invoices, should be specified. Additionally, owners may wish to consider payment for materials stored off-site in the event the construction site will be vacated for an extended period of time (such as winter shutdowns). However, in some jurisdictions, materials not on-site may be seized if the contractor encounters financial problems.

It is important for the contract to state that the safety of stored materials, even if paid for by the owner, is the responsibility of the contractor and that if materials are damaged on-site, the contractor is responsible for replacement. The contract should also stipulate

that the warranty or guaranty dates commence on final acceptance and not on delivery to the site.

Required Documentation

Contract documents should clearly specify what documentation shall accompany the interim and final requests for payment, such as paid invoices, delivery receipts, and release of liens from subcontractors. The owner might need to require an assurance that prevailing wages are being paid.

In states that have lien laws, the contractor must also submit to the owner a statement that gives the names of all those who are furnishing materials or labor for the project, the cost of these materials and labor, and the amounts due or to become due to each of them.

Documents should specify that the owner shall receive all manuals, spare parts, and startup training on specific equipment items before final payment is processed.

Retainage

Contract documents must specify the retainage (chapter 10 also discusses retainage) to be held from each progress payment. Retainage is usually a percentage withheld from the payment request as a guarantee of the quality of completed work.

Statutes of many states permit the contractor to specify how the owner shall invest the retainage and that the contractor is entitled to the interest accrued on the retainage. The owner and the contractor must understand and agree on the procedure for holding and releasing the retainage. Conditions for releasing the retainage are discussed later in this chapter. In some states, a retainage bond may be used in place of retainage. In this case, the decision to use a retainage bond is typically made by the contractor.

PAYMENT PROBLEMS

If the procedures discussed so far are followed, then the potential for problems is reduced. However, a few areas for problems or disputes are discussed next.

Overestimating Progress and Front Loading

Overestimating the value of the work completed by the contractor may cause problems should the contractor default and the work still needs to be completed. The owner should carefully evaluate the actual work completed for each progress payment.

The contractor may overload the value of the initial construction work (also known as front-loading) to cover the costs of project move-in and to provide up-front funding for the contractor's project costs. The contractor is entitled to true move-in costs and true reimbursement for work completed but not excessive front-loaded funding. Often a fixed dollar amount available to the contractor for the first payment request is given in the bidding specifications to let the contractors making bids know what the move-in funds will be.

Underestimating Cash Flow and Late Payments

The owner should have the funding in place to match the contractor's estimated progress payments. To this end, contract documents should require that the successful contractor submit to the owner's field representative an itemized work schedule for complete construction of the project, as well as an estimated monthly payment request, along with the initial payment request.

The owner should advise the contractor in writing immediately if a payment will be delayed or reduced in amount, and the notification should state the reasons for the

discrepancy. If the payment delay is due to the owner's problems, such as funding reimbursement delays, the contractor may be entitled to interest on the delayed amount.

If the payment delay is due to the contractor's operations, the owner should advise the contractor of the problem and the actions required by the contractor to remedy the problem. All payment delays or deductions in processing payment requests should be documented in writing to all parties involved.

PROJECT COMPLETION PAYMENT PROCEDURES

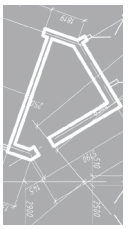
In the final phases of a project, generally referred to as completion, payment procedures are different from progress payments. Various terms for completion are defined below.

- *Substantial completion:* that time in the project when the owner has full and unrestricted use and benefit of the facilities, from both the operational and safety standpoints, and only minor incidental work, replacement, or correction work remains to reach physical completion of the project.
- *Final completion:* that time in the project when all physical work is completed and accepted; and all operational testing has been completed satisfactorily. The final payment, less retainage, may be made at this time.
- *Final acceptance:* that time in the project when all physical work and operational testing have been satisfactorily completed and the contractor has furnished all documentation required by the contract and by federal, state, or local regulations. The release of the retainage may be processed at this time.

Even though the consultant, owner, and contractor have discussed payment procedure throughout project construction, the completion of a project, processing of final payment, and release of retainage are often a source of conflict.

Steps in a typical project completion are as follows:

1. The contractor submits a notice of substantial completion to the owner.
2. The consultant and owner review the work and prepare a list of items yet to be completed (commonly called the punch list).
3. Operational testing of facilities, if required, is scheduled.
4. The contractor completes all physical work, and all operational testing is *satisfactorily completed. Startup services and personnel training are completed, if required.*
5. The owner processes final payment less retainage.
6. The contractor submits all documentation and spare parts required by the contract, such as warranties, release of lien forms by subcontractors and suppliers, and certification that prevailing wages have been paid where required.
7. The owner authorizes release of retainage.



Chapter 10

Performance Clauses

Completing a project on schedule is often as important as the cost and quality. For example, a new facility might be needed before seasonal peak demands, to serve a new industry, to meet the scheduling of subsequent projects, or to meet regulatory deadlines. The project schedule also affects the finances of a project because the interest "clock" on bonds is usually based on the proposed completion date. If the project is not completed on time, the interest cost accrues while revenues may be lost.

Because the completion schedule is so significant, the monetary worth of on-time completion should be estimated realistically and the effects of early and late completion evaluated. Where late completion will cause the owner to suffer damages, the contract terms should address how damages will be assessed. When early completion benefits the owner, the contractor should be appropriately rewarded. The traditional incentives used are *liquidated damages* and *bonus* and *penalty clauses* in the construction contracts. Other incentives, not used as often, are reduced retainage on progress estimates and delay compensation.

This chapter defines liquidated damages, bonus and penalty clauses, delay compensation, and reduced retainage. It also discusses other contractual elements affected by incentives, including progress payment estimates, quality of work, time definition and bid evaluation, and change orders. Examples of performance clause wording are included.

TYPES OF PERFORMANCE CLAUSES

Several types of contract clauses are used to give the contractor an incentive to complete the project on schedule or early. Such clauses are generally called performance clauses.

Liquidated Damages

The term *liquidated damages* refers to a specific sum of money paid to the owner by the contractor if the project is not completed on time. The amount is usually specified on an amount-per-day basis. Essentially, liquidated damages represent a forecast of the financial damage to the owner caused by failure to complete the contract on time. Liquidated damages are not the same as a penalty (as discussed later).

The use of liquidated damages is appropriate when actual damages are hard to calculate and prove. It is difficult to change the liquidated damages amount after the

contract is signed; courts are reluctant to set aside the initial agreement. However, if the contractual liquidated damages amount is highly disproportionate to the damages actually incurred, courts may declare the contractual liquidated damages amount void. Courts tend to do so when, under the circumstances, the amount appears to be a "penalty" instead of a compensation, especially where the bargaining power between the parties was very unequal.

Liquidated damages clauses should never use the term *penalty* and must set forth sound reasons why the parties chose to use a liquidated damages clause. The courts have distinguished between a penalty and liquidated damages. Two criteria seem paramount in determining whether the monetary amount is for the purpose of securing performance of the contract (and is therefore a penalty) or whether it is intended to be paid in lieu of performance (and therefore represents liquidated damages). The criteria, presented in the form of questions, are: (1) At the time of the making of the contract, would the sum provided seem to bear any reasonable relationship to the anticipated damages? and (2) Would the actual damages be difficult or impossible to ascertain? If both answers are "yes," the sum provided would normally be considered liquidated damages.

Another important factor for liquidated damages is the ability to quantify the damages at the time the contract is signed. Whenever all or a portion of the delay is due to an unforeseeable cause beyond the control of the contractor, the courts will not enforce liquidated damages for that portion of the delay. Strikes, fires, delayed delivery of materials, actions of the owner, or natural disasters are the types of events that may excuse a delay. Owners often are faced with spending time and money on legal fees proving a damages claim. Some will just drop the claim and instead disqualify the contractor for future projects. Examples of liquidated damage clauses are included at the end of this chapter.

Bonus and Penalty Clauses

Bonus and penalty clauses are used solely as incentives to finish a project early or on time. A bonus clause is an amount, usually per day, to be paid by the owner to the contractor for work completed before the completion date. The penalty is an amount, usually per day, paid by the contractor to the owner when the project is not completed on time.

Unless actual damages occur, as in liquidated damages, many states will not enforce a penalty clause without a corresponding bonus clause. In many cases, courts will then limit the amount of liquidated damages to the actual damages incurred, up to the maximum amount stated in the contract. The presence of a bonus clause will not preserve a liquidated damages amount if the liquidated damages sums are unreasonably more than the actual damages. Examples of bonus-penalty clause wording are found at the end of this chapter.

Delay Compensation

Contractors are increasingly seeking delay compensation in contracts that contain liquidated damages or penalty statements. Delay compensation may be thought of as liquidated damages in reverse. The owner would pay the contractor an amount, usually per day, if the project is not completed on schedule because of delays caused by the owner. A cap can be established on delay compensation. Unless there is a cap in the contract, a contractor could demand delay damages many times greater than the actual "hard cost" damage. The owner's attorney should determine the legality of such a cap in each respective locale.

Reduced Retainage

The term *retainage* refers to contractor earnings withheld in cases where (1) there was an error in estimating the level of work the project required, or (2) poor quality work or errors were revealed that could not be determined until subsequent work was completed.

The retainage is usually a percentage of the pay estimate, sometimes with a maximum amount specified. The total retainage is usually paid after completion. Chapter 9 discusses retainage in more detail.

Reduced retainage may be used as an incentive for early completion. The contract can be structured such that upon satisfactory completion of key items, or at a certain phase of the contract (such as 50 percent complete), the retainage percentage or maximum amount can be reduced. However, if the owner releases the retainage and there is subsequent damage or default, the owner usually can recover the retainage only if the amount of money that remains unpaid on the project is greater than the retainage itself.

OTHER PERFORMANCE INCENTIVES AND ISSUES

Other incentives for on-time or early completion are available to the owner. These incentives are not usually written into contracts.

Timely Progress Payments

The timeliness of progress payments to the contractor may serve as an incentive for contractors to maintain a contract schedule. If payments are made in a timely manner after a pay estimate is submitted by the contractor and accepted, for example, in 10 days instead of 30 days, the contractor usually will keep the project moving on schedule. Such timely payments help the contractor recover or reduce actual costs, administrative costs, and interest costs.

Time Definition

When bonus-penalty, liquidated damages, or delay compensation clauses are incorporated into contracts, calendar days or working days must be specified as the time basis. Calendar days count every day; working days are Monday through Friday, not including holidays. Calendar days are the easiest to use and the most common practice.

Bid Evaluation

When time of completion is of the essence in a project, the owner may structure the contract award with a stipulated completion date with consideration given to earlier or later dates, if offered by the bidders. If one contractor has a lower dollar amount than another contractor that has an earlier completion date, the owner must determine which bid is actually in its best interest. A bonus or penalty should be calculated based on the completion dates listed by the bidders. The bonus or penalty amount and procedure should be clearly described to bidders in the bidding documents, particularly for public bidding. Otherwise it may be difficult to justify an award to anyone other than the low bidder after the bids are opened. An owner may elect not to have a bonus or penalty in effect for a short period, for example, two weeks before or after the scheduled completion date.

Change Orders

Change orders can significantly delay a project's completion. When a change is proposed, the time necessary to complete the change has to be realistically determined. If the contractor is ahead of schedule and the proposed change adds time to the contractor's early completion schedule, arguably the original schedule should be extended so that the contractor maintains its original incentive for working toward the bonus. If the contractor is behind schedule and the proposed change would decrease working time, the owner should consider whether the original completion date needs to be revised to maintain consistency.

Quality of Work

To a lesser extent, bonus and penalty clauses may be applied to the quality of work. Applying the clause to quality is difficult and may require the use of statistical methods of evaluation as well as a compromise between contract specifications and actual results. For example, if a steel structure receives a coating in excess of that specified, should the contractor receive a bonus for exceptional work? Alternatively, when the coating is less than that specified, should it be accepted and a penalty assessed or should the contractor redo the work at its own expense according to the minimum specifications written in the contract documents? Each case is different and should be assessed on its own merits.

Similarly, should the contractor be rewarded for installing a more efficient system than specified without a negotiated increase in cost, or should such items remain in the realm of negotiated voluntary alternatives? A clause in the contract that the owner and contractor will share the cost savings for acceptable alternatives to the contract documents may be one approach to answering these questions.

EXAMPLES OF LIQUIDATED DAMAGES, BONUS, AND PENALTY CLAUSES

The following are examples of standard liquidated damages and bonus and penalty clauses.

EJCDC Documents

Many water utilities, consultants, and contractors use EJCDC documents in design and construction projects. A history of the EJCDC and list of relevant documents appear in chapter 2. The following clause is drawn directly from EJCDC documents:

> **3.2 Liquidated Damages.** OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that the OWNER will suffer financial loss if the work is not completed within the times specified in paragraph 3.1 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They also recognize the delays, expense, and difficulties involved in proving the actual loss suffered by the OWNER if the work is not completed on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER _____ dollars ($_____) for each day that expires after the time specified in paragraph 3.1 for Substantial Completion until the work is substantially complete. After Substantial Completion, if CONTRACTOR shall neglect, refuse or fail to complete the remaining work within the time specified in paragraph 3.1 for completion and readiness for final payment or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER _____ dollars ($_____) for each day that expires after the time specified in paragraph 3.1 for completion and readiness for final payment.

Indianapolis Water Company Standard Forms

The following two standard forms are specific to the Indianapolis Water Company:

> **SC-18 Liquidated Damages.** It is understood and agreed that time is of the essence of the contract. Should the Contractor fail to perform the work

within the period of time stipulated in the Contract Agreement, the Contractor shall pay to the Owner, as liquidated damages and not as a penalty, all inspection costs and other expenses accruing to the Owner, but not to exceed $500.00 per calendar day of default *unless* extensions of time granted by the Owner specifically provide for the waiving of liquidated damages. The Owner shall have the right to deduct the liquidated damages from any moneys in its hands, otherwise due, or to become due, to the Contractor, or to sue for and recover compensation for damages for nonperformance of this Contract within the time stipulated.

SC-19 Bonus Payment. It is understood and agreed that time is of the essence of the Contract. In the event that the Contractor substantially completes the work ahead of the Contractor's agreed substantial completion date as established in the Bid Form, the Contractor shall receive as additional compensation $500.00 per each calendar day ahead of the substantial completion date. In addition, on the pay estimate following the substantial completion date, the retained percentage on those items substantially complete shall be released.

Discussion

Bonus payments, at times called incentive payments, may have a maximum amount specified. In this case the owner can set a maximum value that early completion is worth. This limit is used more often when the construction schedule is not tight. It is important to note the wording in the liquidated damages examples; the damages must be clearly stated as damages and not as a penalty. In the EJCDC document the wording acknowledges that proof of damage is needed but that, because of the expense of proving it, both parties agree that a certain sum will be paid to avoid costly legal fees. In the Indianapolis Water Company example it is implied that the owner will bear the burden of proving the cost of the project not being done on time.

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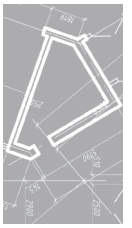

Chapter 11

Warranties

Warranties guarantee the materials and work supplied by the contractor and product suppliers for a prescribed use and length of time. The owner should recognize that more stringent warranties often result in higher costs. As a simple example, the only differences between water heaters having 5-year warranties and 10-year warranties may be the length of the warranty and the price of the water heater. Often there is no difference in construction or materials.

The main warranty issues discussed in this chapter are

- Participant responsibilities
- General content
- Conditions and requirements
- Claims

PARTICIPANT RESPONSIBILITIES

The primary participants in a project—owner; consultant (design engineer or architect); contractor; and the manufacturers, suppliers, and vendors—have responsibilities related to warranties. These responsibilities are introduced in the following paragraphs; most are also discussed in more depth in later sections of the chapter. The responsibilities described are those common in a traditional project, and they will vary from project to project.

Owner

The owner is responsible, often with assistance of the consultant, for defining the desired warranty requirements of the facility to be constructed or materials to be supplied. These requirements include the duration of the warranties as well as any special warranty requirements such as warranty bonds and factory representative maintenance and inspections.

After completion and acceptance, the warranty period begins. To keep a warranty in effect, the owner must correctly operate and maintain the facility and equipment according to the manufacturers' requirements. In addition, the owner has to follow correct notification procedures when potential warranty-covered problems are encountered. Portions

of a project may go into operation in phases. The warranty period for each phase usually begins when the owner takes over the phase, depending on specific contract language.

Design Engineer

The owner's design engineer or a consultant specifies the warranty requirements in the contract documents. During construction, the engineer or construction manager verifies that the equipment and material are in proper condition when received after shipment, are properly stored and protected during construction, and are properly installed and started up by the contractor. These conditions are necessary to prevent voiding any warranties. After construction is complete, the consultant may continue to advise the owner on warranty issues.

Contractor

The contractor usually provides a warranty on all construction that it has been performed or subcontracted. The contractor is responsible for purchasing, receiving, storing, installing, and starting up equipment and materials from the suppliers according to the construction specifications and the suppliers' requirements. The contractor performs all work correctly to ensure that all warranties are maintained in full force and effect. The contractor includes all warranty provisions in its purchase agreements with subcontractors and vendors and obtains appropriate written warranties to be provided to the owner. The contractor provides all maintenance until the owner officially assumes that responsibility.

Manufacturer or Supplier

The manufacturer or supplier must manufacture, fabricate, and assemble the equipment and materials according to the specifications and is usually responsible for proper shipment to the point of use. The manufacturer or supplier defines all manufacturer warranty requirements that include shipping, installation, and maintenance. When required by the owner, the manufacturer or supplier may assist or supervise installation, startup, testing, and maintenance. For example, Figure 11-1 shows assistance with startup. The manufacturer or supplier also responds to problems with the equipment or materials according to the warranty agreement.

Figure 11-1 Manufacturers assist with startup

GENERAL CONTENT

Warranties are of two general categories. The first is a warranty directly to the owner on a specified item of equipment or material by a supplier, vendor, or manufacturer. The second is a warranty of a project or facility by a construction contractor. In the warranties of a project or facility, the construction contractor guarantees its work and materials. When the owner assumes control of the project, any equipment and material warranties provided by subcontractors, suppliers, vendors, or manufacturers then become the owner's responsibility. If a warranty-covered problem occurs, a question often arises as to whether it is a manufacturer's defect, a contractor's installation problem, or an owner's operations and maintenance problem.

The warranty conditions or requirements must be established by the design engineer when the specifications are developed. These requirements must be clearly and fully described in the specifications and included in the purchase order or bid documents. Warranty specifications include three primary elements.

1. Content and extent of the coverage
2. Duration of the warranty
3. Effective date when the warranty starts

Equipment and Materials Warranties

The warranty of equipment and materials guarantees against failure of the equipment or materials to perform or operate as specified in the purchase agreement or construction documents. The warranty covers improper design, defects in the materials, and defects in the fabrication, manufacture, and assembly. If the manufacturer does not install the equipment, the warranty usually excludes the manufacturer from liability caused by incorrect installation. Installation procedures should be documented by the owner in case questions arise. Photographs provide a good record of installation (Figure 11-2).

Figure 11-2 Documentation of equipment installation procedure

Although a typical warranty period is one year, the duration may vary considerably depending on the type of equipment and materials. For example, warranties for some electromechanical equipment may be just 90 days while warranties for pumps, roofing materials, or pond liners may be several years. The owner may require that a contractor or manufacturer obtain a bond for long-duration warranties. However, warranty bonds are expensive and should generally be secured only for very costly items with long warranty periods. The bonds protect the owner in cases when a contractor, supplier, or manufacturer is no longer available to respond to a warranty problem.

The effective date of the warranty may be upon receipt of the equipment by the owner or contractor, upon installation and acceptance of the component, or upon substantial completion of the entire project. The choice depends on the type of equipment and project.

Equipment or material warranty specifications should specify (1) the manner in which the supplier, vendor, or manufacturer is to respond to the owner when notification of a potential warranty problem is given by the owner and (2) the length of time given the supplier, vendor, or manufacturer to respond to the owner's notification.

Projects or Facilities

Warranties on projects or facilities are often more complex than warranties on equipment or materials—more participants are involved, and the variations of responsibilities increase. Warranties must clearly establish who is responsible for the design, construction, and operation of the facility. Additionally, a contractor must require its subcontractors, suppliers, vendors, and manufacturers to guarantee their work, materials, equipment, or systems to the owner.

The duration of a facility warranty is typically for one year or longer. The date the warranty becomes effective is usually the time of substantial completion. As is the case with equipment or materials warranties, the specifications for a project or facility warranty should specify (1) the amount of time the contractor has to respond to the owner when notification is given by the owner of a potential warranty problem and (2) the manner in which the contractor is to respond to the owner.

Nontraditional Construction Contracts

In nontraditional owner–contractor relationships, the contractor often assumes *additional* responsibilities; these will be covered in detail in later chapters. As a brief example, in design-build projects, the design-build contractor must guarantee its project designs or designs by its subcontractor.

CONDITIONS AND REQUIREMENTS

After a purchase order or contract is signed, several activities occur that affect the warranty. These activities include

- Preparation of shop drawings
- Receipt and storage of equipment
- Installation
- Operation and maintenance

Shop Drawings

During the initial phases of construction and fabrication of equipment, the supplier, vendors, and manufacturers of the equipment and materials prepare shop drawings. Basically,

shop drawings detail the equipment and materials to be provided, for comparison to the specifications.

Construction documents normally dictate that warranty conditions and requirements must be included in the shop-drawing submittal. Such conditions and requirements include shipping, unloading, long- and short-term storage, installation, startup and testing requirements, maintenance requirements, and requirements for extended nonuse by the owner ("mothball requirements").

Shop drawings should also state whether a factory representative must be present during the installation, startup, or testing of the equipment or material. Failure to have the factory representative present may void the warranty. For owner-furnished equipment, the owner informs the contractor whether a factory representative must be present.

Receipt and Storage

When equipment or materials arrive at a project, they should be thoroughly examined by the contractor and the owner's representative. Shop drawings and warranty information should be used to determine that the proper materials or equipment were shipped; that there was no damage in shipment; and that there are no readily apparent defects, damage, or problems that could affect the ultimate use of the equipment or materials. The initial inspection should be documented and filed for possible future use if a potential warranty problem occurs.

Shop-drawing information should specify how to store the equipment and materials adequately. Common storage concerns are

- Heat
- Cold
- Precipitation
- Sunlight
- Wind-blown dust
- Sandblasting
- Paint overspray
- Physical damage
- Vandalism or theft

When equipment and materials are in storage, they should be inspected periodically to verify that proper storage is maintained. Periodic maintenance activities on stored equipment are often part of the manufacturer's requirements. If there are potential problems during storage (such as pipe storage, as shown in Figure 11-3), the contractor should be informed in writing of such problems and be given specific directions on correcting the deficiencies. An evaluation should also be made as to whether to provide written notification to, and require a response from, the manufacturer.

Installation

Proper installation of the equipment or materials must be part of the manufacturer's requirements, which are normally included as part of the shop drawings. All affected parties should have a copy of the installation requirements.

Some of the concerns during installation include

- Handling (Figure 11-4)
- Placement (Figure 11-5)

Figure 11-3 Pipe storage can present problems

Figure 11-4 Concerns for equipment handling

Figure 11-5 Concerns for proper equipment placement

Figure 11-6 Concerns for equipment connection

Figure 11-7 Concerns for backfilling

- Connections (Figure 11-6)
- Backfilling (Figure 11-7)

After installation and before the owner accepts equipment from the contractor, each item of equipment must be thoroughly tested to verify that it meets the requirements of the specifications, was properly fabricated by the manufacturer, and was properly installed by the contractor. Each item of equipment has a unique set of criteria that must be verified during the test, and acceptability should never be assumed. A complete report for each test should be made by the engineer and each area of compliance and deficiency recorded. This record is important because it will provide documentation necessary to verify problems or show that startup and testing were performed according to the manufacturer's requirements.

On complex systems or with costly equipment, a manufacturer's representative is usually present to inspect, assist, or direct the startup efforts. This person ensures that the manufacturer's requirements are fulfilled and provides highly competent technical expertise to the project during startup. The presence of a manufacturer's representative also helps reduce warranty-related problems after operations have started.

On complex projects a formal startup and test plan is developed to verify that the total facility meets the specification requirements. The test plan should be developed and executed in a manner to ensure that all equipment and material warranty requirements are met. Test plans should also be developed to show that each specification requirement is fulfilled and that the work, as part of an integrated facility, conforms to contract documents and meets warranty requirements.

After equipment is installed, started, and tested and the project is successfully completed, the owner issues a letter of acceptance of substantial or final completion. After the acceptance letter is issued, the responsibility for proper maintenance and operation

passes from the contractor to the owner. The date of the letter of acceptance is normally the date the warranty period begins.

Operations and Maintenance

Improper maintenance and operations represent the most frequent cause of voiding a warranty. To keep warranties in effect, the owner must operate and maintain equipment and materials according to the manufacturers' requirements. To ensure that proper O&M occurs, the owner must take three primary steps.

1. The owner receives and maintains a functional library of all manufacturers' O&M instructions.
2. The owner develops and implements facility-wide O&M programs including operator training manuals.
3. The owner performs initial and periodic operator training.

The manufacturers' O&M instructions should be received during construction and retained for future use. The library system should include a master file index for use by the O&M supervisory and engineering staff and for making additional copies when the operations copies are lost or worn. The library system should also include second working copies for use by the O&M staff.

The manufacturers' O&M instructions are used to develop an integrated owner's O&M program and operator training program. These programs produce an O&M manual and an operator training manual. Periodically, a manufacturer's representative is required to provide operator training. These sessions can be videotaped for future reference.

The owner must closely adhere to the O&M instructions issued by the manufacturer to keep the warranty in effect. The owner must properly implement a structured O&M program throughout the life of the equipment, especially during the warranty period. It is this preventive maintenance program that provides the owner's legal protection under the warranty and a maximum useful life for the equipment or project.

CLAIMS

If an apparent warranty problem occurs, the owner must inform the contractor both verbally (over the telephone or in person) and in writing (electronically) immediately. In some cases the owner should inform the manufacturer as well, especially if the contractor does not respond adequately. The letter should provide a description of the problem, the date the problem occurred, and a reasonable time for the contractor and manufacturer to respond. If supporting documentation is available, it should also be provided to the contractor and manufacturer. Use of certified mail is advisable.

The owner should provide documentation of potential warranty problems to (1) resolve the warranty problem adequately and as quickly as possible, and (2) determine who is responsible to correct the problem. The owner must be prepared to make a fair and reasonable payment if one party responds to a potential warranty problem and it is determined that another party is actually responsible for the problem.

If the contractor does not adequately respond to the problem, then the owner must inform the manufacturer (if applicable) to correct the problem. If neither the contractor nor the manufacturer is responsive, then the owner may be required to correct the warranty problem and take subsequent legal action to invoke the warranty claim.

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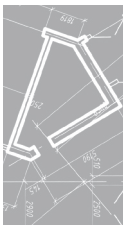

Chapter 12

Risk Allocation

Many aspects of capital construction projects have uncertain outcomes. These outcomes can be either positive or negative. Positive outcomes are considered opportunities. Negative outcomes are risks. The size and complexity of the project influence the extent of the risks. The objective of risk management is to reduce or avoid the risk.

A basic principle of risk management is to allocate a risk to the party most capable of managing it. Management does not mean avoidance. Each risk must be carefully considered and assigned to the owner, contractors, or engineers. Some risks are even shared among project participants.

Risk management should be undertaken early and often in the project cycle. Open discussions should occur during negotiations and partnering sessions. These deliberations are helpful when considering risk allocation assignments.

There are several steps to developing a successful risk management strategy for a capital project. The risks for the project must first be identified. Next, these risks are evaluated to estimate the likelihood of occurrence and the severity of the consequences. Allocation of the most important risks is an important step that ensures the most apt project participant is assigned to manage a specific risk. Contingency accounts are then used to provide the resources to address project issues that are encountered despite the risk management plan.

RISK IDENTIFICATION

Capital project risks take many forms. However, these risks can be grouped into four major categories.

1. Safety risks
2. Business risks
3. Performance risks
4. Liability risks

Safety Risks

Construction activities are dangerous. Accidents may delay a project or may result in costly health-related expenses. Safety incidences can affect future insurability and the cost of insurance.

Business Risks

Contract requirements can pose a major risk not only to the contractor but also to the owner. Contract language that impacts the contractor can lead to higher costs to cover the risk. Contract clauses that are most problematic are

- Indemnity
- Consequential damages
- Differing conditions
- Delays

Requiring involvement of multiple agencies in capital construction project management may be a political necessity, but such involvement can create lengthy approval processes or conflicts in direction, both of which can potentially lead to delays and increased costs. Some contracts include restrictive language specifying partial payment timing and amounts. Contractor cash flow and owner liability risks may develop depending on the details of these requirements.

Performance Risks

Completing the work on time and meeting quality requirements depend on the skill and management of the workforce. There are risks associated with both of these goals. Frequently, portions of the project depend on equipment delivery or materials delivery, the timing of which can pose risks. Weather and environmental factors may also impact the progress of the project.

Liability Risks

Contractors, owners, and management consultants may all be the targets of suits. Negligence is not always the claim. Insurance costs can be a risk in themselves. Litigation or just the threat of litigation can create an adversarial situation that can affect the cost and progress of the project. Regulatory violations can result in fines or serious legal consequences. Complex tax laws affecting employee compensation and business operations can create significant cost impacts.

Examples of specific risks in each of these categories appear in the lists shown in Tables 12-1 through 12-4. These are not intended to be comprehensive lists since the types of risks are dependent on the perspective of the affected party (for example, contractor, owner, or engineer). However, these examples represent some of the more common risk areas faced in capital construction projects.

Identifying risks is the responsibility of the entire project team. All members are needed to draw on their collective experience and combine it with historical information and lists of potential risks (like those in Tables 12-1 through 12-4). Risk identification meetings can be used to define the project risks and to recognize interrelationships.

Table 12-1 Capital project safety risks

Area of Safety Risk	Details of Risk
Project size	• Physical area • Type and amount of equipment • Number of workers • Supervisory requirements
Location	• Topography • Access • Geology • Weather factors
Construction elements	• Areal issues • Excavation issues • Construction techniques • Materials issues
Worker concerns	• Training • Exposure • Skills • Substance abuse
Environmental factors	• Weather patterns • Adverse materials • Potential disasters • Equipment dangers

Table 12-2 Capital project business risks

Type of contract	• Lump sum • Unit price • Guaranteed maximum • Reimbursable
Contract clauses	• Differing site conditions • Responsibility for quality variations • Consequential damages • Damages for delay • Indemnity
Monetary	• Payment float • Retention • Regulatory penalties • Contractual penalties • Bidding costs • Escalation • Overhead costs • Exchange rates • Area cost indexes • Unbudgeted premium time • Bonuses • Shared savings
Regulatory issues	• Permits • Environmental mitigation
Project management	• Skill and experience • Multiple prime contractor • Multiple owner agencies • Government involvement

Table 12-3 Capital project performance risks

Location infrastructure and support	• Police, fire, and medical support • Local residents support • Transportation network • Communications • Government support • Economic conditions
Site factors	• Construction support areas • Availability of utilities • Security • Congestion • Access • Soil conditions
Ability to perform	• Key personnel skills and training • Design quality • Site interference • Local knowledge • Need for new technology • Permit acquisition
Weather	• Knowledge and forecasting • Extreme conditions
Time factors	• Deadlines • Workdays and holidays • Stoppages, strikes, protests
Labor factors	• Productivity standards • Availability and skills • Substance abuse • Wage scales
Materials issues	• Quality • Availability • Delivery • Procurement limitations • Losses • Waste
Equipment Issues	• Availability and cost • Loss or damage
Subcontractor or vendor issues	• Bonding ability • Minority and small business requirements • Financial stability • Technical qualifications
Other exposures	• Storage of materials • Constructed facilities security

Table 12-4 Capital project legal risks

Insurance	• Deductibles • Claims • Natural disasters • Supervisory requirements
Liability	• Third-party litigation • Employee suits • Warranties and guarantees • Vehicle liability
Regulatory violations	• Health and safety • Environmental • Permit requirements
Taxes and fees	• Income taxes • Business taxes and fees

EVALUATING RISKS

Once risks have been identified, they are evaluated to associate a likelihood of occurrence and the severity of the consequences. Included in this analysis is the cost of managing the risk. Cost-effectiveness of risk reduction is an important consideration. Based on this evaluation, one risk management strategy may be to accept the risk and pay the added cost if it occurs.

Risks may be evaluated in many ways. One approach is to rate a risk for the likelihood of occurrence and the severity of the consequences. This approach is pictured in Figure 12-1. "Likelihood level" is ranked from 1–5, where 1 is implausible and 5 is a certainty. The "consequence assessment" is also ranked from 1–5. In this case, 1 represents a negligible consequence and 5 is catastrophic. The chart in Figure 12-1 shows the risk assessment results (rated N, L, M, or H) for combinations of these two variables (likelihood level and consequence assessment).

This approach results in risks that are ranked. Those risks rated "H" or "M" should also be evaluated for the cost of a risk reduction. These evaluations would provide information to determine the cost-effectiveness of a risk reduction strategy. It may also be advisable to reduce the risk for those ranked "L" if the cost of risk reduction is low.

The identified risks then can be ranked in order of priority (Table 12-5) as determined by the significance from the assessment chart (Figure 12-1). Risks ranked highest are "H" and "M" level significance. The risk management approach selected to lower the risk is also listed in this table. More columns may be added to identify the risk manager (allocation) and the estimated cost of performing the risk management approach. The table is a working document that can help when tracking the risk management strategy development and execution.

There are many other risk assessment methods. The range of methods varies in sophistication and complexity. Below are some examples of risk assessment methods used for capital delivery projects.

Table 12-5 Example of a risk ranking table

Risk ID	Rank by Priority	Description	Consequence Value	Likelihood Value	Significance	Management Approach
R001	1	Details about risk 1	5	5	H	Implement mitigation
R002	2	Details about risk 2	4	5	H	Implement mitigation
R003	3	Details about risk 3	4	5	H	Implement mitigation
R004	4	Details about risk 4	4	4	H	Contingency
R005	5	Details about risk 5	4	3	H	Contingency
R006	6	Details about risk 6	3	4	M	Transfer risk
R007	7	Details about risk 7	3	3	M	Implement mitigation
R008	8	Details about risk 8	3	3	M	Implement mitigation
R009	9	Details about risk 9	4	2	M	Accept risk

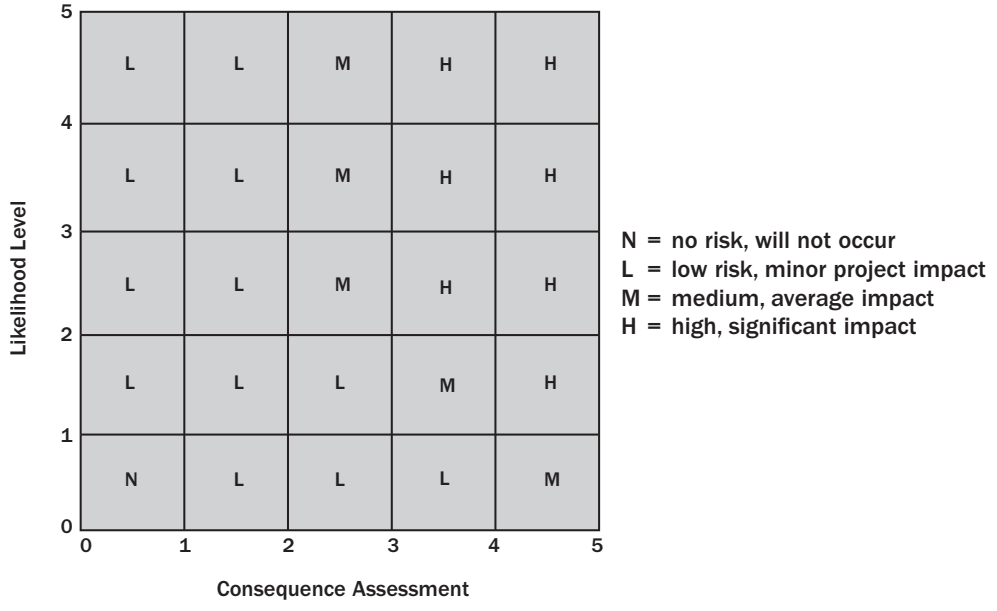

Figure 12-1 Risk assessment chart

Experience-Based Allowances

Using experience-based allowances in risk assessment is a traditional approach that introduces allowances for expected cost or time increases. Judgment is based on experience for similar work. Examples where this approach is commonly used are to estimate the risk of wage increases and to estimate the expected cost of unaccounted materials. Some projects may even estimate a percentage markup for the entire job.

Table 12-6 Project participants' individual interests

Participant	Individual Interests
Owner	
Project manager	Complete project on time and within budget Minimize change orders
Operation manager	Ensure that project costs are capitalized Provide design input
Executive management	Transfer risk Meet budget and schedule Reduce cost if possible
Contractor	
Project manager	Increase profit Complete project early Avoid problems
Company executive management	Increase profit Cover risks Satisfied client leading to additional work
Engineer	
Design manager	Increase fees Position for additional work Control scope of design
Company principal	Increase fees and profit Establish reputation Transfer risk Referral for new work

Computer Simulations

Several computer simulation programs are available to aid project estimators. These programs can also be used to evaluate risks and estimate costs. Some engineering firms have their own proprietary programs to use for clients. These programs are sophisticated, but the reliability of the results is fully dependent on the accuracy of the data supplied to the program. Many times unsupported estimates are used for data input, and then the output is questionable.

Analytical Calculations

Engineering calculations of probability are sometimes used to combine the potential risk effects. Sometimes a "risk index" is calculated to estimate the combined risk from several factors. The value of extensive mathematical models is debatable since much of the data used in the calculations is imprecise.

Decision Analysis

The decision analysis approach for risk assessment uses decision trees or diagrams to sort through the various choices and decide the most effective risk reduction strategy.

Computerized programs using this approach help by automating many of the tedious estimations. Decision analysis has gained popularity for many management applications.

Large capital delivery projects often use all the risk assessment methods mentioned in this chapter. By combining the results of several methods, both experience and science are used to arrive at a reasonable risk reduction strategy.

RISK ALLOCATION

Assigning risk management responsibility to project participants based on an evaluation of knowledge and ability is termed *risk allocation*. This approach is an important method used to assist the efficient conduct and completion of the capital delivery project. Assuming risk by a single party is often most desirable; however, for some parties risks require shared responsibility.

Successful risk allocation requires that all parties work together. The three main project participants are the owner, the contractor, and the design engineer or architect. Not only does this project team need to be engaged unselfishly to manage risk, but it also needs to participate from the beginning of the design through completion. This total involvement of all parties provides the best opportunity for reducing risk.

The project participants enter a project with their own interests. Successful risk allocation requires a team environment. If individual interests (Table 12-6) are allowed to take hold, these may prevent a focus on the *project* and destroy the opportunity to reduce significant risks.

The owner should take the lead at the beginning of the project to establish a *project team* philosophy. The owner should bring all parties together to discuss potential challenges so that the team members can identify among themselves who is best equipped to take risk management responsibility. The remaining project participants will also understand their roles so they will be prepared to offer input when needed.

There are several key project areas where major project risks usually develop and where employing risk allocation may yield great benefits. These project areas include

- Selection of the design engineer or architect
- Ensuring a quality design
- Selecting a contractor
- Communication among the members of the project team

Design Engineer Selection

Qualifications are important when evaluating potential project design engineers or architects. Owners must strongly consider past performance and experience of competing firms. Equally important, the philosophy and culture of the owner must be matched. Although difficult, communicating these values to establish an understanding is fundamental to setting up a successful project team approach.

Quality Project Design

Many parties must contribute to result in a quality project design. The design engineer and the owner must often bring in experts for specialty design elements. Including input from operations and maintenance personnel is critical for a functional design. Sometimes the owner may also include experienced construction experts to ensure a contractor's view is available. If the owner does not have its own staff with this experience, valuable insight may be gained from these experts about contract clauses, constructability, schedule, communications, and other potential risks.

Selecting a Contractor

Often a contractor is selected as the result of a bid process. Even though there are many considerations when evaluating a bid proposal, in reality the low bid is often the winner. Therefore, it is important to develop the request for proposal to bid to reduce uncertainty and to include requirements that can improve the likelihood of success by the best contractors. Successfully allocating risks requires project team members with similar philosophies about this topic. The contractor's risk philosophy should be considered when seeking a contractor.

Communication

Communication or the lack thereof is often the cause of many conflicts. Many risks can be reduced with frequent and effective communication. Therefore, an important feature of managing any risk is to specify communication responsibilities and to include quality checks. Effective communication is needed among all members of the project team and at every stage of the project.

CONTINGENCY MANAGEMENT

Project managers set up contingency accounts to cover cost increases and to schedule extensions. Managing these accounts usually falls on the project manager since they cover losses from several project elements. Careful management can result in lower project costs and completion schedule adaptability.

Commonly, cost contingencies are a single-line account in the project budget. This treatment can create management challenges when distributing the contingency amount to cover cost increases for multiple accounts. Cost contingency accounts often are accessed on an "as needed" basis. This practice leads to exhaustion of the account before the project is completed. Also, there is a tendency to delay corrective action when cost increases early in the project are covered by the contingency.

One account-control approach is to spread contingency funds to the accounts that were used to calculate the contingency amount. It is unlikely the account is enough to cover the maximum estimated cost increase for each risk, but it can be distributed proportionally on this basis.

A contingency drawdown curve (Figure 12-2) is a useful tool to ensure the account is not exhausted before the funds (or time extensions) are needed. Funds can be released according to percent activity completed. Additionally, many managers do not reserve contingency funds through the entire project but rather identify milestones dates (shown as down-pointing arrows on Figure 12-2) where funds are withdrawn if they are not used.

The effective use of contingencies is a proven management method for dealing with cost increases and schedule extensions. Contingency accounts are established for likely risks. Opportunities are created for project managers when these accounts are unused.

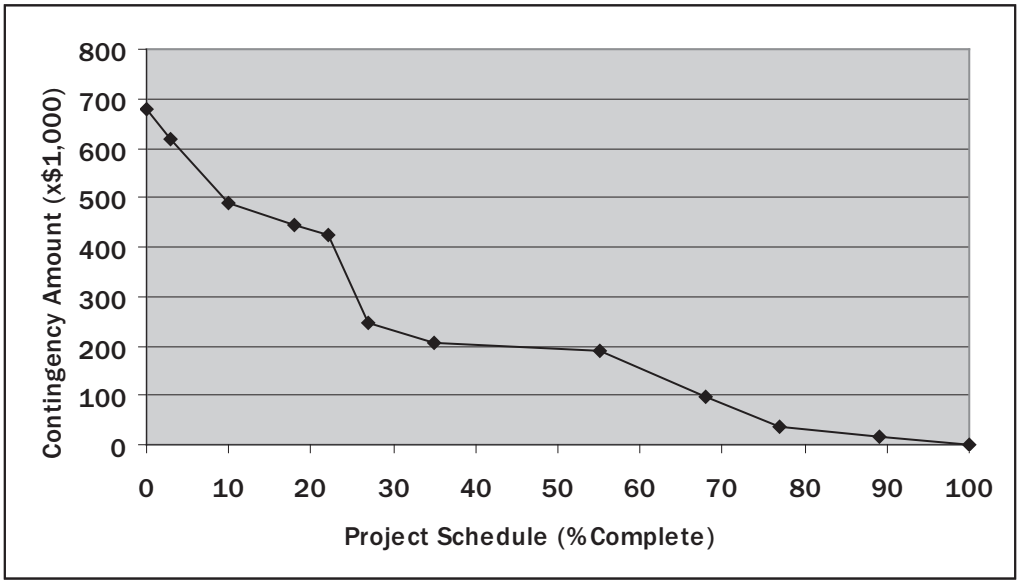

Figure 12-2 Contingency drawdown curve (example)

SUMMARY

Capital project delivery by its nature includes many uncertainties. These unknowns lead to risks and opportunities. Project managers need to manage risks to reduce the negative impact on the project. Project stakeholders should keep these points in mind when facing a risk management situation.

- *Avoid risk when it does not add value.* To assume a risk, ensure there are potential benefits that outweigh the potential consequences. Exploit risk when the likely benefits exceed the costs. Use the "80:20 rule" by employing standard or proven techniques for 80 percent or most of the project requirements. By focusing risk in the remaining 20 percent of the project, there is the greatest potential for controlling and producing a positive outcome. This approach allows the best or most experienced personnel and critical resources to be focused on the critical 20 percent rather than being spread across the entire project.
- *Stay flexible on unresolved issues.* Employ parallel or redundant approaches. Sometimes it is possible to narrow choices rapidly and carry forward two approaches rather inexpensively or with little impact to the project.
- *Address the riskiest items earliest.* These items have the greatest potential impact on the project and control project execution or configuration. Outcomes from the riskiest items often nullify work or decisions made on other tasks or elements.
- *Allocate risk carefully.* Building on the idea of avoiding risk when it does not add value, it is helpful to concentrate risk in just a few areas. This ensures the best resources can be assigned to manage each risk.

Successful risk management techniques for capital projects use the following steps:

1. Identify risks
2. Evaluate risk likelihood and consequences
3. Assess the significance of each risk
4. Allocate risks to manage each effectively
5. Set up and manage contingencies

Employing these processes often leads to the delivery of a capital project with a minimum of disruption, meeting project schedule, and within the expected budget.

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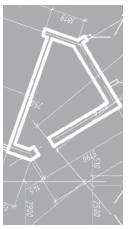


Chapter 13

Disputes

The complexities of the construction process are fertile ground for disagreements and misunderstanding that, if not promptly resolved, may grow to the level of a dispute. A dispute is defined as an unresolved claim. In the past 20 years the number of disputes among various parties of the construction contract has risen dramatically. The number of attorneys and legal firms with large divisions that specialize in construction claims and disputes has also risen. Disputes can lead to time-consuming, costly resolution, often through litigation. The cost impact, both in time and money, is substantial for all parties, even the prevailing party.

Because of the high cost of dispute resolution, more emphasis is now being placed on claims avoidance and management. Earlier chapters have emphasized the importance of proper project planning, design, contracts, and administration in minimizing construction claims and disputes. Nevertheless, disputes may occur even with the best efforts.

This chapter defines terms and common causes of disputes. It also presents methods of resolving disputes, including negotiation, arbitration, litigation, and alternative dispute resolution such as the use of mediation, a summary jury trial, or a dispute review board. The focus is on providing the contracting parties insight into the various dispute resolution methods and describing pitfalls that lead to problems, claims, and disputes.

BACKGROUND

The following discussion defines terms used in dispute resolution and identifies common causes of disputes.

Definitions

Problems during construction are not unusual; in fact, the entire design and construction process consists of problem resolution. All the parties—owner, design engineer, contractor, subcontractors, suppliers, and others—involved in the project undertake a certain amount of risk. When a problem goes beyond the risks that initially have been accepted by the parties, a dispute often arises. A construction problem becomes a claim when a party asks for more money or more time or both that result in no tangible benefit to the owner.

For example, a contractor may view site conditions that differ from those originally anticipated as a basis for making a claim, but the owner might not consider the claim

justified based on the information provided to the bidders by the owner. The contractor can then make a formal claim to offer sufficient justification for all or a portion of the claim, and a settlement can be negotiated on-site. A change order then formalizes the contract change, and the issue is resolved. A change order is a response to a problem that is agreed to by all parties. It is an agreed change to the contract and can call for an increase or decrease in both price and time.

A claim escalates to a dispute when the other parties cannot agree on the justification for the claim. Proper claim procedures involve the presentation of a well-documented claim that advances the merits of the claim, together with documentation on the associated cost, schedule, and other particulars. The party to whom the claim is presented must make a thorough and fair evaluation. Unfortunately, each of the parties often advances to an uncompromising position without really knowing the value of each other's positions.

Causes of Construction Disputes

The causes that can lead to a construction dispute are numerous and often complex. Disputes are often the result of an accumulation of minor confrontations and disagreements. The increasingly litigious nature of the industry causes dispute participants to direct much energy toward "building a case" and taking a position from which they will not move for fear of compromising that case. This tendency makes it important for the various parties to understand what can be involved in resolving a claim once it has reached the dispute stage.

Two factors equally important in understanding why disputes arise are the origin of the underlying problem and the way parties handle the problems. Insight into some of the major causes of disputes can be helpful in avoiding and resolving disagreements before they become full-blown disputes.

The perception of the construction contracting process 30 or 40 years ago was entirely different from today. Relatively few entities were involved other than the owner and a contractor. Today, many more entities and experts may be directly involved in the project, such as consultants and subcontractors. In addition, other entities outside the contract may exert considerable influence on the project, such as regulatory agencies, local government units, state highway departments, the Army Corps of Engineers, environmental agencies and organizations, and neighborhood and citizens' groups.

Figures 13-1 through 13-4 illustrate some of the typical contractual arrangements that are encountered in water utility projects. Figure 13-1 depicts the originally conceived form of contract in which an owner contracted with an engineer for design and made a separate contract with a general contractor to build the facility.

Figures 13-2 to 13-4 illustrate the much more complex contractual process of today. The term *surety*, which appears on Figures 13-2 and 13-3, is defined as the guarantee that the various parties will perform. Sureties may take the form of performance bonds or payment bonds. All of the entities identified in these contractual relationships are potential dispute adversaries. It should be well recognized that the many participants have different roles, policies, and operating procedures, as well as different personalities and behavior. The variety brought to the process is essential in this age of rapidly changing technology and specialization. However, the very complexity of the player matrix creates an environment that is more conducive to misunderstandings that lead to disputes. All of this definitely suggests that the contract process that ties various entities to the project must be carefully crafted.

The following paragraphs discuss some of the specific causes of disputes.

Contracts. Because of the complexities of any particular project and the general complexities noted previously, the contract itself can be the main source of problems contributing to disputes. Some of the problem areas with contracts include ambiguous contract language, outright omissions, conflicting requirements, and unrealistic time or performance requirements.

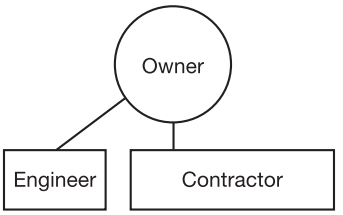


Figure 13-1 Typical contractual arrangement 30 years ago

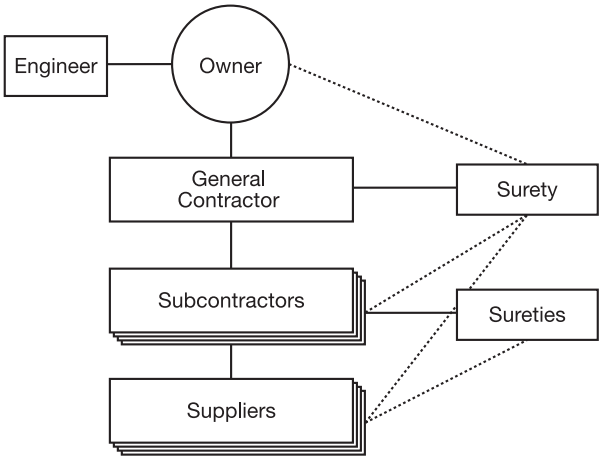


Figure 13-2 Typical general contractor format today

Changes. When the contractor is required to undertake any type of work that deviates from the original bargain of the contract or from the scheduled work plan or time of performance, a change in the project occurs. A dispute typically arises when the contractor seeks adjustments that the owner feels are excessive.

General classes of changes include formal changes, constructive changes, and cardinal changes. *Formal changes* are the traditional change orders that direct specific changes, acknowledge the change is being made, and involve a formal contract change-order provision. *Constructive changes* result from actions of the owner or its agents that have the effect of a change directive but often without any formal recognition of a change. *Cardinal changes* occur when the changes are sufficient to change the entire character of the work.

Regardless of the reason or justification, changes often have a ripple effect that impacts other areas of work and escalates problems that were difficult to foresee at the time the change was started. The ripple effect, for example, could be a lengthy delay that now puts the construction into the rainy season where weather now becomes a factor that it otherwise would not have been.

Site conditions. Different site conditions from those predicted are perhaps the most frequent reason for a claim that leads to a dispute. In many cases, the owner has attempted to shift the risk of the unknown onto the contractor with the aim of reducing up-front design or investigative costs. However, the contractor that must win by making the lowest competitive bid cannot afford to include substantial amounts of contingency costs. Disputes arise over differing opinions as to what should "reasonably" have been expected.

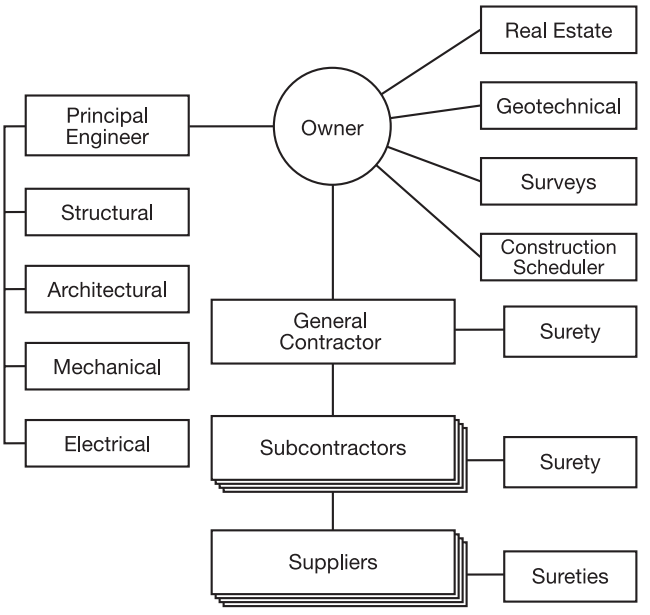


Figure 13-3 Typical format for modern large projects

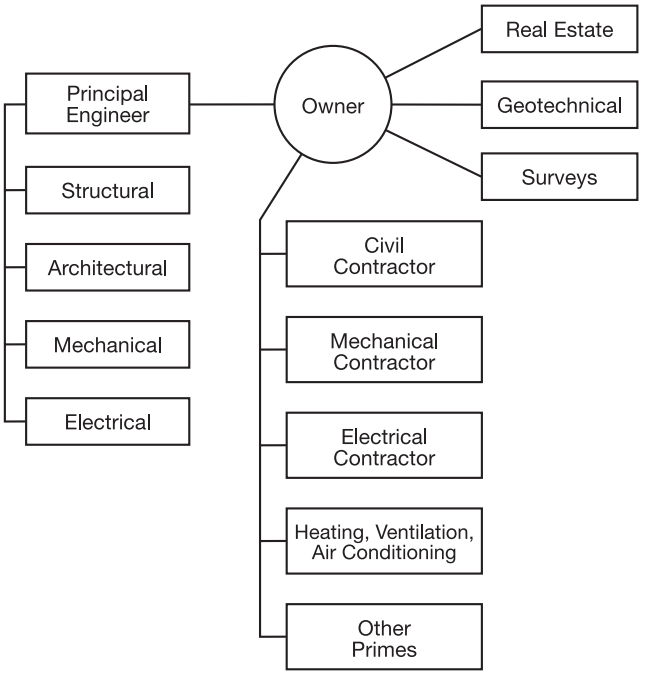


Figure 13-4 Typical modern format with multiple prime contractors

Delays. A delay more often than not impacts costs for all parties involved in the construction process. A delay may be caused by any one or combination of the parties. The owner's failure to obtain timely financing and rights-of-way, give approvals, or render decisions can lead to delays that result in claims for extra compensation. The design engineer may be tardy in responding to requests for information or reviewing submittals and

shop drawings or may unreasonably deny the approval of an "or equal" (comparable item). Likewise, a supplier's untimely delivery of materials can delay other subcontractors and ultimately delay the entire project, adversely affecting the owner and the engineer financially. Frequently the engineer handles the construction-phase services on a limited budget; delays on the project lead to claims for extra compensation. The owner may often be reluctant to recognize the full cost impact of delays on the other parties.

Quality or performance. Poor installation, defective materials or equipment, and even construction failures are typical problem areas for disputes. Many of these problems may not become apparent until well into the construction process or until after the project is completed and put into operation. Such problems discovered at this stage are usually very difficult to remedy to the satisfaction of all parties.

Outside forces. Forces outside the reasonable control of any of the contracting parties may dramatically impact the progress and cost of a construction project and result in a claim. Such naturally occurring forces include floods, earthquakes, wind, and unusually severe weather. Other outside forces of a less dramatic nature are more common concerns. Intervention by a governmental agency, a public body, or citizens' group can impede, change, or delay a project. Adequate planning and anticipation can reduce the likelihood that these forces will cause problems. Construction contracts should include a "force majeur" clause. A force majeure clause will exclude a specific party from liability in the event some unforeseen event, outside the control of the party, precludes the party from completing an obligation under the contract, e.g., completing the project within the specified time period. To be given relief under force majeure, the party is excused only if the failure to perform could not have been reasonably anticipated with due diligence. To be fair, force majeure clauses should apply to both parties.

DISPUTE RESOLUTION

The three traditional methods of formal dispute resolution are

- Negotiation
- Arbitration
- Litigation

More recently a fourth method has evolved—alternative dispute resolution. Regardless of which method is chosen, several steps should be followed for a successful resolution, as discussed next.

Preparation

Once it becomes apparent that a dispute must be resolved in a formal manner, experts in the area of construction claims and litigation should be consulted. Over the past 25 years, the area of construction claims litigation has become a relatively complex and specialized field. Even those owners and their engineers that have a capable staff may need to be supplemented by experts who can render at least a knowledgeable second opinion on the basis of the claims. Detailing all of the preparation needed to resolve a dispute is impossible, but the following general preparatory steps are most important:

- Identify and isolate the problems responsible for the dispute, including personality conflicts and emotions.
- Organize all available facts, documents, notes, and circumstances that bear on the problem.
- Give proper and timely notices to those entitled to receive them.

- Determine what and to what extent additional assistance from consultants or others may be required. For example, a scheduling consultant may be required for analysis of delay claims.
- Determine options, probable costs, whether a settlement is possible, whether there are grounds to sue, and whether contract documents provide for specific means of dispute resolution.

Negotiation

A negotiated settlement should almost always be considered as the method to resolve a dispute. The art of negotiation is always subject to the particular style and experience of the participants. However, some of the following elements are common to successful negotiations:

Be prepared. It is important to know the details and anticipate the opposing party's arguments. The relevant facts should be presented and documented with letters, memos, logs, and contract provisions. Charts, graphs, drawings, and photographs can be used effectively to illustrate points. The cost components or specific disagreements should be identified with respect to the claimed costs. A chart comparing "as planned" versus "actual" scheduled tasks is always helpful.

Pick the negotiating team. Different circumstances call for different types of negotiators, but two types of individuals are usually essential for successful negotiation: the party's representative most closely associated with the project and the party's decision maker. The party's attorneys may also be present.

Know negotiation techniques. Several books and manuals on negotiation are available. An understanding and appreciation of the opponent's particular problems that contributed to the dispute will be helpful in forming a negotiating strategy.

Prepare a memorandum of agreement. The results of the agreement reached through the negotiation process should be promptly summarized in a memorandum of agreement. A complete record should be made that identifies the important documents and points presented, the presenting party (or parties), and the times presented. Both parties and witnesses should sign the memorandum.

Arbitration

If attempts at negotiation prove fruitless, the claimant may have two alternatives: arbitration or litigation. The availability of arbitration as an alternative depends on whether or not the contract contains an enforceable arbitration clause covering the dispute.

Today, contract clauses providing for arbitration of disputes are commonplace. The Engineers Joint Contract Documents Committee Standard Forms of Agreement, typically used in water utility projects, provide for arbitration in accordance with the Construction Industry Rules of the American Arbitration Association (AAA). Arbitration is provided for in the EJCDC standard contract between owner and design engineer and between the owner and contractor.

An important provision of the arbitration clause prohibits the inclusion of another entity that is not a party of the specific contract. This provision means that arbitration between the owner and contractor cannot include the engineer or other parties in the proceedings.

Following the AAA rules, the complaining party files a Demand for Arbitration with the AAA regional office. The Demand for Arbitration does the following:

- Names the parties
- Describes the nature of the dispute

- Requests the dispute be resolved by arbitration
- Recites the agreement to arbitrate
- Designates the location for requested arbitration proceedings

The demand need not be formal or detailed, but it must be sufficient to notify the AAA and the adversary of the foregoing elements.

The AAA administers the arbitration, assigning it an identifying number and notifying the adversary party of the demand. The adversary then normally has one week in which to file its answer to the Demand for Arbitration, failing which the allegations contained in the demand are automatically denied. (There is no award by default in arbitration proceedings.)

If the adversary files an answer, the AAA then furnishes the parties or their attorneys with a list of arbitrators from which to select (often a panel of three arbitrators is used). When the selection process is complete, the arbitrators then conduct the arbitration according to established practice and written rules.

In the arbitration process, there are limitations on discovery of the facts, i.e., on the prearbitration disclosure of pertinent facts or documents. Therefore, the owner (assuming it is the adversary party) should seek as much informal discovery from the contractor as possible. Given the fact that the contractor's claim is usually based in large part on its own documents and records, an owner bound to defend the claim in arbitration may be at a disadvantage unless it is allowed access to the contractor's documentation.

Arbitration proceedings are more informal than proceedings in litigation. Rules of evidence do not exist, and the arbitrators are not bound to accept or reject any established rules of law. In spite of these relaxed procedures, the award of an arbitration panel will generally be enforced in a court of competent jurisdiction and will not be overturned for a lack of evidence unless gross negligence, fraud, or corruption on the part of one or more of the arbitrators is established.

Informality aside, arbitration proceedings do have some similarities to litigation. In each proceeding, the parties present their cases to the arbitration panel (or judge or jury, in the case of litigation). In each, the parties attempt to persuade the arbitration panel of the correctness of their causes by testimony, documents, and argument. Each proceeding will result in an enforceable judgment.

Arbitration allows parties to present their positions to a single arbitrator or panel of arbitrators while avoiding many of the drawbacks and technicalities of the normal judicial process. However, arbitration also has its drawbacks. The advantages and disadvantages most frequently cited are described in the following paragraphs.

Speed of resolution. Arbitration may avoid the lengthy waiting period common with court calendars. However, once arbitration is started, it may be a more time-consuming process than litigation. The difficulty of scheduling continuous arbitration sessions because of other demands on the arbitrators' time can result in long delays between sessions, and the process may drag out over many months in a complicated construction case.

Cost savings. Arbitration may be less costly than a comparable court proceeding, but this is not always the case. Construction arbitration almost always involves attorneys. Attorneys presenting a case for arbitration should be as prepared as if the case were being tried before a judge or jury. Preparation requires examining documents, interviewing witnesses, performing legal research, preparing experts, and developing demonstrative evidence. All of these activities and their attendant costs are common to trial preparation. In addition, there are arbitrators' fees, administrative fees, and the cost of meeting rooms. These costs are unique to arbitration and generally exceed typical court costs. They need to be estimated on a case-by-case basis and will vary depending on location.

Technical expertise of the arbitrators. Presentation of construction claims to a panel of experienced construction arbitrators is generally cited as an advantage of arbitration. Ideally, panels selected for construction disputes consist of a contractor, an engineer, and a construction lawyer. Frequently, however, the parties' attorneys do the selecting and tend to load the panel with other attorneys.

Privacy. Arbitration has the advantage of privacy. Arbitrators are not required to issue written decisions, and decisions are not a matter of public record. The absence of a written decision is of little concern to most since the primary goal of the disputing parties is the prompt resolution of the dispute.

Avoiding legal technicalities. In arbitration, strict rules of evidence do not apply. Arbitrators are generally liberal in their acceptance of evidence. This circumstance permits an easier and faster presentation of records, correspondence, documents, photographs, and testimony. The AAA rules encourage arbitrators to accept all evidence that may shed light on the dispute. Arbitrators retain the right to determine the weight that they will give to each piece of evidence. They may choose to disregard an item of evidence even after it has been submitted for consideration.

Lack of discovery. Formal discovery procedures are not used in arbitration unless agreed to by the parties, specifically authorized by statute, or ordered by a court or arbitration panel. Prehearing document exchange is virtually always ordered by the arbitrators. An inability to compel discovery may be either a drawback or an advantage, depending on the status of a party's own knowledge of the facts and documentation.

Location of the arbitration. The location of court proceedings is determined by complex rules of jurisdiction and venue. In arbitration, the parties can use the hearing locale established in their contract.

Waiver of jury rights. Although a panel of technically skilled arbitrators may be a good tribunal for a complex construction dispute, parties to an arbitration agreement should remember that they have waived the right to present their arguments to a jury.

Limited scope of judicial review. Because arbitrators function in a quasi-judicial role, their award will not be overturned by a court unless there is proof of fraud, undue bias, or corruption.

Litigation

Litigation is an expensive and time-consuming process. Much of the lawyers' time spent handling a construction claim deals with procedural issues, such as discovery, motions, and pleadings, as discussed later. These procedural issues often drag out the case for a year or more.

The rules governing court proceedings are quite complex and vary among federal, state, and local courts from jurisdiction to jurisdiction. Therefore, the party initiating the litigation should have its attorney present a probable scenario of the course of the litigation, the probable schedule, and cost of the process. The party should also consider staff time that will be involved. An analysis of the cost-effectiveness of the litigation process would be in order, much like comparing alternatives for a treatment process.

A decision that must be made concurrently with the selection of parties is the choice of the most desirable court. Typically a jury trial is afforded, but in some jurisdictions and in federal court, a demand for a jury trial must be filed in a timely manner. Parties may waive their right to a jury trial. Which option is best depends on the nature of the case and whether a jury may be more sympathetic to the claim. A jury may be better able to understand a single-event case such as an automobile accident or murder, but a typical jury may not understand as well the complexities of a multifaceted construction claim with many technical sidelights.

A judge can hear all of the evidence and render decisions without a jury. A judge sitting alone is more likely to admit disputed evidence that would normally be excluded from a jury. In such a case, the judge is relying on experience and training to give any evidence the weight it deserves. However, a judge is not likely to be swayed by sympathy factors, which are frequently played to before a jury.

Discovery. Discovery is the statutory means by which a party is able to elicit facts from the opposing party. The process of discovery is very important and the point at which many construction cases are won or lost. Attorneys must discover every fact, every document, every witness, every photograph, and every other item that will assist in presenting the case. Discovery is designed to eliminate courtroom surprises and encourage settlement. The process may begin as soon as litigation starts.

The discovery process includes the following elements:

Interrogatories. Interrogatories are answers prepared in response to written questions.

Depositions. Depositions are the oral examination of any person with knowledge pertinent to the case. Depositions are taken under oath and recorded by a stenographer. The transcripts may be used at the trial. An opportunity to cross-examine is given to the other party.

Admission. Admission entails one party requiring another party to admit, in writing, the truth of certain facts.

Documents. The production rule allows one party to compel another to furnish designated documents or tangible items that have a direct bearing on the case.

Trial. The purpose of the trial is not to demonstrate to the judge or jury how much work has been done in preparation but to present the case in its simplest, most persuasive form. The core of the case involves the resolution of two distinct issues, liability and damages. Has the defendant performed or failed to perform, to the plaintiff's detriment, an act or acts for which the defendant was obligated? If so, has there been any resulting damage to the plaintiff and in what amount?

Trial tactics, strategies, and procedures are beyond the scope of this discussion. However, the approach used in a trial is mostly directed by the legal counsel that is retained for the litigation process. The preparation for the trial, the presentations during the trial, and the closing arguments are under the control of the counsel. The counsel's primary goal throughout the entire process is to present the facts that substantiate the client's position.

Costs of Resolution

Trials and arbitration both are costly. The cost of either approach should be estimated beforehand with the construction claims attorney. It is important to know or at least have a good idea as to the possible costs. A party should never hesitate to question its attorney, both before and during the representation, concerning legal fees, as well as other expenses for expert witnesses, documentation, discovery, and other related costs. There are several areas where cost savings can be realized, and these should be pointed out in the beginning and investigated throughout the process.

ALTERNATIVE DISPUTE RESOLUTION

Alternative dispute resolution (ADR) refers to methods of resolving construction-related disputes without resorting to either arbitration or litigation. The interest in ADR in the construction industry is increasing for many reasons, some of which are

- The extremely high cost of either arbitration or litigation

- The need to resolve a dispute more quickly than the time required to resolve it by either arbitration or litigation
- The clogged court system, which encourages ADR as a fair way to resolve disputes and also relieve the court calendar
- ADR's ability to balance the desire for speedy resolution against the desire for just resolution

ADR is not an attempt to bar the litigant's right to a jury trial under the Seventh Amendment to the US Constitution. Rather, it is a resolution alternative for complex construction-type disputes that are more appropriate to nonjury trials. That is, parties in construction claims cases are less likely to rely on winning their positions by playing to juries made up of randomly selected laypeople, so such cases lend themselves more to nonjury trials.

Mediation

Mediation is an ADR process that uses an impartial mediator to assist the parties in reaching a settlement by suggesting ways to resolve the dispute. Unlike an arbitrator, a mediator does not render a decision and has no power to force the parties to accept a settlement. A variety of procedures and techniques is used by the mediator to help the parties reach and agree on a resolution.

Mediation has been increasingly used in the last five years or so to resolve disputes in the construction industry, particularly in federal courts. Judges have encouraged mediation as a trial alternative. The mediation process hastens the settlement, reducing the costs to the litigants and the burden on the court system.

The mediator's role can take various forms. The mediator can

- Identify and narrow issues
- Identify underlying interests and concerns
- Carry messages between the parties
- Explore bases for agreement and the consequences of not settling
- Develop a cooperative, problem-solving attitude in the parties

The advantages of mediation include the following:

- The cost is usually much less than other resolution options.
- Communication between the disputing parties is enhanced through a skillful mediator.
- Personality issues are kept out of the process to a large extent.
- The mediator can work behind the scenes to structure a framework for settlement.
- Even if a full settlement is not reached, mediation can narrow issues in a dispute, which can be very helpful in complex cases that include many disputed issues.

Mediation is only as good as the parties' willingness to work at it. Even though parties enter into mediation, they may not be satisfied unless they win their positions completely.

The following paragraphs describe the steps that usually occur in mediation.

Agreement to mediate. A trial judge can impose or suggest mediation, often at the same time a trial date is set. The parties can also agree to mediate. When they agree to mediation, they typically sign a written agreement that deals with such matters as

identifying the mediator, fees, and confidentiality. Mediation for the construction industry is offered by the AAA, which first published rules in 1984. If the AAA receives a request to mediate, it will appoint a mediator. Several private firms offer arbitration and mediation services specifically to the construction industry.

Mediator selection. Upon receiving a request for mediation, an agency will appoint a qualified mediator to serve. Most likely the mediator will be an attorney. Normally a single mediator will be appointed unless the parties agree otherwise.

The appointed mediator from the AAA or from a mediation agency should have expertise and experience in construction litigation, although nonattorney experts are also active in the field. In addition, the mediators should have received a substantial amount of mediation training and should typically have nonjudgmental personalities.

The credentials of the proposed mediator should be carefully reviewed. Criteria for selecting the appropriate mediation agency to furnish the mediator and rules of mediation include

- Experience of the agency
- Training and experience of the mediators
- Agency's success rate
- Fees and references

Mediation process. Once the parties enter mediation, the mediator makes all arrangements with or between the parties. Each side is represented by a person who has adequate authority to enter into a settlement agreement. This means that clients, as well as their attorneys, should attend the mediation sessions and that a public water agency should be represented by a high-level manager who has the authority from the board to make decisions. The mediator conducts joint and separate meetings with the parties, reviews the positions, reviews supporting data, and may shuttle back and forth between the parties.

If necessary, the mediator may obtain expert advice on technical issues, provided the parties assume the expenses of obtaining this advice. Mediation sessions are private. The mediator cannot divulge confidential information disclosed by the parties. All records and reports are kept confidential. No stenographic record is kept of the mediation process. The expenses of witnesses for either side are paid by the party producing the witness. All other expenses of the mediation, including travel, are borne equally by the parties unless they agree otherwise.

Mediation ends when (1) a settlement agreement is reached by the parties, (2) the mediator issues a written declaration to the effect that further efforts at mediation are no longer worthwhile, or (3) either party issues a written declaration that the mediation process should be terminated.

Summary Jury Trial (Minitrials)

A summary jury trial, also called a minitrial, is a nonbinding, informal settlement process in which jurors hear abbreviated case presentations, typically lasting no more than a day. A judge presides over the hearing. No witnesses are present and the rules of evidence are relaxed. Important to the process is that party representatives authorized to settle the case are *required* to attend. After the minitrial, the jurors deliberate and hand down an advisory verdict, which becomes the starting point for settlement negotiations. The presiding judge may participate in these negotiations. The verdict is nonbinding upon the parties and is used by the parties to predict the likely outcome of an expensive jury trial.

A summary jury trial is a more elaborate ADR method that requires the attention of a judge and a jury. It is best suited to large, complex cases that would take weeks or months

to try, as well as to cases for which the savings in time and money resulting from a successful summary jury trial would be the greatest. A judge cannot prevent parties from getting their day in court but may require them to submit to a summary jury trial before they may proceed to a full jury trial. When such a procedure is imposed, many cases are settled before reaching the actual trial stage.

The real purpose of the summary trial is to get to the essence of the case in as short a time as possible. The process forces the parties to evaluate their cases and get to the core of their positions. It enables the parties to view how their cases may be seen when examined in the full light of a jury. It also provides each party the opportunity to view the opponent's case.

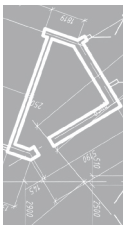
The advantages and disadvantages of summary jury trials include the following:

- The strengths and weaknesses of each party's position are revealed, which permits a better evaluation of each position.
- Summary jury trials provide a less costly, nonbinding process that encourages settlement. The required involvement of the decision makers and principals is important in reaching a settlement.
- The summary jury trial is supposed to be indicative of a full jury trial, but this may not be the case since each jury is unique. Juries are highly unpredictable and often seem to favor large settlements from the party they perceive to be "wealthy."
- Since the summary jury trial reveals the essence of each party's case, there is the need for mutual good faith.
- Despite the results of a summary jury trial, the dispute may still go to court, in which case the cost of the summary jury trial becomes an additional expense.
- A summary jury trial has limited usefulness and is best suited to large, complex cases that would involve months of court time.

Dispute Review Board

A dispute review board (DRB) generally consists of three members selected and approved by both the contractor and the owner at the time a construction contract is executed. DRB members are experienced with the type of work involved, respected by their peers, and neutral. They visit the job regularly during construction and are kept advised on its progress. When disputes arise, the DRB can recommend settlement quickly, before adversarial attitudes grow and harden. Experience has shown that the existence of an impartial, respected panel encourages parties to view their differences more objectively and to resolve them without a hearing. The DRB provides an independent assessment on the merits of disputes and does not usurp the owner's authority to direct the work as provided in the contract. Although DRB recommendations are not binding, parties normally give them great weight and in most cases accept the findings. Should further proceedings such as arbitration or litigation become necessary, DRB recommendations are admissible as evidence.

The DRB is not intended to supplant existing dispute settlement methods. Rather, it is an earlier, nonbinding, intermediate step directed at avoiding the need to resort to more expensive, more time-consuming, and less satisfactory procedures. On June 1, 1993, a new set of Construction Industry Dispute Review Board Procedures, administered by the AAA became effective.



Chapter 14

Communication

Throughout this manual, direct and open communication has been mentioned as being critical to successful project management. Good communication increases the chances of project success, but such communication does not happen accidentally. When project participants understand the fundamentals of the communication process and conscientiously apply them, there is a good chance communication will be effective.

This chapter presents the basics of good communication, describes the types of communication, and gives guidelines for effective project communication.

BASICS OF GOOD COMMUNICATION

The process of communicating can be presented in a simple model (Figure 14-1). In this model, two participants are a "sender" and a "receiver." The sender sends a message, which the receiver tries to understand. Interfering with understanding is "noise." The most important part of the model is the receiver. A sender needs to understand the receiver—his or her technical knowledge and needs—before communicating. In other words, a sender should be sensitive to the receiver.

Usually, noise is thought of as interfering sounds, such as the noise of construction machinery. That noise would interfere with two people trying to talk to each other. However, noise can come from a variety of other sources, such as unclear writing, anger, poor photocopies, lack of attention on the receiver's part, or misspelled words.

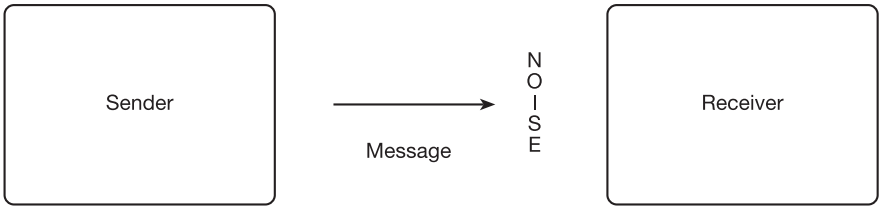


Figure 14-1 Communication model

Figure 14-2 Construction signage displaying a concise message

Eliminating Noise

Eliminating noise is a key to effective communication. A message that has eliminated noise is

- Clear
- Concise
- Specific

In a *clear* message the sender has made the message as understandable as possible. The sender uses words that the receiver understands, not words understood only in the sender's profession. For example, a design engineer talking to homeowners about a treatment plant expansion should clarify terms such as "flocculation." In addition, the sender's message should be unobstructed by physical noise or other noise such as anger or mistrust.

A *concise* message starts with the sender determining exactly what information—the topic—should be communicated. The message should then be restricted to the topic and should not obscure the important information. Nor should important information be left out. For example, does the homeowner's group need to hear a technical lecture on flocculation? The group may be interested only in the expansion's effect on rates. Figure 14-2 shows an example of a concise written message.

Both a sender's writing and speaking styles should be concise. For example, look at the two sentences in Figure 14-3 and decide which is noisy and which is concise. A specific message uses concrete rather than abstract words. Abstract words are open to interpretation, whereas concrete words are less vulnerable. In the example in Figure 14-3 the contractor must give at least 48 hours notice, not "due" notice or "adequate" notice.

Reducing Anger

Trying to communicate in anger is one of the most disruptive sources of noise. Unfortunately, construction projects can be highly stressful to the participants, and that stress often overflows into anger. The source of the anger is often frustration based on the participants' lack of understanding of each other's situations. For example, suppose the contractor has bid the project as tight as possible and is worried about losing money on

It is vitally important that the owner be notified by the contractor with due notice before the procedures of the startup process are initiated.	The contractor must notify the owner at least 48 hours before startup.

Figure 14-3 Contrast in communication

the job. The owner has to answer to the utility's board members, who question every penny being spent. The design engineer worries about the chance that the calculations were based on inaccurate field data. These different concerns cause each person to approach a problem differently.

The key to reducing anger, besides remaining calm, is first to seek to understand the other's position. Often the disagreement is not one of facts but one of interpretation. A contentious issue may also be divided into subissues, some of which can be agreed to by all. Finding out what the participants can agree on will often diffuse anger.

If a situation has reached the boiling point, it helps to back off until anger has cooled. It is important not to say things that will require an apology later and not to bring up past disagreements or issues that have nothing to do with the current problem. In dealing with anger, it also helps to detach oneself from the situation. In other words, it helps to reduce one's personal involvement by acting as a mediator in one's own disagreement. One must remain objective and not become defensive.

Knowing the Purpose of the Message

An effective message has a purpose. Knowing that purpose allows a sender to focus on the message. The main purposes of communication are

- To inform or clarify
- To instruct
- To document
- To persuade

To *inform* or *clarify* means that the sender is imparting knowledge that the receiver desires. Before sending the message, the sender should determine what information the receiver needs and how best to communicate that information without noise. For example, most memoranda or phone calls are messages that inform or clarify. The sender has information or the receiver requests information, such as test results or an interpretation of a specification. The sender informs the receiver of the test results or gives an interpretation. Messages that inform or clarify should be concise.

A message that *instructs* is intended to teach the receiver a concept or procedure. Manufacturers' equipment manuals and training sessions are examples. Instructional messages, particularly those for procedures, are best presented as concise procedures listed step by step in the order they need to be completed.

Document messages are intended to provide a permanent record of decisions, events, or results. Plans and specifications document the results of the design process. Meeting minutes document the discussion and decisions made at a meeting. Contracts document an agreement between parties. Construction diaries document the daily events on a project. Document messages should be clear and unambiguous.

Messages that *persuade* try to convince the receiver to accept the sender's position on an issue. For example, by making business proposals, a firm is trying to be selected to

perform consulting services. Persuasion is also used, for example, to convince others that a particular treatment option or piece of equipment is better than another. Clear, concise facts, as opposed to unsubstantiated opinions, are the most persuasive.

Managing Meetings

Meetings can be an effective means of communicating and reaching understanding, but they can also be ineffective. The difference is that effective meetings are managed. Just as effective communication is no accident, good meetings result from good techniques. Most effective meeting management styles take the following issues into account:

- *Purpose.* Have a clear purpose for the meeting. Whether for a regularly scheduled progress meeting or a special meeting called to address specific issues, make sure the participants know the purpose so they can prepare.
- *Start and end times.* The most important meeting management step is to set start and end times and stick with them.
- *Agenda.* Before the meeting, send each participant an agenda that lists the purpose of the meeting, the start and end times, the place of the meeting, the participants, the items to be discussed in the meeting, and the proposed time limits for each.
- *Focus.* Keep the meeting focused on the agenda items and on reaching agreement or arriving at required actions. Do not let the discussion get off course or be dominated by one participant. Elicit the input of all members. Use communication basics to keep the discussion focused.
- *Summary and minutes.* When an item has been completed, give a summary of the agreement or the required action items and deadlines to make sure everyone understands. Record the summary as part of the minutes of the meeting.
- *Next meeting.* If needed, set the time and place for the next meeting. Send a copy of the minutes to each participant before the next meeting.

PROJECT COMMUNICATION

During a construction project, many communication events will occur. The typical communication events and messages in each phase of a project are discussed in this section.

Planning

During the planning phase, several meetings usually take place to define the scope of the project, establish priorities and budgets, select project team members, and develop a plan of action. These meetings usually involve only the owner's staff. It is important to keep good summary minutes so that nothing has to be discussed again. It is rarely necessary to keep detailed records of the discussion leading up to agreements.

If a consultant is hired to help with planning, the owner should make clear what types of communication the owner needs and at what points in the process. Usually there is an initial meeting at which the consultant meets the owner's project staff and clarifies the project scope. The owner and consultant should decide who will be the meeting manager and take minutes.

The consultant then usually works with individual staff members to develop alternative design criteria or other project criteria. These communications are done in one-on-one meetings or telephone calls as necessary. There is usually a meeting to present alternatives and other items in a preliminary report to the owner's final decision maker.

A final report and presentation are then prepared based on feedback from those authorized to review the preliminary report.

Design and Bidding

The design process itself is similar to the planning phase, with several meetings held to solve problems or present options. Meetings serve to refine the project scope and to define the quality criteria the owner desires (and can afford). The key to these meetings is to make sure all those involved understand the agreements reached on design issues. This understanding will reduce many problems later.

Results of the design process are documented in the contract documents, which consist of plans, specifications, and bidding documents. Above all, these documents must be clear and specific. Previous chapters have discussed the specifics of the bidding process, including having a prebid meeting to clarify the contract documents, as well as sending addenda to the bidders as needed. Contract documents were discussed in chapter 2.

Construction

Meetings and the associated documentation typify the construction phase. The usual meetings include

- A preconstruction meeting that includes all participants as well as any other utilities or agencies affected by the project
- Regular progress meetings that usually include the contractor, program or construction manager, owner, and other parties immediately affected by the current work
- Problem-solving meetings that include the affected parties

The basics of good meetings also apply to construction meetings, in particular, keeping them focused and starting and ending them on time. Otherwise, the meetings will be perceived as a nuisance rather than an effective method of keeping the project on course.

Construction documentation has also been discussed in previous chapters. Examples of such documentation include pay requests (discussed in chapter 9), change orders, construction manager's diaries, and test results. Again, the key to good documentation is making it clear and specific.

Operations and Maintenance

After construction is complete, the main activities are related to operations and maintenance, most specifically, manuals and training. These activities require instructional communication. The key to good instruction is presenting the information in clear chronological steps. Keeping the terminology understandable is highly important.

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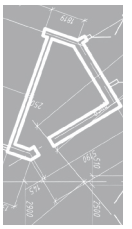

Chapter 15

Selecting Consultants

The success of capital projects depends on developing an integrated project team of managers, design professionals, constructors, and operators. Depending on the size of the water agency or water utility, the management, planning and design, environmental permitting, and construction oversight may be contracted out to individuals or firms for assistance. In this section, the term *consultant* refers to these professionals. Consultants could include program and project managers, construction managers, environmental consultants, financial and legal consultants, design engineers, surveyors, geotechnical engineers, and resident engineering firms. Usually firms providing engineering and other technical services are required to have individuals licensed by the state in which the work is to be performed. Often the firm itself needs to be licensed; some states require the firm to carry professional liability insurance. Some states prohibit competitive bidding of professional services. The Board of Professional Registration for the particular state should be contacted if there are any questions. An excellent resource regarding consultant selection is the National Council of Examiners for Engineering and Surveying (NCEES).

This chapter provides broad guidelines to owners that are selecting consultants to handle various aspects of their programs or projects. It must be pointed out that the methodology and procedure for selecting consultants varies from location to location and depends on whether the owner is a private entity or public agency. Generally the public sector is more regulated than the private sector. Experience has shown that the larger the private water company, the more closely it aligns itself with the public sector in selecting, for example, professional design consultants.

OVERVIEW OF SELECTION METHODS

When a consultant is required, the consultant is typically selected by the utility or agency using either noncompetitive or competitive methods. These methods include the following:

1. Noncompetitive methods
   - Sole source
   - On-call
   - Standardized preselection process

2. Competitive methods
   - Selection from a consultant list (prequalification)
   - Selection from a proposal
   - Selection from a proposal and an interview

The selection process preferred varies widely from state to state and region to region. It depends on the size and complexity of the project and the size and organization of the agency making the selection. Selection processes have evolved over the years as more laws and regulations have been promulgated to protect the interests of the public and encourage fair competition in the marketplace. Selection processes also vary from the public to the private sector. Private utilities or organizations are typically not subject to the same regulations that public utilities or agencies are required to follow. Often organizations have policies for the selection of consultants.

All of the selection processes have advantages and disadvantages, and some processes may be more appropriate than others for specific projects. The utility or agency must be aware of these factors and make an informed decision on which method is best for it in the particular situation. Using an inappropriate method may result in the utility or agency not getting the best value for its investment.

NONCOMPETITIVE SELECTION PROCESS

Sole Source

Sole source selection occurs when a utility or agency issues a contract for consulting services without soliciting proposals from any other individuals or firms. This process is typically used for small projects, emergencies, and project modifications or used when very specialized expertise and experience are required. Sole source selection may not be permitted in some areas or by the policies of some agencies due to its inherent lack of competition. Advantages to sole source selection are (1) quickness and speed, (2) minimal effort and expense required of the agency and consultant in the selection and contracting process, and (3) the agency is able to retain its preferred firm. Sole source may be selected when a consultant has an established business relationship with the utility or agency that gives the consultant knowledge and insight of current utility infrastructure, practices, and organizational culture. Such a preexisting relationship can be an advantage to both parties because less time and effort is needed to get the consultant up to speed. A potential disadvantage is that the firm may not necessarily be the most qualified or have the best approach to designing the project.

On-Call

An on-call services contract is often used where the consultant may be acting as an extension of the agency's staff providing ongoing or frequent services for the utility or agency. Examples are a corrosion consultant, welding inspector, or a firm to design small pipelines and special water service connections. Prior to starting work on a given task, the consultant often provides an estimate of the cost to the owner for approval. The selection may or may not have been the result of a competitive selection process. The consultant invoices the owner on the basis of a billing schedule—typically on an hourly basis plus out-of-pocket direct job-related expenses.

The on-call arrangement has been used as a method to streamline the selection process and reduce the time and expense required to evaluate consultants for specific projects. Advantages to the on-call contract are (1) speed and quickness, (2) minimal effort and expense required of either the agency or the consultant, (3) familiarity of an ongoing

working relationship, and (4) continuity. One potential disadvantage is that the firm or individual may not be the most qualified to perform all aspects of the requested work.

Standardized Preselection Process

The standardized preselection process may or may not be the result of a competitive process. The usual method is for the utility to develop a list (in order by rank) of acceptable consultants beforehand, typically every few years, and select from the list for specific projects. Agencies and utilities will frequently use this process when there are a number of very similar types of projects, e.g., water lines, reservoirs, or regulating stations. A selection list can be developed for each general type of project. When a project comes up, the agency selects from the list, typically the firm at the top of the list or the next firm from the top if the top firm has already been awarded a contract. If allowed by statute, it is common to have elements such as hourly rates and markups all preapproved. The agency or the consultant prepares a detailed scope to perform the specific task or project, and the consultant provides an estimate of hours and costs. The scope and cost are then negotiated. The advantages of this process are (1) speed, (2) minimal effort required of either the agency or the consultant, (3) owner is familiar with the firms on the list, and (4) some consideration of qualifications is given. One disadvantage is that the utility or agency may not have evaluated the most qualified firms or the ones having specific experience required for the given project. The most qualified firm may not be next on the list or may already have been selected for another project and thus not be eligible for the next project.

COMPETITIVE SELECTION PROCESS

Selection from a Consultant List

To select from a consultant list, the utility or agency develops a list of acceptable firms and, as projects come up, solicits detailed proposals from multiple firms (usually three to four) on the list. This approach is similar to the standardized preselection process described above except multiple firms are contacted. Selection from a list allows the utility or agency to evaluate competitive proposals for a project but eliminates the need to evaluate numerous proposals to arrive at a short list of candidate firms. Some time and effort are saved, and the utility or agency is still provided with a competitive selection process. Depending on the project, the agency or utility may or may not elect to interview the consultants before making a final selection. The advantage with this approach is that it speeds up the selection process and the consultants can focus on preparing a scope of work, schedule, and cost. There is no need to repeat a firm's qualifications for each project, since the firm is prequalified by virtue of being on the consultant list. When firms prequalify in specific projects, an owner is almost assured of having qualified firms doing the work. It is also possible to spread the work around by rotating through the list. Disadvantages are that if the project requires some special expertise, the firms on the consultant list may not have that expertise; and a well-qualified firm may be excluded because it is not on the list.

Selection from a Proposal

In this process, an advertisement or solicitation letter is prepared requesting proposals from any firm that believes it is qualified for the work. Depending on the number of proposals, the utility may evaluate the proposals and develop a short list of three or so of the most qualified firms for further consideration prior to making a selection. This process can take longer to evaluate all of the proposals; however, it provides the utility with the best opportunity to select the most qualified firm for a particular project. Again, depending on the project, the utility or agency may or may not conduct interviews prior to making the final selection. Advantages with this approach are the openness and competition.

The owner will be able to select the best firm with the best ideas and approach providing the qualification-based selection is used. The disadvantages are the time that it takes to go through the selection process and the time commitments needed from both the owner and the consultant.

Selection from a Proposal and an Interview

This process is the same process as described above for selection from a proposal with the exception that the interview is not optional. An interview is a formal presentation by a proposing firm and typically requires responses to questions posed by the owner. The owner may request presentation from all of the proposers or just from the best proposing firms. The interview is described in more detail later in this chapter. This process can be used for large and very complex projects, such as tunnels, water treatment plants, and large transmission conduits. The advantage with this approach is that the owner has an opportunity to observe the firm and the firm's project team in action, which allows the owner to probe deeper into the firm and team's experience. The disadvantages are the time it takes to go through the process and the time commitment from the owner's staff, not to mention the added cost to the responding consultants.

DECISION TO USE COMPETITIVE OR NONCOMPETITIVE SELECTION

Whether to use noncompetitive or competitive selection is decided based on local laws and regulations, policy, and preferences. Noncompetitive methods of consultant selection should only be considered for small, noncomplex projects or under other special circumstances, e.g., when the agency or utility is very familiar with the qualifications of the firm and the project is well defined. If the agency uses a competitive selection process, the selection is based on one of the following:

- Fee-based
- Politics
- Qualification-based
- A combination of the above

Fee-Based Selection

Fee-based selection is the process of relying almost exclusively on the amount of the proposed fee to select a consultant. Soliciting bids or costs for consulting services is becoming more and more prevalent as utilities and other public agencies try to keep fees, rates, and taxes down. Unfortunately selecting a consultant from a group of proposals based on fees for a project that is in the conceptual stages and, therefore, not well defined is akin to comparing apples and oranges. The key to having a meaningful evaluation is to have a scope that is well defined. The utility may receive a number of proposals with widely varying fees, each describing a totally different scope of work and level of effort. Selecting the lowest price in this situation often will not result in the most cost-effective finished project. Furthermore the project being proposed by the consultant may not be what the utility or agency wants or had in mind. In fee-based selection the utility may deny the project one of the most valuable assets a professional has to offer—creative technical knowledge and experience that allow evaluation of alternatives in sufficient detail to make intelligent decisions and allow development of the most cost-effective, functional design.

In an effort to be competitive and offer a low fee, consultants will often develop a limited scope of work and minimize the detail and evaluation of different alternatives. With cost as a consideration, firms will have to minimize senior staff involvement in brainstorming, technical development, and review of alternatives. As a result, a firm may not

consider or may inadequately evaluate some cost-effective alternatives. In the end, the agency may not get the project that it anticipated and will be disappointed in the consultant for not coming up with the best solution. A common consequence of using fee-based selection is an amendment to the consultant's contract to increase the scope of work to look at other alternatives. This increase in fee may result in a higher total cost to the agency than if fee-based selection was not used.

If the consultant is not constrained by fee, an experienced consultant can propose a realistic fee resulting in the agency being satisfied and a project that will provide years of service. However, if the agency is not looking for an extensive evaluation of alternatives, this should be stated in the request for proposals; then the scope and budget can be negotiated with the most qualified firm that is focused on the end result as defined by the agency. Even with this negotiated limited scope, the most qualified firm can still use their expertise and creativity to the agency's benefit while staying within the agency's budget constraints.

Politically Based Selection

Politically based selection is, as the name implies, based on the political influence that a consultant may have with the utility or agency. While good working relationships are essential for a successful project, selection based on politics very rarely serves the best interests of the utility or agency and should be avoided if at all possible. Elected officials usually do not have the technical background needed to make an informed decision on the selection of a consultant. The utility's technical staff has the best understanding of the project definition and objectives and should be making the selection of the consultant based on the qualifications of the firm and its ability to complete the work to the agency's satisfaction.

Qualification-Based Selection

Qualification-based selection is the process of making an evaluation and selection considering *only* the firms' qualifications, experience, and project understanding. Cost and specific scope of work are negotiated following selection. A variant of true QBS, if permitted by state or local statutes, is for the owner to ask for a detailed scope and estimate of personnel hours and cost in a separate sealed envelope as described in the hiring section below. In understanding qualification-based selection, it is important to distinguish between actual selection and contracting. Selection is completed first and is based strictly on evaluation of the consultant's qualifications. During this evaluation it is important that the consultant's expertise is aligned with the agency's needs. Contracting is a separate and subsequent process that includes final agreement on consultant's fees, specific scope, and schedule usually achieved through roundtable discussion and negotiation.

The cost of engineering design services typically represents less than 2 percent of the total project life-cycle cost—life-cycle costs cover all activities in development, design, construction, and operation and maintenance of a facility over its lifetime (ASCE 1988). Nevertheless, project design has a major influence on construction and operation and maintenance costs. Since the cost of design is relatively small in comparison to overall life-cycle costs and since design heavily influences recurrent costs, it is wise for the owner to deemphasize the initial cost of design and consider the recurrent influence of design in overall life-cycle costs. Qualification-based selection is a process that allows the owner to do just that. The process is described in the following paragraphs.

Request for proposal (or qualifications). In qualification-based selection, the owner has the option of a single-step or two-step selection process. Typically the two-step process is used on large, complex projects. In the two-step process the owner issues a request for qualifications from a known list or open advertisement. The purpose of the

RFQ is to identify the most qualified firms. Once the most qualified firms are selected from their submitted qualifications, the owner issues a request for proposals. The RFP describes the project and intended scope, requests a statement of qualifications (past projects, staff, references), and gives guidelines for submitting proposals. An estimated fee for the work is usually not requested of the consulting firms in the proposals, unless the consultants have a clear understanding of the scope of work the consultant is to perform and the owner is comfortable with the qualifications of all of the area consultants. This is discussed in the section on QBS above.

If the owner is comfortable with the qualifications of the consultants in the area , the owner can issue an RFP at the start, skipping the RFQ step. The RFP would be issued to a list of known qualified consultants.

Presentation and selection. In QBS, following review of the proposals, the owner selects those firms believed to have the capabilities, approach, ideas, and resources that best fit the needs of the proposed project. These consultants would be asked to make presentations to the owner to demonstrate more clearly their understanding and role in the project and provide the owner with the opportunity to meet the consultant's proposed team and to ask questions of team members.

After the presentation or submission of the proposals (if a presentation is not required), the owner ranks each of the consultants based on preestablished criteria such as technical ability, understanding of the project, and references. The owner then selects a consultant and negotiates a contract with the selected consultant that establishes a detailed scope of services, fee structure, and other terms and conditions, including insurance, method of payment, and so. Standard contract forms for consulting services are available from various organizations (see chapter 2).

Fee in QBS. The owner and the consultant negotiate a fee after they have both defined in detail the specific project scope. Following arrival at a mutually acceptable fee, both parties enter into a contract. Types of fees are discussed in the following paragraphs.

Lump sum. The consultant and owner agree to a set price, or lump sum, for the agreed scope of work. Obviously, the scope must be clearly defined to make this approach acceptable for both parties. Periodic payments may be made based on percentage of work completed or deliverables made. Any work beyond the original scope may be negotiated in terms of an increase in the lump sum.

Time and expense with or without a maximum. In this approach the consultant provides an hourly rate schedule for various categories of staff and then invoices the owner on the basis of the number of hours spent by each category of employee on the project during the invoicing period. This is probably the most common method of retaining consultants. The rate schedule includes the direct salary paid to the employee, overhead, and a profit. Any job-related direct costs (for example, travel, reproduction, subsistence, and subconsultants) would be added to the invoice. Some firms will include a markup for these "out of pocket" expenses that is usually in the range of 5 to 15 percent. This markup covers the cost of interest for carrying the costs, risk, and subcontract administration and monitoring.

Contracts typically include a "not to exceed" amount; but where the scope of services is indefinite, there is no "not to exceed." The owner should be aware that although the contract is on a time and expense basis, if there is a change in scope, the "not to exceed" amount will have to be adjusted.

Cost-plus a fixed fee. In this approach, the consultant and owner usually agree to an upper limit for the agreed scope of work, overhead multiplier, and the "fee" or "profit." The consultant provides an invoice periodically (typically monthly) that includes costs only, i.e, salary and reimbursable expenses and a percentage of the fee or profit. If the scope has not changed, the fee or profit is not changed. If the consultant is very efficient, the firm will complete the work quickly. The owner benefits since the cost is reduced; the consultant

benefits since the profit is maximized due to efficiency. If the consultant is not efficient, the cost to the owner will increase but the percent profit to the consultant is reduced. This reflects badly on the consultant's financial ledger. Hence there is a real incentive for the consultant to complete the project.

Percentage of construction costs. The consultant's fee may be based on a percentage of the total construction cost, although this method is used less often than the other methods. This method is often used as an estimate of fees. The percentage varies according to project size and complexity. This form of compensation is complicated since the design consultant needs to be hired before construction cost is known. Adding to the complexity is the fact that the project may change in scope during any of the various phases, requiring multiple adjustments at the conclusion of the project. The owner and the consultant may agree to put a cap on the amount of the adjustment. A real disadvantage of this type of compensation is that there is little incentive for a consultant to do extra work evaluating options that will result in lower construction costs for a project.

IMPLEMENTING QUALIFICATION-BASED SELECTION

QBS is a step-by-step process—the process may be customized by aligning steps of the procedure with the particulars of the project. QBS may differ for small-, medium-, and large-sized projects—project size distinction is relative and will vary from agency to agency. A large project typically incurs professional fees in excess of $1,000,000. Fees for small projects are usually less than $100,000, leaving medium-sized projects between $100,000 and $1,000,000. The major difference between QBS processes for large and small projects is that the two-step RFQ/RFP process or formal presentations is typically not requested on smaller routine projects because of the time and costs involved.

It has been stated previously that interviews are not recommended for small projects since interviews are time-consuming for all parties. In some cases, however, an agency may want to interview. In these cases it is recommended that the interviewed firms be limited to the top two firms and the interview be less formal—more of a discussion with questions and answers.

Consultants commit significant staff and financial resources in responding to RFQs and RFPs and in making presentations (interviews). To minimize marketing costs, thereby helping to keep the consultant's overhead and fees down, it is important to remove consultants from the selection list as soon as the process indicates they are no longer in contention. In this way, professional courtesy is extended on the part of the owner, preventing a prospective firm from wasting valuable resources when a selection is highly unlikely.

Initiating the QBS Process

An agency must take several steps at the onset, before soliciting an RFQ or RFP. First, the agency should clearly define the project scope and then identify key agency personnel that will work on the project and ultimately execute the selection process. Project definition is achieved by succinctly stating the purpose of the project. The purpose should include a description of the agency's needs. Principal components of a project that should be considered include

- Issue being considered/solved by project
- Project budget
- Project phasing and schedule
- Development
- Planning
- Design

- Construction
- Permits
- Environmental impacts
- Public outreach
- Resident engineering
- Traffic and transportation impacts or constraints
- Testing, startup, training, and possible operation

After defining the scope of the project or to assist in defining the scope, the agency should designate an in-house project team. A project manager should be selected to act as the main point of contact for the agency. The project manager then completes the makeup of the project team and designates a consultant selection committee. Members of the project team may also serve as members of the selection committee. To manage the selection process, the agency should identify a selection committee manager. The project manager may serve as the selection committee manager, or this function may be filled by other management personnel. In any case, the project manager should be on the selection committee. The project manager must be comfortable with the scope, with the schedule, and ultimately with the firm selected. Once the selection committee is in place, it should focus on the necessary steps to complete the qualification-based selection process.

Depending on the complexity and scope of the project, the tasks required to complete the work can be delegated in several different ways. A single consultant may be retained to provide all services; several consultants may be retained for handling specific, specialized tasks; or the agency may use in-house staff to complete specific tasks. For such major tasks as design, survey, geotechnical assessment, environmental considerations, permitting, and public information, using several different consultants under contract to the agency will require additional management effort by the agency's staff. As an option these tasks could be included in the prime consultant's scope of work and have the consultant manage these efforts. If a project is very large and complex and the agency does not have the experience, staff, or desire to manage all of these consultants and construction contracts, a program management consultant may be retained to perform these functions.

The use of in-house staff to complete portions of the project may reduce the costs of the project, but care must be taken to assess staff availability. If the staff does not have the time to complete the work, the overall project schedule will be impacted.

One of the most important steps in QBS is the formation of the selection committee. Ideally, the committee should include individuals that are familiar with the project scope and the consultants under consideration. The selection committee should be comprised of individuals having expertise in one or more of the following:

- Planning
- Design
- Construction
- Budget and financing

For most projects, the selection committee should consist of three to five members that include the agency's project manager and agency representatives from planning, design, construction, finance, and operations. It is also helpful to seek input from an impartial individual who otherwise would not be directly involved with the project. An impartial committee member, for instance, could be a public works director from a neighboring community, an engineer from another department within the agency, or a consultant that is not under consideration for the project. The impartial member may or may not receive

voting privileges; nevertheless, the impartial member may contribute significant insight to the selection committee. The selection committee needs to determine evaluation criteria and the weighting of each of the criteria beforehand.

Preparing the Request for Qualifications for the QBS Process

The purpose of an RFQ is to initially reduce the selection set to consist only of those firms that are known to have completed similar projects and are adequately staffed with readily available resources. It must be determined whether or not the consulting firm has completed a project under similar conditions and constraints and also whether the firm has maintained a consistent performance record. A firm's response to the RFQ (i.e., submittal of the firm's statement of qualifications) should be as brief as possible to avoid overburdening both the consulting firm preparing it and the agency's staff reviewing it. Limiting the response to 2 or 3 pages for general information and 8 to 10 pages for key staff biographies and project experience summaries is more than adequate for most projects. Limiting the size of the response will demonstrate the firm's ability to be concise and brief. Information typically solicited by the RFQ includes

- General information about the prospective firm such, as the number of employees on staff, number and disciplines of registered engineers on staff, number of years in business, and contact information for key personnel.
- Statement of related project experience allowing prospective consultants to indicate previously completed work that is nearly the same in size and scope as the project under consideration. Usually it is best to request recent experience, i.e., within the last five years.
- Brief biographies on key engineering, management, and professional staff who have had relevant experience on similar projects and who will likely be assigned to the project. Information on the firm's proposed project manager must be included.
- Other relevant information indicating resources of the firm, specialized capabilities, financial strength, insurance commitment, and track record on working within similar schedule and budgetary constraints.
- Client references and testimonials with contact information.

The RFQ is typically in letter form and includes a brief description of the project, contact person, format for the submittal and requirements, and a closing date and time for the submission. The description should address the owner's specific needs with regard to schedule, size of submittal, closing date, and the owner's staff contact person receiving responses to the RFQ. The RFQ should be developed with a specific format that facilitates review and comparison of professional firms. It is often helpful to list the selection criteria, i.e., those factors that are important to the owner. Consultants will want to contact the agency's project manager to ask questions. It should be stated if this is allowed at this time. Answering questions could be quite time-consuming for the project manager, particularly if there are large numbers of consultants considering this project. It also would be advisable to include whether a proposal and/or interview are anticipated prior to final selection of the consultant.

The RFQ should state in no uncertain terms that those firms submitting brochures or suchlike, in lieu of specific project experience, will not receive consideration. Most firms should be able to prepare a statement of qualifications in response to the RFQ within two to three weeks' time.

Reviewing the RFQ Responses

In processing the statement of qualifications, the owner should tabulate the responses in a form that allows easy application of evaluation criteria. Evaluation criteria will help normalize the evaluation and make processing fast and easy. A weighted scoring system that factors in the relative importance of each selection criteria is typically used. Each member of the selection committee makes a preliminary review of each statement of qualifications to determine whether or not all RFQ requirements have been met. RFQ submittals not meeting the requirements should be excluded from further consideration or be scored low based on what is submitted. RFQ submittals meeting the requirements should be given a detailed evaluation. The selection committee manager should compile results obtained from each of the selection committee members and reconcile any differences. Typically, four to six firms are selected for further consideration. Avoid including marginally qualified firms just for the sake of requesting four to six proposals.

Firms remaining in contention should be notified by letter that they have been shortlisted. The letter should thank them for their participation and indicate how the selection will proceed. It is equally important to notify the other firms that are no longer in contention and politely thank them for their time and effort. Once a final selection is made and a contract has been signed, it is proper for the owner to disclose each firm's overall ranking, although discussion of the actual numerical scores is discouraged.

Preparing the Request for Proposal

The RFP should transmit information regarding the owner's objectives with regard to the project. This information will enable prospective firms to develop their proposals around the owner's needs. Many owners use standardized forms for RFPs—this provides a good starting point for the prospective firms in tailoring their proposals to the owner's needs. An RFP contains the following:

- Important background information on the project, e.g., project description, relevant studies, contractual agreements, required permits, scheduling, and budget constraints
- A list of the owner's needs accompanied by a general outline of the work elements (scope of work) to be accomplished in satisfying those needs
- Closing date and time for proposal and the agency's contact person who responds to questions regarding the RFP
- Notification of any preproposal meeting or "job walk," which is encouraged since it can provide significant insight into the interested firms
- Definitive requirements on form and content of the submitted proposal
- Requirements on contract language, insurance, licensure, and certifications
- Clear statement outlining work to be performed by owner and the work to be performed by the prospective consulting firm
- Other pertinent information that may assist prospective firms, e.g., criteria for evaluation and selection

The RFP should indicate the general form of the contract agreement between the owner and the professional consulting firm. It is often beneficial to the consultant if the owner indicates the criteria being used in evaluation of the prospective firms. The RFP is transmitted with a brief cover letter along with attachments, as appropriate. In the RFP, specific documents may be called out as suggested references.

On projects where the scope of work is rather open-ended, as in feasibility studies or master planning, it is proper for the owner to reveal budget allocated for professional services. This revelation allows the prospective firm to scale its efforts and properly focus the work on the most relevant issues. Often, owners will first request that the prospective firm consider the allotted budget and then ask it to determine which elements may be scaled back to keep the project within the given budgetary constraints. Information typically requested in the RFP includes

- A scope of work that outlines in detail both the order and schedule for tasks.
- A schedule of activities that includes submission due dates and review periods.
- Organizational structure of the firm's proposed project team that includes the firm's project manager, key personnel, and any subcontracted consultation work. Biographies of any previously unsubmitted key personnel should accompany the RFP submittal; client references should be included with the biography submitted for the firm's project manager.
- Demonstration of the firm's ability to meet schedule and budget requirements on projects of similar size and complexity.

Strong emphasis should be placed on the team submitted in the proposal. A firm should be required to demonstrate that the personnel being proposed for the project actually are available to work on the project and there is a commitment from the firm's management to that effect.

The agency may request, depending on local regulations, that the consultant submit a breakdown of professional hours by category and task. Sometimes the agency requests that this information be put in a separate envelope, which is not opened until the selection process is complete. This procedure avoids the temptation of "looking at the cost" and biasing the selection. The breakdown provides an indication of the level of effort the firm believes is necessary to complete the specific task and the emphasis the firm places on this activity. The agency can use this as a gauge of the firm's understanding of the effort, and during the final negotiations, the agency may request the firm to increase or decrease the level of effort for a specific task as the agency deems appropriate.

The intent of the RFP is not to have the proposing firms develop detailed, in-depth engineering solutions. Rather the intent is to clearly demonstrate the proposing firm's qualifications and understanding of the proposed project.

Requesting that a specific RFP submittal format be followed streamlines the review process. As with the response to an RFQ, imposing page limits on RFP submittals encourages brevity. However, it is not recommended that an agency impose page limitations on relatively large and complex projects that likely need more pages to address the multitude of issues associated with the undertaking.

For projects where the selection process does not involve an official RFQ (for example, in smaller projects), information typically requested in the RFQ such as specific project experience, firm resources, and client references will need to be included in the RFP.

The owner's project manager should anticipate that the consultants will want to contact him or her and ask specific questions about the project. The preproposal meeting is typically not to be used for this purpose because the consultants are reluctant to ask questions that might give competing firms an idea of what the firm has in mind as an approach.

Reviewing Responses to the RFP

Reviewing responses to the RFP is similar in many ways to review of RFQ responses. A weighted scoring and ranking system should be implemented during review and evaluation. A determination should be made regarding the consultant's understanding of the project issues as demonstrated by (1) the level of detail provided in the scope of work, (2) the proposed schedule and organization of activities, and (3) qualifications and availability of a firm's project manager and key personnel assigned to the project.

The agency's selection manager should review the scoring and ranking by individual members of the selection committee and reconcile differences. Next, the selection manager and selection committee members should decide whether or not to conduct interviews and, if so, which firms should be interviewed. Interviews need not be conducted unless it is unclear which firm is superior in its qualifications. Ideally, at most three of the highest scoring firms should be invited for interviews. Firms not selected for interview should be promptly notified by letter with an offer to discuss the reasons why they were not selected. A letter should be sent notifying the selected firms and instructing them on how to proceed with the interview process.

Conducting the Interview

First, it should be recognized that interviews need not be conducted unless a firm possessing superior qualifications cannot be determined from review of the RFP and RFQ responses. The interview process requires a large expenditure of time and effort by both the firm and the agency that, if avoided, would increase the efficiency of QBS. The interview provides the owner and consulting firm with an opportunity to deepen the understanding of the project and further determine relevance of the previous experience of each firm's project manager. Firms selected for an interview should be informed that the selection committee does not want the interview discussion to be a mere reiteration of professional qualifications that were previously stated in the responses to the RFQ or RFP. Rather the committee wants the interview discussion to revolve around particulars of the current project under consideration. Sometimes it is helpful to the presenting firms if the composition of the interview committee is known. Instead of listing names, the owner may state which departments are likely to be present.

The consultant's personnel involved in the interview should be limited to three to five individuals. The firm's proposed project manager should make the majority of the presentation and will be supplemented by other key project personnel as needed. The involvement of the firm's principals, senior officers, or marketing staff in the interview should be minimized. Generally, the length of the interviews should be consistent with the time and complexity of the project—interviews generally run between 45 and 90 minutes with 15 to 30 minutes reserved at the end for questions and answers. If at all possible, all consultants should be interviewed on the same day, either all in the morning or all in the afternoon. Breaking for lunch can distract the interview process. Having interviews extending over several days often provides an advantage to the firm(s) presenting on the last day since their presentations are the freshest and could bias the process.

Preparing for the Interview

To derive the greatest benefit from the interview process, the interview panel should meet in advance to discuss each member's questions and concerns. The interview panel should then develop a set of standardized questions to ask all firms being interviewed. In addition, firm-specific questions should be developed that help identify unique aspects of each firm and clarify uncertainties. Prerelease of the questions should be given strong consideration to maximize the effectiveness of the interview process, and firms should be required to specifically answer each of the questions during the interview.

A prospective consulting firm will typically deliver an uninterrupted presentation that is followed by questions and answers. If possible, the review panel should not interrupt the presentation, holding questions until later. Interviews should be scheduled allowing sufficient time between interviews for the interview panel to complete standardized evaluation forms.

In some cases elected officials desire to be a part of the interview panel. In some states attendance by officials presents problems if a quorum of the elected officials is present. In that case the interview would have to be conducted in public session, which may put the consultant in a very uncomfortable position. Out of professional courtesy, and to ensure fairness, it is important that none of the competing firms are present at an interview of another firm. A separate waiting room should be provided for the next consultant team.

An appointed interview panel chairperson, typically the agency's selection committee manager, should start the interview process by introducing interview panel members and stating the interview ground rules. Upon completion of the consultant's presentation, the panel chairperson should start the questioning period and refer to other members of the panel for continued questioning.

Evaluating the Interview

After all interviews are completed, an evaluation score sheet should be filled out that ultimately ranks the competing firms. At this time, differences among selection committee members should be reconciled by the agency's selection committee manager. The selection committee should make a determination soon after the interviews to maintain process continuity. Ideally, the evaluation should represent the panel's collective thoughts on each firm's qualifications and ability to satisfactorily complete the work. The postinterview evaluation should place heavy consideration on leadership and communication qualities of the prospective firms' project managers. The interview provides an excellent opportunity for the owner to assess how well each prospective project manager answers impromptu questions. It is important that the owner feel comfortable with the consulting firm's project manager. The interview allows the owner to determine what other commitments the firm's project manager has and assess whether those commitments may interfere with the project.

The interview process allows the owner to determine the most qualified firm amongst competing firms. The best firm is then selected on the basis of qualifications as determined by RFP responses and the interview process.

Unselected consultants will likely want to get a debriefing after the selection process is completed. This debriefing will help them in future proposals with the agency and is a good way for the agency to obtain feedback on the process so that the process may be improved during the next selection.

Hiring

In QBS, professional fees are not considered in determining the most qualified consulting firm. To avoid the temptation of considering fees before the hiring process, the RFP should require that fees not be submitted until the selection process is complete. In practice though, some owners depart a bit from this stipulation and allow submission of fees and labor estimates in a separate envelope—the envelope remains sealed until the most qualified consulting firm is finally selected. In observing the strict definition of QBS, professional fees are not disclosed at any time during the actual selection process. This is sometimes called the "two-envelope" system.

Negotiation

After being selected, the most qualified firm is asked to submit a detailed cost proposal if it was not submitted in a separate envelope with the proposal. Any revisions to the scope of work should be noted and reflected in this cost proposal. After receiving the cost proposal, negotiation may ensue to reach agreement on the scope of work, schedule, and professional fees. Negotiation is facilitated by first identifying disagreement on specific issues followed by constructive discussion that promotes resolution. Fees may be adjusted by changing the allocation of risk and/or by reducing the number of design alternatives that may have been agreed to at the onset. If an agreement cannot be reached with the selected firm, the utility or agency should be prepared to enter into negotiation with the next firm on the selection rating list. Should this be necessary, it is important to notify the top-ranked firm of the agency's decision to cease negotiations prior to beginning negotiations with the second-ranked firm.

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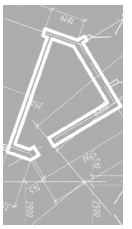

Chapter 16

Partnering

Partnering is a management method in which all of the participants make a special effort to cooperate in working toward completing the project successfully. Partnering can lead to many benefits, including: improved morale, reduced costs, development of innovative solutions, and effective problem solving or troubleshooting.

As defined by the US Army Corps of Engineers (Edelman, Carr, and Lancaster 1991), partnering is an agreement in principle by the participants to share the risks involved in completing the project and to establish and promote a mutually supportive environment. Partnering is not a contractual agreement, nor does it create any legally enforceable rights or duties. Rather, partnering seeks to create a new cooperative attitude in completing contracts. To join in this partnership successfully, each member must seek to understand the goals, objectives, and needs of the other parties and mutually to seek a working relationship with other members.

Critical to successful partnering is the creation of an owner–contractor relationship that promotes the achievement of mutually beneficial goals. This approach is useful with a single prime contractor, but it works particularly well with a multiple prime contracts project (chapter 6). Close association among the owner, design consultant, and construction manger through the entire construction process is of great benefit to the owner and to team members. Good specialty contractors work effectively in the team approach under owner–designer–CM direction.

Figure 16-1 shows a partnering agreement for a plant expansion. The goals and objectives agreed to by the project participants are listed.

The key players in a typical partnering scenario include

- Owner
- Design engineer
- General contractor
- Electrical contractor
- Heating, ventilation, and air conditioning contractor
- Plumbing contractor

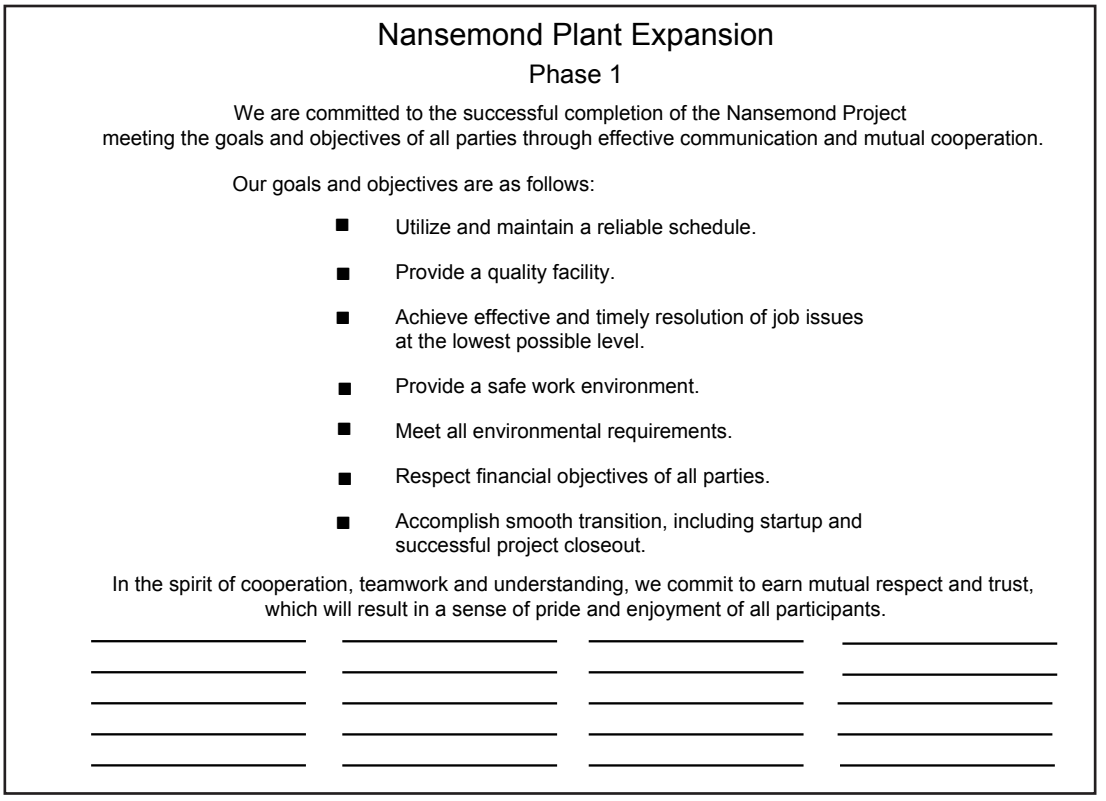

Figure 16-1 Partnering agreement for plant expansion

- Other prime contractors
- Equipment suppliers
- Material suppliers

A key to making partnering successful is effective communication of needed information, particularly that from the owner. For example, the owner knows treatment plant characteristics, is aware of different ways to handle existing flows, and is familiar with the underground distribution system. Project contractors need such information to perform their work, and the owner should willingly provide it.

The presence of an experienced resident inspector, from the staff of either the owner or construction manager, is also important to successful partnering. When a resident inspector is not on the project, problems are not solved as quickly. The project design engineer's responsibilities in partnering include reviewing shop drawings, answering technical questions, and sharing expertise with the particular type of project. The general or trade contractor in a partnering scenario should work closely and openly with the owner and engineer and vice versa. In traditional construction projects, the contractor may feel a sense of "us against them," since its work is constantly being scrutinized and it is pressured to complete the work on time. In a successful partnering project, the feeling should be "one for all and all for one."

Partnering applies to all phases of the construction project and should not be used only when convenient. For example, toward the end of a project, it is easy for the participants to go their separate ways. However, if the owner, the engineer, equipment suppliers, and contractor continue to work together at the time of equipment startup, the process will go more smoothly, and the project can be brought to a more satisfying conclusion.

CASE STUDIES

The following case studies illustrate problems encountered when team members do not work together, as well as benefits gained when they do.

Partnering Case Study 1

The first case study involves two belt filter presses. In the proposal, the design engineer left the polymer specification open, leaving the choice of polymer feed equipment up to the contractor. The filter press equipment supplier ran a pilot test at the plant site to predict how the equipment would perform under full-scale conditions.

At project completion, the belt presses did not perform as specified—the 50 percent sludge mixture specified in the contract was not achieved. The contractor and equipment supplier were facing a large penalty for additional costs to the project.

Two main factors caused the belt presses not to perform as specified.

1. The polymer equipment furnished by the contractor was not compatible with the belt press equipment requirements but was approved by the engineer.
2. The belt press equipment had mechanical problems.

Under such circumstances, the project could go in one of two directions:

1. No one agrees to a solution and large penalties are assessed, often resulting in litigation to determine blame.
2. The parties put aside their differences to create an appropriate solution.

In this particular situation, all parties acknowledged that there was fault on everyone's part, and all parties worked together to solve the problem. Soon, the belt presses were operating satisfactorily, in fact, better than specified. Liquidated damages were not charged because there was full cooperation from all parties. The result was an excellent installation, with all parties satisfied they had cooperated fully toward fulfillment of their common goal.

Partnering Case Study 2

The second case study involves a project in which a brand model of equipment was specified as the only option. The contractor questioned the design engineer and owner before the bid to confirm that this was a sole-source specification. After bids were received, the low-bidding contractor approached the owner with an offer to reduce the contract price considerably if allowed to use alternative equipment. The proposed equipment, in addition to being less expensive, had a proven track record.

The owner disagreed with the suggestion and instead wanted to use the equipment specified in the contract, despite the fact that there had never been an acceptable installation of that equipment. In fact, this project would be only the second in production for this equipment. Early in the construction phase it became obvious there would be many problems with the equipment. The highly sophisticated equipment, with many electrical components and computerized operating parts, was being installed in the open without cover. Heat, cold, rain, dirt, and other contaminants damaged the equipment. A cover had originally been included in projects specifications, but the first round of bids came in too high and the specifications were revised to omit the cover. The protective cover would have provided protection for the computer, air compressor and components, air valves, and electrical controls. The cover was installed later under another contract.

Further complicating the situation, the owner would not allow its personnel to work with the equipment until the project was complete. Earlier testing of the equipment would

have helped to identify some major problems, such as a problem with the incoming electrical power. The equipment's supplier eventually resolved the power problems, although they were not the supplier's fault. Upon completion of the project, the owner withheld a large amount of payment due the contractor because of the equipment problems and the increased costs to solve them.

A partnering approach could have led to lower costs and a much more satisfactory conclusion to this project because

- The owner could have given more consideration to the contractor's recommendation to use proven equipment.
- The owner could have encouraged staff to work closely with the equipment supplier during installation. The power supply problem would have been discovered earlier, and the staff could have made additional provisions for protecting the sophisticated equipment.
- The supplier would not have been penalized for problems it did not create.

Partnering Case Study 3

Another partnering example is a 1992–1993 project in which a deteriorating timber pile foundation threatened to shut down a major West Coast grain export facility. In this project, the goal was to introduce high-capacity pin piles to support collapsing grain silos. Groneck et al. (1993) have described several factors that complicated the project.

- Operations of the silos could not be interrupted.
- Access was extremely limited for work in the basements of the silos.
- The explosive nature of the grain dust prohibited use of combustion engines and any metal welding, cutting, or grinding equipment in the basements.
- Extending the underpinning elements among the existing timber piles—which were very competent below the top of the water table—down to the competent bearing level of the piles would be difficult.
- The concentration of the foundation support around the columns and walls could have overstressed the minimally reinforced concrete walls and slabs.

This project required innovation and careful planning. Special drilling techniques were employed that limited the problems caused by the high density of the lower gravel and cobble soils and the maze of timber pilings.

Construction began in February 1992 and was completed in January 1993. On March 25, 1993, an earthquake measuring 5.6 on the Richter scale shook the site. With the epicenter just 44 mi (70.8 km) away from the construction site, extensive damage could have been expected. However, none occurred, demonstrating the quality of the construction.

Groneck et al. attributed the success of the project in a large part to effective partnering efforts. At the start of the project, all parties signed a one-page agreement stating common goals of safety, successful and timely completion, uninterrupted operation of the facility, and maximization of the contractor's profit. This agreement helped establish positive attitudes and an open level of communication.

Partnering Workshops

Principles of partnering are simple enough to understand. However, implementing them may require changing attitudes and behaviors—which is not as easy to do. A partnering workshop might be helpful for the participants who are not familiar with the concept's principles. The workshop should be facilitated by someone who has extensive experience in partnering. Figure 16-2 shows a typical agenda for a two-day partnering workshop.

Day One		
7:45 a.m.	■ Registration and continental breakfast	
8:00 a.m.	■ Welcome and administrative announcements ■ Introductions, organization overview, expectations for the workshop	— Facilitator — Participants
	■ Baseline evaluation of working relationships	— Facilitator
	■ Video ("The Business of Paradigms") and discussion (the acceptance and possible benefits of change)	
10:00 a.m.	■ Break	
10:15 a.m.	■ The partnering concept ■ Small group team-building exercise (teamwork, trust, and communication)	— Facilitator — Facilitator
12:00 p.m.	■ Lunch	
1:00 p.m.	■ Develop project team's partnering pledge (large and small groups)	— Facilitator
2:30 p.m.	■ The partnering process, ground rules, and the problem-solving process	— Facilitator
3:30 p.m.	■ Break	
3:45 p.m.	■ Large-group brainstorming; identifying, combining, and prioritizing issues and concerns	
5:30 p.m.	■ Social hour	
6:30 p.m.	■ Dinner	
7:30 p.m.	■ Evening program	
Day Two		
7:45 a.m.	■ Continental breakfast	
8:00 a.m.	■ Review issues and concerns previously defined ■ The definition and action plan process ■ Small groups define assigned issues and concerns and develop action plans ■ Report to large group, develop consensus	— Facilitator — Facilitator
10:30 a.m.	■ Break	
10:45 a.m.	■ Small groups define assigned issues and concerns and develop action plans ■ Report to large group, develop consensus	
12:30 p.m.	■ Lunch	
1:30 p.m.	■ Small groups define assigned issues and concerns and develop action plans ■ Report to large group, develop consensus	
3:30 p.m.	■ Break	
3:45 p.m.	■ Select and commission focus group ■ Review workshop achievements and commitments	— Facilitator
	■ Wrap up	
5:00 p.m.	■ Adjourn	

Figure 16-2 Partnering workshop schedule

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NOTE: *f.* indicates a figure; *t.* indicates a table.

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