ASCE Manuals and Reports on Engineering Practice No. 45

2012 Edition

How to Select and Work Effectively with Consulting Engineers

>> Getting the Best Project

ASCE

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How to Select and Work Effectively with Consulting Engineers: Getting the Best Project

2012 Edition

Prepared by
the Task Committee for the Update of Manual 45 of
the Committee on Business Practices of
the Committee on Professional Practice of
the American Society of Civil Engineers

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MANUALS AND REPORTS ON ENGINEERING PRACTICE

(As developed by the ASCE Technical Procedures Committee, July 1930, and revised March 1935, February 1962, and April 1982)

A manual or report in this series consists of an orderly presentation of facts on a particular subject, supplemented by an analysis of limitations and applications of these facts. It contains information useful to the average engineer in his or her everyday work, rather than findings that may be useful only occasionally or rarely. It is not in any sense a "standard," however; nor is it so elementary or so conclusive as to provide a "rule of thumb" for nonengineers.

Furthermore, material in this series, in distinction from a paper (which expresses only one person's observations or opinions), is the work of a committee or group selected to assemble and express information on a specific topic. As often as practicable, the committee is under the direction of one or more of the Technical Divisions and Councils, and the product evolved has been subjected to review by the Executive Committee of the Division or Council. As a step in the process of this review, proposed manuscripts are often brought before the members of the Technical Divisions and Councils for comment, which may serve as the basis for improvement. When published, each work shows the names of the committees by which it was compiled and indicates clearly the several processes through which it has passed in review in order that its merit may be definitely understood.

In February 1962 (and revised in April 1982) the Board of Direction voted to establish a series titled, "Manuals and Reports on Engineering Practice," to include the Manuals published and authorized to date, future Manuals of Professional Practice, and Reports on Engineering Practice. All such Manual or Report material of the Society would have been refereed in a manner approved by the Board Committee on Publications and would be bound, with applicable discussion, in books similar to past Manuals. Numbering would be consecutive and would be a continuation of present Manual numbers. In some cases of reports of joint committees, bypassing of Journal publications may be authorized.

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AUTHOR BIOGRAPHIES

Thomas E. Decker, P.E., M.ASCE
Tom Decker is a vice president of Brown and Caldwell based in Alexandria, VA. He received his bachelor of science and master of science in civil engineering degrees from the University of Missouri.

Francine Eide, P.E., M.ASCE
Fran Eide is the City Engineer for the City of Olympia, Washington, the state's capital city. She serves on ASCE's Committee on Business Practices. Eide received her bachelor of science in civil engineering degree from Saint Martin's University.

Harold J. Farchmin, P.E., F.ASCE, LEED AP
Harry Farchmin is vice president of Bloom Companies, LLC in Milwaukee, Wisconsin, past president of the Southeast Wisconsin Branch, and past director of the Wisconsin Section of the American Society of Civil Engineers (ASCE). He served as chair of the ASCE Membership Committee, Committee on Business Practices, and Engineering Management Division Executive Committee, and as a representative of ASCE on the Engineering Accreditation Commission of ABET, Inc. Farchmin received his bachelor of science and master of science in civil engineering degrees from the University of Wisconsin–Milwaukee.

Theodore L. Niemann, P.E., D.WRE, M.ASCE
Ted Niemann is a branch manager of RJN Group, Inc. in Louisville, Kentucky. He has served as president of the Louisville Branch and Kentucky Section of ASCE. Niemann received his bachelor of science and master of science in civil engineering degrees from the University of Kentucky.

Gary A. Parks, P.E., F.ASCE
Gary Parks retired from the Bonneville Power Administration as the regional manager in Redmond, Oregon. He is currently a consultant to the Western Electricity Coordinating Council, headquartered in Salt Lake City, Utah. He is a past president of the Oregon Section of ASCE and is the past chair of ASCE's Committee on Professional Practice. Parks received his bachelor of science in civil engineering and master of science in structural engineering degrees from Oregon State University.

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ASCE Task Committee for the Update of Manual 45 of the Committee on Professional Practice's constituent Committee on Business Practices

Harold J. Farchmin, P.E., F.ASCE, Chair
Thomas E. Decker, P.E., M.ASCE
Francine Eide, P.E., M.ASCE
David F. Garber, P.E., F.ASCE
Theodore L. Niemann, P.E., D.WRE, M.ASCE
Gary A. Parks, P.E., F.ASCE

The Task Committee for the Update of Manual 45 developed the survey questionnaire to solicit input from consulting engineering firms and prepared the text for this revised edition of Manual No. 45.

BLUE RIBBON REVIEW PANEL

Gregory E. DiLoreto, P.E., L.S., F.ASCE
Gregory C. Heitzman, P.E., M.ASCE
Kam Movassaghi, Ph.D., P.E., F.ASCE
Thomas R. Walther, P.E., F.ASCE

The Blue Ribbon Review Panel conducted an independent peer review of the draft manuscript.

ASCE Staff Contact
Rebecca M. Waldrup, P.E., M.ASCE

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FOREWORD

The American Society of Civil Engineers (ASCE) has been concerned with procedures for engaging engineering services since the early 1900s. The first ASCE manual on the subject was published in 1930. The designation *Manual No. 45—A Guide for the Engagement of Engineering Services* ("the manual") was adopted in 1964, with revisions issued in 1972, 1975, 1981, 1988, 1996, and 2002. This manual is the 2011 edition. It has been renamed *How to Select and Work Effectively with Consulting Engineers: Getting the Best Project*.

This manual is intended to outline the functions of the consulting engineer in serving a project owner or other engineering services client, explain the services usually offered, provide methods of determining compensation for engineering services, and provide historical information on the remuneration received by consulting engineers for their services. A recommended procedure for interviewing and selecting a consulting engineer and guidance on contracts for engineering services are provided. This work is designed to serve the best interests of both the owner and the consulting engineer and to foster better understanding between them. The information offered is intended to apply to civil engineering practice and civil works projects; however, certain aspects of this manual may not be applicable to specialty practice.

The ASCE Task Committee for the Update of Manual 45 ("Task Committee") began the update process by surveying users of the 2002 edition of the manual and prospective users. The survey responders evaluated the 2002 edition of the manual and provided suggestions for improvement. The Task Committee evaluated the results of the survey and used the results to prepare this new edition. Survey questionnaires were prepared by the Task Committee and were sent in early 2008 and again in late 2009 to consulting engineering firms and major owners whose assistance was requested to provide recent completed project data. Responses

were received from more than 360 firms and agencies. The Task Committee evaluated the results of the data in preparing this edition.

This edition omits the "fee curves" that were included in previous editions. While the previous fee curves were based on historical data collected and were meant to provide a frame of reference, they were sometimes used inappropriately to dictate the percentage fee. In lieu of the curves, the Task Committee has included plots of actual fee data obtained from recent surveys to give a visual sense of fees, but at the same time demonstrate the scatter in values due to the fact that each project is unique.

The Task Committee gratefully acknowledges those firms, agencies, and individuals that contributed their time and talent to make the revised manual better able to serve the public, clients, owners, and the profession.

CHAPTER 1
THE PRACTICE OF ENGINEERING

Over the next decade, public entities and private enterprise in America will allocate billions of dollars to improve infrastructure at the local, state, and federal levels in an effort to maintain current levels of services and to improve services in underserved areas. ASCE's *Report Card for America's Infrastructure*[1] estimates that trillions of dollars will be needed over the coming years to bring the nation's infrastructure to an acceptable level of service. ASCE's Infrastructure Investment Policy (PS 299)[2] warns of the potential adverse effect on our quality of life and U.S. competitiveness in world markets if our infrastructure is allowed to continue to deteriorate. Delaying infrastructure improvements until systems fail will result in even greater costs. ASCE is dedicated to advancing the highest standards in civil engineering to achieve quality-built projects that best utilize public and private funding sources. Many of these projects will be developed by government agencies and private owners working closely with consultants.

Civil engineering consulting firms serve as an adjunct to public agencies and private corporations when engineering expertise is needed or extra staffing is required. These firms can often provide project owners with expertise for a wide array of projects that the owners may not be able to complete with current staff.

Civil engineering firms vary in size and services offered. Some larger firms are able to provide a wide range of services covering all of the

[1] ASCE. (2010). *Report card for America's infrastructure,* <http://www.infrastructurereportcard.org/> (Sept. 21, 2011).
[2] ASCE. (2011). "ASCE policy statements." <http://www.asce.org/policystatements> (Sept. 21, 2011).

engineering disciplines. Smaller firms, independently or in partnership with other firms, can also meet a project's requirements and needs. In this manual, the terms *civil engineer*, *consultant*, and *consulting firm* all imply either a single firm or a project team of multiple firms in partnership.

This manual was developed to help all project owners—from seasoned professionals to those responsible for supervising their first civil engineering project. Understanding project scope, interacting with consultants, and knowing how to select and work effectively with consulting firms are just some of the many abilities needed to bring a project to successful fruition. This manual is intended for use primarily with traditional design-bid-build (DBB) projects for new construction or modifications to existing facilities.

QUALITY

This manual serves as a guide to procuring high-quality engineering services for a quality project. Quality service entails meeting the owner's expectations as well as project specifications. Quality does not just happen; it must be proactively incorporated into every aspect of the project. This requires dedication, effort, and adequate time for investigation, planning, and innovation. To achieve this, the consultant must be competent and responsible, with appropriate authority and responsibility, while being compensated fairly to complete the project. Clear, unambiguous communication between the owner and the consultant is required to understand both the owner's needs and the consultant's options in delivering or meeting those needs.

Quality is the result of a team effort and is measured largely by the degree of satisfaction of all parties involved. This manual is dedicated to advancing the understanding and quality of practice in civil engineering as well as promoting the profession's standard of care (see also ASCE Manuals and Reports on Engineering Practice No. 73, *Quality in the Constructed Project: A Guide for Owners, Designers, and Constructors*[3]).

PROFESSIONAL RESPONSIBILITY

Engineers typically are given project responsibilities that include studying, conceiving, designing, and managing the project through the design phase. They may also be charged with managing and observing

[3] ASCE Manuals and Reports of Engineering Practice No. 73. (2000). *Quality in the constructed project: A guide for owners, designers, and constructors*, 2nd Ed. ASCE, Reston, VA.

construction. These responsibilities are governed by state laws, regulations, and codes, and engineers are licensed professionals. Engineers are also asked to help establish operating and maintenance (O&M) standards for engineered works. The need for other services may arise as the project evolves. The health, safety, well-being, efficiency, and comfort of facility users, as well as the project's ultimate cost, all depend on how well the engineering team members fulfill their contractual responsibilities. Thus, the engineer has an obligation as a trustee of the public interest, as well as of the private interests of owners. Successfully fulfilling these responsibilities requires candor, mutual trust, effective communication, and understanding between the consultant and the owner. The engineer should look to the ASCE Code of Ethics[4] and associated canons for acceptable practices worldwide. Only in this way can a professional relationship be established and the project completed successfully.

OWNER-CONSULTANT RELATIONSHIPS

Many engineering works are conceived, designed, and constructed by practicing engineers who are employed in public agencies or private industry. Other engineering projects come to fruition through the efforts of an independent consulting firm engaged for a specific project or program. Many government entities and private companies rely on consultants to accomplish projects that require special expertise or when there is more work than their own staff can handle.

The success of any project is heavily dependent on mutual trust and effective communication between the owner and the consultant. The owner's level of engineering knowledge varies from project to project. Some owners are deeply involved and provide input at various project stages, while others allow the consultant to reach specific project milestones before providing input. Either method is acceptable when both the owner and the consultant understand each other's expectations and roles, as documented in their contractual agreement.

In addition, owners may use delivery methods such as program management, design-build/turnkey, and design-build-operate-and-maintain (DBOM) to implement projects. With a clear understanding of the project needs, the owner and consultant can determine which delivery method is right for a particular project. Traditionally, the owner-consultant relationship stipulates that the consultant is the agent responsible for designing the project for the owner. Delivery methods such as DBOM make the

[4]ASCE. (2011). "Code of ethics." <http://www.asce.org/Leadership-and-Management/Ethics/Code-of-Ethics/> (Sept. 21, 2011).

consultant a shared owner. Explaining relationships between consultants and public and private owners is an important objective of this manual.

ENGINEERING SERVICES

The guidelines in this manual were developed specifically for the engagement of engineering services when the consultant serves the owner directly as the *prime professional* for the project. Some sections also apply when a consultant serves the owner indirectly as a subconsultant through another engineer or architect who is serving as the prime professional. Although the consultant might be a prime professional or joint venture partner on design-build (DB) or DBOM contracts, more often the consultant is a subconsultant to a construction contractor who serves as the prime professional.

Independent engineering consulting firms can provide a host of important services to public and private owners. These services are explored in depth in Chapter 2 ("Classification of Engineering Services"). Typical services include

- Consultations and advice;
- Feasibility studies;
- Field investigations and engineering data collection;
- Environmental assessments and impact statements;
- Engineering reports;
- Development of opinions of probable construction cost;
- Preliminary and final designs, drawings, specifications, and construction bidding documents;
- Assistance in evaluating construction bids and awarding contracts;
- Construction administration and observation;
- Arrangement for and/or conducting of tests of materials and equipment;
- Assistance in start-up, assessment of capacity, and operation of facilities;
- O&M manuals preparation;
- Appraisals and rate studies;
- Value engineering;
- Expert testimony;
- Provision of supplemental temporary staff;
- Risk management; and
- Representation of projects to reviewing agencies.

Consulting engineers also may serve as construction managers, program managers, or O&M managers and may employ other consultants and contractors as part of their services. Consulting civil engineers may

also serve municipalities of limited size, serve as resources to city engineers, or act as resources to staff on an as-needed basis.

Many consulting firms specialize in specific areas of engineering, for example, field and photogrammetric surveying or geotechnical, structural, civil, environmental, mechanical, or electrical engineering. Others may offer diversified services in several engineering disciplines. Consultants draw on the combined talents of economists, planners, engineers and designers, estimators, architects, scientists, technical analysts, specification writers, field representatives, surveyors, and others.

The consultant provides services that result in the owner committing financial resources for land and buildings, material or equipment purchase, construction, and O&M of a proposed project. Consulting services must be performed in a competent and efficient manner. Consultants must be highly professional and ethical and create an atmosphere of mutual respect and trust. The owner, who may be unfamiliar with the technical and engineering aspects of the project, must often rely on the representations of the consultant as to the suitability of the constructed project for its intended function. Therefore, it is vital that the consultant and the owner agree on the project scope and budget from the outset, with defined milestones and periodic updates as the project progresses. If the budget is insufficient to realistically meet the owner's expectations, it is the consultant's responsibility to resolve this matter with the owner. Although the consultant cannot guarantee final construction costs, the consultant makes decisions that affect the final costs and, therefore, must work closely with the owner to ensure that costs are in line with the owner's expectations.

PROJECT IMPLEMENTATION APPROACHES

Project implementation has become increasingly complex, involving financial, environmental, regulatory, technical, and managerial matters. As a result, owners have opted to pursue a number of approaches to implementation.

One commonly used approach is *program management*. Owners typically utilize program management consultants when they recognize that, as owners, they do not have the expertise to pull together all the elements required to complete a group of similar projects. Therefore, an owner may retain a program manager to perform the specialized tasks necessary to develop specific projects and oversee their design and construction. Moreover, the owner may retain a program manager to have the lead responsibility for developing, defining, and overseeing the program; preparing budget estimates and schedules; evaluating and selecting team members; and providing periodic status reports. In other cases, the program manager's staff serves as

an extension and augmentation of the owner's staff throughout the life of the program. In most cases, the owner continues as the contracting agent and hires all members of the program team and the contractors. The program manager acts as the facilitator and assumes whatever responsibilities and authority the owner wishes to delegate to achieve a successful project.

Other approaches include *design-build* (DB) and *design-build-operate-and-maintain* (DBOM). Design-build is a turnkey approach in which the owner provides a concept for the desired project; then a team of engineers, architects, and builders combine to design and construct the entire project and turn it over to the owner upon completion (hence, ready to turn the key). Under DBOM, the design-builder takes on the additional responsibilities of O&M for a specified period of time. DBOM can be employed when an owner lacks readily available capital resources to initially fund the project and is therefore interested in having the DBOM team finance all or a portion of the project in exchange for payments over an extended period of time (i.e., the period of O&M).

Selecting a Consulting Engineer

Selecting a consultant is one of the most important decisions in the project development process. The owner's ability to meet the project objectives—including the effective use of financial resources, soundness of design, sustainable solutions, and suitability of the proposed project for its intended function—depends on the experience, organization, skill, integrity, and judgment of the consultant. The consultant's recommendations affect life-cycle costs and, thereby, influence the project's economic feasibility.

Engaging the most qualified and reputable consulting firm available is in the owner's best interest. It is usually best for the owner to select a consultant who can support the project from conception through design, construction, and project start-up. Continuous partnership and interaction between the consultant and the owner during the project builds a solid relationship and helps lead to a successful outcome. The fully engaged consultant has design insights that may prove useful in resolving issues that develop during construction or start-up phases.

Qualifications, experience, reputation, and quality of service are critically important in selecting a consultant. Selection based primarily on cost of services, with only limited consideration of competence or expertise, can result in unsatisfactory project delivery to the owner and higher overall project costs. The consultant's competence in specialty fields, performance on similar projects, interrelationship with project team members, proposed personnel, provision for independent reviews, and quality assurance influence not only the construction cost but also the O&M cost of the project over its life cycle.

ASCE recommends that the owner engage a consultant in two steps. (A detailed discussion of methods for selecting engineers is included in Chapter 3, "Selecting the Engineer.") The first step is a selection based on qualifications vital to the project. Because selecting an engineer based on quality and expertise is somewhat subjective, screening should be performed by individuals in the owner's organization best suited to the task. The first stage is typically accomplished through a request for qualifications (RFQ) that provides the owner with an overview of qualifications from several consultants. This is typically followed by a request for proposals (RFP) from a smaller number of consultants, which are then typically evaluated by both written proposals and oral presentations. The RFP should be as detailed as possible so that consultant qualifications required for a specific project may be easily compared.

The owner should be aware that consultants incur costs in providing statements of qualifications and detailed proposals for specific projects and that these costs raise their overall operating expense and ultimately the cost to the owner to hire them. Owners may choose to engage an engineer on a *sole-source* basis, without qualifications-based selection. This can be a timely and cost-effective approach, but it must be executed with care to avoid potentially unlawful exclusion of competition, restrictions imposed by funding sources, appearances of conflicts of interest, or selecting a consultant that is not truly the most qualified.

Once a consultant is selected, the next step is to define the scope and expectations of the engineering services to be provided. Often the process begins with the owner documenting and clarifying the project goals. The consultant then responds with a detailed *scope of services* describing how those objectives will be met. This process must be completed before negotiating a fee for services. A clearly defined scope of services greatly reduces the potential for misunderstandings or confusion that can later evolve into project delays and claims for additional compensation. A detailed scope of services protects the interests of both the owner and the consultant.

ASCE supports procedures such as those specified by the Brooks Act (P.L. 92-582) and the American Bar Association's Model Procurement Code for State and Local Governments for the engagement of engineering services. In applying these procedures, the selection, procurement, and administration of engineering services should be the responsibility of the owner.

Design Competition

In a design competition, a consultant is selected based on an innovative approach to meeting the owner's needs. All competing consultants should be awarded a stipend to participate in the competition and to provide compensation toward their costs. Design competitions usually are reserved

for significant or highly unusual projects, such as a signature bridge. Because these types of projects are as important for the competing consulting firms as for the owner, the firms may spend a significant amount of time and effort in pursuit of the project. Since the stipend generally is small in comparison with the competing consultant's actual expenditures, final selection criteria should be well specified in advance. A poorly defined selection process may limit the number of firms willing to commit resources to compete for the project. Designs submitted from nonselected consultants remain their property.

Contingency Basis of Employment

Canon 5c of the ASCE Code of Ethics provides that "Engineers may request, propose, or accept professional commissions on a contingent basis only under circumstances in which their professional judgments would not be compromised." Although contingent commissions are permissible, ASCE and the Task Committee for the Update of Manual 45 believe it is not generally in the best interest of the owner or the public for the consultant to provide professional services on a contingency basis.

Similarly, it is ASCE's opinion that it is inappropriate and not in the owner's best interest to use a contingency basis for professional engagements such as expert witness service, up-front engineering studies, development projects, or patent engineering where the consultant's compensation is dependent on a successful venture or court finding.

SUMMARY

The foundation for a successful project begins with an appropriate working relationship developed between the owner and the consulting engineer. A professional and trusting relationship is essential to ensuring that the project satisfies the owner's needs and is accomplished within the agreed schedule and budget.

CHAPTER 2

CLASSIFICATION OF ENGINEERING SERVICES

An owner's need for professional engineering services will vary depending on the nature of the project and the owner's organizational structure, size, and capability. Many consulting engineering firms provide comprehensive services. Others specialize in specific areas of engineering—such as geotechnical, environmental, traffic, or structural—and provide their services to a prime engineer, architect, or owner. Only a limited number of consulting firms are qualified to provide complete services for all projects; thus, a team of associated consulting professionals is frequently assembled.

The services provided by consultants can be grouped into three broad categories:

1. Consultations, investigations, and studies;
2. Design and construction; and
3. Special services.

This chapter describes the types of services that a consultant may be expected to provide an owner. These classifications and categories, however, are not nearly as important as ensuring that the scope of services for a particular project is mutually understood by the consultant and the owner. Clear communication between the consultant and the owner about the scope of services required is critical to a project's success.

Both parties must clearly understand and agree on which tasks, activities, and chargeable items are included in the scope of services (and to what extent) and which are not. For instance, an owner may assume that certain services, such as extra meetings, are included in the cost, while the consultant intends to charge additional fees for them. Or the consultant

might expect to be paid for computer and cell phone time that the owner does not plan to reimburse. To avoid conflict and confusion, the detailed scope of services and the contract must delineate the type of engineering services to be provided and expenses to be reimbursed.

CONSULTATIONS, INVESTIGATIONS, AND STUDIES

Consultants may be engaged to provide certain consulting services or to conduct various types of studies or investigations. These latter services primarily deal with collecting, interpreting, and reporting information, as well as formulating conclusions and making recommendations. Typical services in this category include the following:

Preliminary and Feasibility Investigations and Reports

These services usually precede the authorization of a capital project and may involve extensive investigations, analyses of conditions, and comparisons of several possible alternative solutions. They may focus on such factors as environmental impact, sustainable development, capital and operating costs, life-cycle costs, risk management, financing considerations, and expected revenues as the basis for conclusions and recommendations about the advisability of undertaking a project.

Planning Studies

These services include the broad areas of developing master plans for long-range capital improvement programs; preparing land development plans, urban plans, and regional plans; preparing facility master plans; conducting corridor studies; and investigating environmental conditions and preparing environmental impact studies. Such planning often requires coordinating the work of many engineering specialties and other disciplines.

Public Involvement

The owner may engage the consultant to present a project concept, technical analysis, or planning study to the public. In addition, the consultant may represent the owner before planning boards or other government review agencies, or represent those agencies in the review process. The owner may also engage the consultant to solicit public involvement on a particular project or study. These services require the consultant to be familiar with an array of public involvement techniques and their relative effectiveness. Familiarity with the public's interests and its stake in

the project helps the consultant lead an open and productive effort to gather and share project information.

Appraisals, Valuations, and Rate Studies

These services may include investigating and analyzing existing conditions; estimating capital and operating costs, overhead costs, and financing costs; developing cost-of-service studies for use in determining utility rates; and forecasting revenues for property development of toll facilities or studies to recommend prospective utilization rates.

Assistance in Financial Matters

An owner who is planning to issue bonds—particularly revenue bonds—to finance a capital project may engage a consultant. The scope of services may include participating in bond feasibility studies; evaluating the capabilities of existing and proposed facilities to meet present and projected future needs; assessing probable construction costs and estimating annual revenue requirements; and determining the appropriate rates, fees, or other charges to offset the anticipated costs. The consultant also may act as the responsible agent to certify that certain terms and conditions of bond issues are met.

Materials Engineering and Equipment Tests

These services include tests of materials and equipment under established codes and standards; specialized examination of equipment and materials used in construction and industry; and other inspections and monitoring required by the owner.

Inspections and Evaluations of Existing Facilities and Structures

These inspections and evaluations may include material testing for bridges, roadways, wastewater treatment plants, airport runways, and other facilities or structures. They may also evaluate the interaction of the facility and its surroundings, such as bridge abutments and scouring possibilities in a streambed.

Professional Services

These include services such as assistance in preparing for legal proceedings; appearances before courts, boards, or commissions to render expert opinions and conclusions; and investigation of technical matters requiring specialized engineering knowledge, experience, and

judgment. In addition, some owners contract consulting engineers to act as their representatives on individual projects or capital improvement programs.

DESIGN AND CONSTRUCTION PROJECTS

Professional engineering services are needed for each of the six typical phases of a design and construction project. For consistency and efficiency, all services can be provided by the same consultant, although at times certain services can be furnished by different consultants or by the owner.

The six standard phases of a design and construction project and the engineering services needed for each are as follows:

1. *Study and Report Phase.* Analysis of the owner's needs, conceptual design, and conceptual opinion of probable construction costs.
2. *Preliminary Design Phase.* Preparation of final design criteria, preliminary drawings, outline specifications, and preliminary opinion of construction costs.
3. *Final Design Phase.* Preparation of contract plan drawings, specifications, permit applications, constructability review, opinions of probable construction cost, and other contract documents.
4. *Bidding or Negotiating Phase.* Assistance to the owner with the bidding or negotiating process for project construction.
5. *Construction Phase.* Representation of the owner during construction and observation of construction.
6. *Operation Phase.* Assistance to the owner in start-up, including periodic input and inspections during initial operation.

In some cases, the study and report phase, the preliminary design phase, and the final design phase may be combined, especially for smaller projects. Although the owner often will specify the services required, the engineer also may suggest appropriate project steps.

Study and Report Phase

This phase involves determining the project scope and cost, and technically evaluating feasible alternatives. The services performed during this phase can include the following actions:

- Review available data, and consult with the owner to clarify and define the project's purpose, need, and financial requirements.
- Advise the owner about the need to provide or obtain additional data or services, and assist in obtaining them. These additional

services may include photogrammetry, reconnaissance surveys, property surveys, topographic surveys, geotechnical investigations and consultations, compilation of hydrological data, traffic studies, materials engineering, environmental assessments and impact studies, computer modeling of existing and/or proposed facilities, and assembly of zoning, deed, and other land-use information.
- Identify and analyze pertinent government regulations, and work with regulatory agencies as needed to ensure that the design and specifications meet their approval.
- Provide analyses of the owner's needs, planning surveys, and comparative evaluations of prospective sites and solutions.
- Provide a general economic analysis of alternatives that meet the owner's requirements.
- Present the project concept to obtain input from the public or other affected stakeholders.
- Prepare a report that includes the consultant's findings, alternative solutions available to the owner, and the consultant's recommendations. The report may contain schematic layouts, sketches, conceptual design criteria with appropriate exhibits to indicate clearly the considerations involved (including applicable governmental and regulatory requirements), and the consultant's conceptual opinion of probable project costs.

Preliminary Design Phase

This phase establishes the general size and scope of the project and its location on the property. Services can include the following actions:

- Consult with the owner, review preliminary reports, clarify and define the project requirements, review available data, and discuss general scheduling. Confer with approving and regulatory agencies and utilities.
- Advise the owner on whether the additional data or services described in the study and report phase are required, and assist the owner in obtaining such data and services.
- Prepare preliminary design documents, including final design criteria, preliminary drawings, outline specifications, and an overall project report.
- Present the project to the owner, owner's representative, governing body or government authority, and the public or other affected stakeholders.
- Prepare a preliminary opinion of project cost.
- Conduct peer reviews for owners.

Final Design Phase

This phase of project development is undertaken after the preliminary design phase to refine and complete the design to the level that the construction of the project can be accurately priced and executed. The basic services for the final design phase can include the following actions:

- Prepare contract plan drawings and specifications showing the character and extent of the project based on the accepted preliminary design documents.
- Prepare and present an opinion of probable project construction cost based on the final contract drawings and specifications.
- Furnish the necessary engineering data, and assist in applying for regulatory permits from local, state, and/or federal authorities.
- Prepare a constructability review to assess potential issues during project construction.
- Prepare basic documents related to construction contracts for review and approval by the owner and the owner's legal counsel and other advisors. These may include contract agreement forms, general conditions and supplementary conditions, invitations to bid, instructions to bidders, insurance and bonding requirements, and other contract-related documents.
- Present the project to the public or other affected stakeholders.
- Conduct peer reviews for owners.

Bidding or Negotiating Phase

Services under this phase can include the following actions:

- Assist the owner in advertising for and obtaining bids or negotiating the contract(s) for construction, maintain a record of companies who have been issued bidding documents, attend or conduct prebid conferences, and receive and process deposits for bidding documents.
- Issue addenda as appropriate to interpret, clarify, expand, or amend the bidding documents.
- Prepare documents for surety, bid, performance, and/or payment bonds.
- Respond to bidders' requests for information.
- Assist the owner in determining the qualifications and acceptability of prospective contractors, subcontractors, and materials and equipment suppliers.
- Advise the owner on the acceptability of alternative materials and equipment proposed by prospective contractors when bidding documents allow substitution prior to awarding the contract.

- Attend the bid opening, prepare bid tabulation sheets, and assist the owner in evaluating bids or proposals and in assembling and awarding the contract(s) for construction, materials, and equipment.

Construction Phase

During this phase the services performed are usually associated with acting as the owner's representative. These services can include the following actions:

- Conduct baseline surveys prior to construction.
- Review the shop, false-work, and erection drawings submitted by the contractors for compliance with the design drawings and specifications.
- Review laboratory, shop, and mill test reports on materials and equipment.
- Be present on the project site at agreed intervals as construction proceeds to observe and report on the progress and the quality of the executed work.
- Provide construction administration services, including a resident engineer and other support staff to ensure that construction is accomplished in conformance with the design drawings, specifications, and other contract documents.
- Issue instructions from the owner to the contractors, interpret and clarify contract documents, and respond to requests for information as necessary.
- Make recommendations about the acceptability of the work.
- Prepare contract change orders.
- Perform special inspections and testing of the work.
- Make recommendations to the owner on corrective actions or contractual measures that may be exercised by the owner.
- Prepare directives as required to resolve problems due to actual field conditions encountered.
- Determine amounts of progress payments based on degree of completion of the work, and recommend issuance of payments.
- Observe and assist in performance tests and initial operation of the project.
- Prepare project record documents, and certify them when requested.
- Make a final inspection and report on completion of the project, including recommendations about final payments to contractors and release of retainage.
- Recommend the acceptance of the constructed project.

Operation Phase

The owner can request that the consultant assist with start-up of project operations. The consultant may be commissioned to prepare a manual for both operation and maintenance requirements and may also provide assistance in adjusting and balancing equipment, identifying deficiencies and assisting in obtaining corrections, and performing inspection before the end of the project warranty period. The consultant may assist in training the owner's staff, setting up job classifications and salaries, organizing the purchase of supplies, developing charts to record operational data, and observing and reporting on project operations.

SPECIAL SERVICES

Special services required during a project's study, design, construction, and operation phases may include investigations, reports, and activities beyond the scope of the basic engineering services described previously in "Design and Construction Projects." These special services, several of which are listed earlier in this chapter under "Consultations, Investigations, and Studies," relate to feasibility, scope, and location of the project. The research, compilation of engineering data, planning, and acquisition of property may involve professional specialists in other disciplines.

Special services may be provided by the consultant directly or via subcontract, or they may be provided by other consultants directly to the owner. Special services may include:

- Geotechnical engineering, including test borings, sampling and analysis, and recommendations;
- Special studies, tests, and process determinations to establish design criteria or demonstrate compliance;
- Environmental assessments, evaluation, and testing, including developing environmental compliance requirements;
- Preparation of permit applications and supporting documentation for execution and submission to permit agencies;
- Land surveys, establishment of boundaries and monuments, preparation of easement descriptions, and related computations and drawings;
- Engineering and topographic surveys for design and construction;
- Mill, shop, or laboratory inspections of materials and equipment;
- Value engineering, including reviewing the work of other consultants, either within the same organization or from other firms, to determine whether the proposed solution is optimal and, if not, to suggest an alternative approach for meeting the project's functional and financial criteria;

- Redesign to reflect changes requested by the owner or necessitated by acceptance of substitutions proposed by the contractor;
- Assistance to the owner as an expert witness in litigation or in hearings before approving and regulatory agencies;
- Investigations involving detailed consideration of operation, maintenance, and overhead expenses, and preparation of final rate schedules and earnings and expense statements, appraisals, valuations, and material audits or inventories required for certification of force account construction performed by the owner or for extra work done by the contractor;
- Preparation of detailed applications and supporting documents for government grants or loans;
- Plotting, computing, and filing subdivision plats, staking lots, and other land-planning and partitioning activities;
- Preparation of environmental assessment and impact statements;
- Assistance to the owner in connection with public meetings and hearings;
- Additional studies and design efforts to meet special conditions encountered during construction;
- Assistance in the selection and engagement of architects, other professional service firms, contractors, and subcontractors; review and approval of their work;
- Special structural engineering inspections of the building construction or of existing structures;
- Services resulting from changes necessary because of a construction cost overrun that are outside the control of the consultant; and
- Services resulting from corrections or revisions required because of errors or omissions in construction by the contractor.

SUMMARY

Consulting engineers can add value to a project's many phases. Understanding the types of services that can be provided will help the owner develop a scope of services that will best serve the project. To ensure a project's success, the scope of services needs to be clearly communicated between the owner and the consultant.

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CHAPTER 3
SELECTING THE ENGINEER

The selection and engagement of a consultant is the most important decision in an engineering project. No two consulting firms have the same training, experience, personnel, workloads, and capabilities. Selecting the most qualified firm is the best assurance that a well-planned, well-designed, economical, and successful project will be the eventual outcome.

Professional engineering is a service—not a product or a commodity. The selection of an engineer should consider the specifics and nuances of the project at hand, the qualifications of the competing engineering firms, and the capabilities and benefits each firm offers. Figure 3-1 depicts a typical selection process. Additionally, engineering planning and design is a collaborative process between the owner and the engineer, and the right "chemistry" and an open and positive relationship are key ingredients in the ultimate success of the project endeavor.

The engineering work performed on a project is the greatest single contribution to the completed facility's performance throughout its functional existence, its total life-cycle cost, and the owner's ultimate satisfaction with it. Arbitrarily reducing engineering services or hours can later cost the owner more in construction costs or operating and maintenance (O&M) expenses after the project is placed into service. This magnifies the importance of hiring the right engineer by selecting that engineer in the right way.

BASIS FOR SELECTION

The owner should have an established administrative policy with criteria for the selection of qualified consultants for particular projects. When

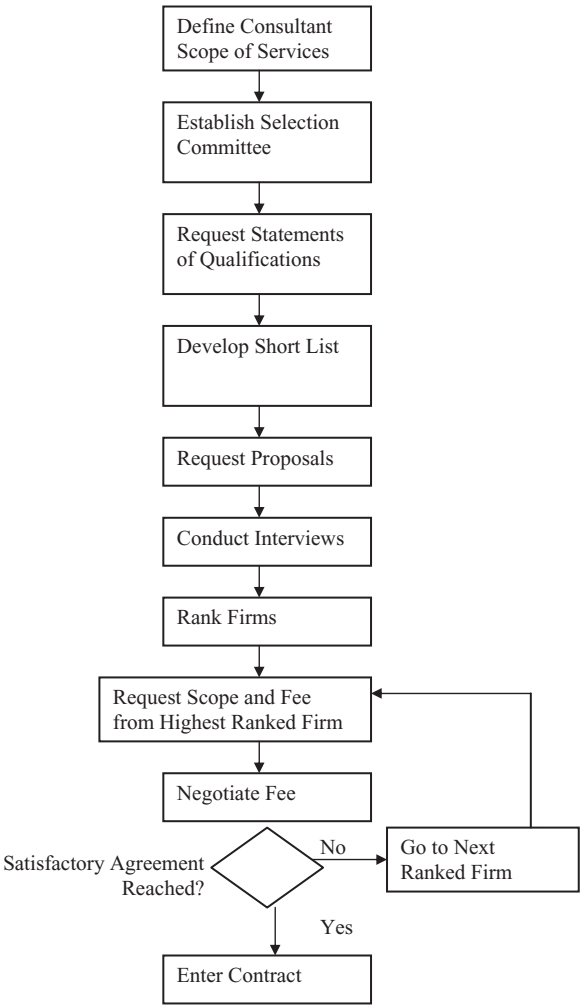

Fig. 3-1. Qualifications-based selection process

the time comes to select an engineer for a particular project, the owner's first step is to define the scope of the proposed project. In some cases, a general statement of the project's objectives and expected performance requirements may be all that is necessary or possible. At other times, the tasks to be performed can and should be individually identified and defined. The more clearly the owner can define the engineering services required and the project outcomes expected, the more specific and respon-

sive the consultant can be. This allows the owner to more accurately judge which firm is best equipped to provide the services desired.

The following factors are important considerations in the selection process:

- *Ethical Reputation.* The professional and ethical reputation of the consulting firm and its staff should be determined by inquiries to previous clients and other references.
- *Licensed Professional Engineers.* The practice of civil engineering in the United States is governed by the individual states, and their licensing laws and requirements vary. Responsible employees of the consulting firm must be licensed professional engineers in the state where the project will be designed and constructed and/or licensed in the states in which they practice engineering for the firm.
- *Specialty Certifications.* Specialty certification is a voluntary, post-licensure credential that recognizes advanced expertise in a technical specialty and a commitment to continuing professional development. The Diplomate, Water Resources Engineer (D.WRE) from ASCE and the Board Certified Environmental Engineer (BCEE) from the American Academy of Environmental Engineers are two examples of this type of certification. Consideration of actively engaging specialty-certified individuals in key project roles should be part of the overall evaluation.
- *Experience.* The consulting firm should have demonstrated qualifications and expertise in performing the required services for projects of scope and complexity highly similar to the owner's current project.
- *Staff.* The consulting firm should be able to assign qualified project management and engineering staff to take charge of the project and to provide the required services within the time allotted. These individuals should be available for the amount of time necessary to deliver the project.
- *Financial Resources.* The consulting firm should have the necessary financial resources to accomplish the assignment and provide continuing service.
- *Current Technology.* The consulting firm should possess the equipment and expertise to utilize current technology as necessary to both execute the project and incorporate current technological standards into the design of the project.

SELECTION COMMITTEE

The owner should have an established administrative policy for designating individuals authorized to select or recommend selection of

consultants for specific assignments. The administrator, department head, or manager who will ultimately be responsible for the project should designate a selection team or committee for that project. Those appointed to the committee should be familiar with the project requirements and should remain free of internal or external pressure, conflicts of interest, and other factors that could bias their objectivity during the selection process.

A selection committee should consist of a minimum of three individuals to obtain a well-rounded and diverse set of opinions and perceptions. Ideally, a selection committee should have at least one engineer (preferably a licensed professional engineer) who is familiar with the project's technical issues, someone knowledgeable about working with consultants and the practice of consulting engineering, and an end user. Other individuals with a specific interest or expertise can be added as appropriate, perhaps including a representative from the owner's procurement, purchasing, or finance departments to ensure that required procurement processes and policies are followed and to provide an independent viewpoint. The owner's project manager should always be a member of the committee. The committee is responsible for making recommendations after conducting appropriate reviews, interviews, and inquiries. The final selection by the owner's administrator or governing body is then based on the selection committee's recommendations.

The selection committee should establish its procedures and ground rules prior to soliciting engineering services so that members know their roles and how the selection process will be carried out. The weighting and rating scales should be determined in advance of the selection process. Another common issue that arises is how much access competing consulting engineers should be given to committee members and to others on the owner's staff during the actual selection process. Although in practice this ranges from absolutely none (sometimes the identity of the selection committee members is not even made public) to unlimited contact, a workable approach is somewhere in the middle. An owner wants the best and most responsive submittals possible from the engineers, and the engineer and the owner will both benefit from incorporating the preferences and knowledge of the owner's staff (particularly the selection committee members) into the qualifications statements, proposals, and presentations. If given unlimited contact, however, some consultants may monopolize the time of the selection committee or members of the committee can "play favorites" by allowing more access to some consultants than to others. Some owners have established a single point of contact to meet with the consultants, field questions, and provide responses. In any case, it is important to establish the ground rules early and adhere strictly to them, and those ground rules should allow some contact with the owner's staff.

PREQUALIFICATION

Prospective consultants' qualifications and their firms' capability to deliver the project should be the primary focus of the selection process. Many large industrial firms and land development companies, practically all branches of the federal government, and many state, county, and municipal agencies that engage consultants have a prequalification procedure. They require consulting firms to submit a statement of qualifications that describes their credentials to perform their full range of services. These prequalification packages are evaluated, and each firm is notified whether it is eligible to compete for projects in certain categories. The owner will then notify each prequalified firm whenever a relevant project is about to be initiated. This process has the advantage of selecting the best firms for certain types of services and barring those who may only be marginally qualified. This can save both the owner and consulting firms time and money.

Prequalification packages often include a standard form, brochures, or both. Federal agencies and a number of state, county, and municipal agencies use U.S. Government Standard Form 330, Architect-Engineer Qualifications,[1] as a prequalification or statement of qualifications for a specific project.

A prequalification package should be succinct to facilitate review and should not be onerous or time-consuming to prepare. At a minimum, the following elements should be included in the package:

- Name and address of firm;
- Telephone and fax numbers and e-mail address;
- Name of person to contact;
- Services offered;
- Representative projects for which the firm was the engineer of record, including at least one project for each service area offered;
- Number of personnel by specialty, including the number of licensed professional engineers or licensed land surveyors;
- Estimated annual business volume based on revenue dollars;
- Banking references;
- Brochures or other promotional information provided at the discretion of the consultant; and
- Client references.

[1] U.S. Government Standard Form 330, Architect-Engineer Qualifications, can be obtained from the General Services Administration, Regulatory Secretariat Branch (MVCB), 1275 First St. NE, Washington, DC. It is also available online at http://contacts.gsa.gov/webforms.nsf/0/21DBF5BF7E860FC185256E13005C6AA6/$file/SF%20330.pdf.

By standardizing the content of the prequalification packages as much as possible, the evaluation process becomes more straightforward.

QUALIFICATIONS-BASED SELECTION (QBS) PROCEDURE

ASCE recommends that the selection of professional engineers should be based on the firm's qualifications, including training, experience, capabilities, personnel, workload commitments, and the proposed approach to the project. Accordingly, ASCE supports QBS procedures, such as those specified in the 1972 Brooks Act (PL 92-582) and the American Bar Association's Model Procurement Code for State and Local Governments for the engagement of engineering services.

The QBS procedure is characterized by three basic steps: (1) the owner selects the engineer best qualified to perform the work without considering the cost of the engineering services; (2) the owner and the selected engineer mutually determine the final scope of work; and (3) the fee for the engineering services is determined based on that agreed-upon final scope.

A QBS procedure is most effective when the owner initially describes the project in detail and prepares a project scope and an outline of services expected from the engineering consultant. In some cases, however, the owner may not be able to thoroughly define the project scope and describe the required services. At a minimum, the owner should provide a broad description of the project requirements and what is expected of the consultant.

At each stage of the evaluation, prospective consultants should be informed of items of importance to the client and how these items will be evaluated. A matrix can be developed that lists the items and the relative weight to be given to each.

The typical steps in a QBS procedure are presented in Fig. 3-1. If the owner has had a satisfactory experience with one or more of the consultants submitting their qualifications, it may not be necessary to follow all of the steps outlined.

REQUEST FOR QUALIFICATIONS (RFQ)

By invitation or by public announcement, the owner requests a statement of qualifications (SOQ) from consultants. Information requested should be specific to the project and might include the following:

- Résumés of proposed project staff;
- Location of each of the project staff;

- Similar projects completed by the firm and by the individuals on the project staff;
- Anticipated workload versus capacity during the proposed project's duration;
- Names and qualifications of any subconsultants to be used and their roles; and
- Other information at the consultant's discretion.

It is important to ensure that the firm as well as the members of the proposed project team have the requisite experience. In addition, client references and contact information should be provided by the consultant for each similar project, and they should be contacted by the review team.

As noted in the "Prequalification" section, Form SF 330 is sometimes used as a standard form for submitting this information. Regardless of the format used, the owner should always encourage consultants to streamline the information presented in their response and focus on the items requested.

A common practice is to limit the number of pages that will be accepted in the SOQ. This offers the twofold advantage of reducing the review and evaluation time required by the owner's staff and lowering the cost to the consulting firms. In addition, it provides the owner with a sense for how succinctly the consultant can describe and communicate information.

SHORT LIST

Ideally, the owner should select at least three consulting firms that appear to be best qualified for the project. Often more than three firms might appear to be equally qualified, in which case more firms may be considered. However, in view of the ever-increasing time and cost required to prepare high-quality proposals and presentations, the owner should make a conscientious effort to keep the number selected for further consideration to a realistic minimum. Business development cost is a significant component of a consulting firm's overhead expenditures, and this cost is reflected in the multiplier that consultants attach to their hourly billings. Consequently, the owners can save the consultants money—which ultimately saves the owners money—by being diligent and decisive in their short-listing procedure.

As part of the evaluation process prior to issuing the short list, owners should check with each firm's recent clients to determine the quality of its performance. This check need not be limited to the references listed by the consultant.

REQUEST FOR PROPOSAL (RFP)

The owner should prepare and transmit an RFP to each short-listed firm. The RFP should describe the project scope and provide an outline of services required. It should also detail required elements of the proposal, which should include the following:

- Consulting engineer's work plan for performing and delivering the required services;
- Organization chart showing the roles of each individual on the team and reporting relationships;
- Availability of each person on the organization chart to work on the project;
- Proposed schedule;
- Office location(s) in which services are to be performed and/or managed;
- Project management plan and methodology for coordinating and communicating with the owner;
- Quality assurance plan;
- Financial stability of the firm (including ability to meet owner's insurance requirements); and
- How the owner intends to evaluate and/or rank the proposals and the subsequent presentations.

The RFQ and the RFP should be complementary, not repetitious. For instance, if the owner has already requested résumés of personnel in the RFQ, that request need not be duplicated in the RFP. An exception would be to ask for résumés of any personnel that might have changed since the SOQ was submitted. In general, the RFQ should focus on the credentials and capabilities of the firm related to the proposed project (the "what"). The RFP should concentrate on the approach and plan to deliver the project (the "how").

The owner should consider a page limit for the proposal for the same reason as noted in the SOQ.

An RFP should be accompanied by the owner's standard contract general terms and conditions. The owner can request, as part of the proposal, any comments or concerns that the proposing consultants may have with those terms and conditions.

Each short-listed firm should have an opportunity to visit the project site, review all pertinent data, and obtain clarification of any items as needed. This will lead to more responsive proposals but will require time and attention from the owner's staff. As noted earlier in the chapter, the owner must establish the rules and requirements for personal contact with the owner's staff in general and with the selection committee in particular

during the selection process. Some availability to answer questions and provide pertinent information improves the quality of the proposals and is desirable and beneficial. Owners frequently hold a single preproposal conference with all short-listed consultants in attendance. While this provides a venue for imparting information from the owner's perspective, it does not offer a forum for probing details about the project and discussing potential options or alternative approaches. With competitors in the room, a consultant is understandably reluctant to expose and explore potential new concepts or approaches. A better approach is to hold an individual preproposal conference with each short-listed firm that allows time for an open exchange of ideas about the project. It is more time-consuming for the owner, but the benefit of obtaining more responsive and more creative proposals can well be worth it.

PRESENTATION AND INTERVIEW

A presentation and interview may be held following review of the proposals. Some projects are sufficiently basic and straightforward that a selection can readily be made from the proposals. However, for larger and more complex undertakings, it is often necessary to invite the short-listed consulting firms to meet individually with the selection committee for an interview and to discuss the project and the engineering services required. These interviews should consist of a formal presentation by the consultant and a question-and-answer session. These face-to-face encounters give the owner an opportunity to meet the consultant's proposed project team, "see them in action," and get a sense of what it would be like to work with them.

It is imperative that all members of the owner's selection committee read both the SOQ and the proposal thoroughly before the presentation and interview and are prepared with questions to ask.

The presentation portion of the interview should be well rehearsed and allow the consultant to present—in a structured and persuasive manner—the credentials and capabilities, the project approach, and why that firm is the best to deliver this project. The interview portion (question-and-answer) offers the owner an opportunity to probe into parts of the presentation, clarify points the consultant may not have covered in depth, and observe the consultant's teamwork and responsiveness—all highly important elements that will have a bearing on the final assessment and decision.

The presentations and interviews may be held at the owner's or the consultant's office. At the interview, the owner may consider supplementing the selection committee with personnel who have specialized relevant expertise to serve as advisors. During each interview, the selection

committee should evaluate each firm's qualifications and experience, its technical capability, its capacity to provide the services within the time allotted, key personnel assigned to the project, and the consultant's approach to satisfying the project requirements. The consultant's proposed project manager should be present at the interview and should have a prominent role in the presentation.

The formal presentation should be limited. Time allocated may range from as little as 10 minutes to more than 1 hour but should depend in large part on the size and complexity of the project. The owner should also stipulate a time limit for questions and answers but should reserve the right to extend it if warranted.

SELECTION

Using the policy, criteria, and factors established in the section "Basis for Selection," the selection committee should rank the firms in its order of preference, taking into account their approach and understanding of the project, reputation, experience, financial standing, size, available personnel, quality of references, workload, location, and other factors pertinent to the project being considered. The selection committee should strictly adhere to these criteria and factors. This ensures a fair and open competition for the consultants and also provides a degree of protection for the owner if the selection is challenged. The selection procedures should be objective, defensible, and interactive.

"Objective" means "measurable." The owner should clearly describe how each criterion will be evaluated as noted in the "Request for Proposal" section of this chapter. Many owners have developed a weighted or numerical scoring system. While such systems provide a sense of numerical objectivity, they can also be manipulated if careful oversight and an open decision-making deliberation by the selection committee are lacking.

"Defensible" refers to the procedure being sufficiently straightforward so that the owner can use it to meaningfully debrief the competing consultants following the selection. The debriefing is critical to those consultants because it provides insight into how to prepare a more responsive and improved proposal the next time. This obviously benefits the owner in the long run as well.

"Interactive" means making the final selection in a collaborative group setting. In addition to any numerical scoring system being used, the nonquantifiable perceptions, opinions, and past experiences of each member of the selection committee on similar projects or with any of the consultants under consideration should be openly shared. A free exchange in a meeting builds consensus and brings up factors that may not be easily rated on a scoring sheet.

NEGOTIATION

Following selection, the committee should invite the consultant chosen as best qualified to develop a detailed scope, list of deliverables, and a schedule, and then meet to discuss these components. This is where the project takes shape because both parties have the opportunity to provide additional input, challenge assumptions, and clarify aspects of the proposal. It is important to reach an agreement on these components (that is, to define precisely what the project will and will not be) before discussing price and compensation.

The selected consultant needs to know the owner's preferred method of compensation (discussed in Chapter 4) and level of effort, then price it by project task. Evaluating the level of effort, price, and compensation proposed by the consultant should be based on the owner's experience, budget estimate, and overall expectations, taking into account the range of charges for engineering services (discussed in Chapter 5). The owner should consider each project's unique characteristics, complexity, special conditions, and scope of services mutually agreed upon. Providing equitable compensation, including a fair profit, to the consultant is vital to the project's success because it will enable the consultant's expertise to be fully utilized and applied, and should be part of the discussion.

If a satisfactory agreement is not reached with the selected consultant, the negotiations should be terminated and the firm notified in writing to that effect. Similar negotiations should then be held with the second-ranked firm and, if necessary, with the third-ranked firm. If no accord is reached, the owner should seek outside assistance from an independent advisor before continuing with the selection process. All negotiations should be on a strictly confidential basis, and the compensation discussed with one consultant should never be disclosed to another.

CONTRACT

When agreement has been reached on scope, schedule, and compensation, the owner and the selected consultant should formalize their agreement in a written contract conforming to the guidelines in Chapter 6. Both parties should execute the contract, and the consultant should be given a notice to proceed with the work. Typical forms for various activities in the selection process are included in Appendix 2.

HELPFUL INSIGHTS INTO THE SELECTION PROCESS

Owners should consider the following when selecting an engineering consultant:

- A poorly defined scope of required services can result in numerous misunderstandings and change orders. The owner should define what is needed from the consultant in the RFQ and RFP as thoroughly as possible, meticulously review the consultants' proposals, and negotiate the final scope and compensation collaboratively.
- Federal Form SF 330 compartmentalizes information about the firm and can be a valuable tool when used correctly. For example, a consultant might indicate that the firm has 600 employees; however, only five of them may be located in close proximity to the project. Determine which staff members are local and available for the project, while recognizing that with today's technology, much of the design and calculation work can and often is done at distant offices while still under the control of the local project manager.
- Carefully examine the ability of the consultant to commit the necessary resources to the project. Are there other projects and demands that could take priority?
- Insist on meeting the project manager and the lead engineers who will be assigned to the owner's project, and have them attend the interview. This is especially true for any person who will be dealing directly with the public.
- When issuing an RFQ or RFP, define as clearly as possible what information is desired and limit the number of pages in the documents to be submitted. Insist that each person on the selection committee read each SOQ and proposal thoroughly. Reject SOQs or proposals that do not respond to the specific instructions or directives.
- Allow the consultants to have some interaction with the selection committee and other relevant staff in a controlled manner. Establish one point of contact for administrative matters. This person should be capable of objectively answering questions and ensuring that all firms receive the same basic information.
- Assess the level of professional liability insurance needed for the project. If it is higher than what the consultant normally carries, the owner may be required to reimburse the consultant for the added cost.
- Determine the process for performing quality assurance and what percentage of the time and cost in the final scope are devoted to it.
- Clarify how the consultant's services during construction will be handled. At a minimum, the consultant should be engaged in the bidding process and processing requests for information from contractors, shop drawing submittal reviews, and general construction administration. The consultant also could be helpful in resolving construction problems in the field and could even serve as the owner's representative on site. These services can be procured

at the same time as the design engineering and can be performed by the same firm that creates the design, or the owner could reserve the right to have another solicitation prior to construction and select a different firm.
- Have an attorney review the contract documents.

OPEN-END CONTRACTS

An *open-end* contract for engineering services is used to supplement an owner's staff or to provide services for several specific projects. These are commonly referred to as *indefinite delivery, indefinite quantity* (IDIQ)- or *basic ordering agreement* (BOA)-type contracts. Staff requirements, projects, or tasks may or may not be completely known at the time of the announcement for consultant services. The contract for these types of services normally will provide for a *maximum figure* or *not-to-exceed amount* for the consultant's total compensation, or a maximum amount for an individual task.

Owners can add consultant staff to supplement in-house staff or add disciplines that are not available in-house. Consultant compensation normally is based on a schedule of hourly rates specified in the contract. Fees are negotiable for each individual task or project under the maximum figures specified in the contract.

The selection process for this type of contract also can use the QBS procedure. The project announcement will specify the type of services anticipated, the engineering disciplines needed, and any maximum figure for total compensation. For multiple project services, the announcement will specify the general nature of the work and could include specific information on the initial project to be undertaken. The consultant is expected to respond with qualifications information, staff composition and résumés, similar experience, availability of staff, and other pertinent information.

BIDDING

Many federal, state, and municipal agencies, as well as professional engineering and architectural societies, recognize QBS as the preferred method for procurement of professional services. In fact, most states and the federal government have adopted laws (for example, the Brooks Act) that require the procurement of professional engineering and architectural services only by a QBS process similar to that described earlier in this chapter. The cost of engineering services, while important and meriting careful negotiations and performance accountability, cannot be accurately

determined until the final scope of work is thoroughly defined and agreed on. This does not occur until after the engineer is selected. Therefore, selecting the consulting engineer on the sole basis of cost is not recommended.

There are many reasons why bidding for consulting services often produces unsatisfactory results for an owner. Principal among these are the following:

- *Professional Judgment.* Bidding does not take into account professional judgment, which is the key difference between providing professional services and supplying products. Judgment is an essential ingredient in quality engineering services.
- *Incomplete Scope.* It is frequently not possible to completely detail the scope of services required for an engineering project in advance—especially in the study and preliminary phases—without the expert input obtained via lengthy discussions and negotiations with the selected firm. In the attempt to stay competitive while lacking specifics, the bidding firms will submit a price for the least possible effort in an attempt to be low and win the project. The consultant's latitude to search for innovative and lasting solutions, explore a broad range of alternatives, or arrive at the best long-term value for the owner thus becomes constrained. Furthermore, experience has shown that fees virtually always increase during negotiations following a bidding process and that the negotiations can be more tumultuous than on QBS procurements. The owner can generally expect to negotiate fees for extra services not initially included in the consultant's low-bid proposal. This tends to create an atmosphere of disappointment and mistrust, which weakens the owner-consultant relationship and affects the project throughout.
- *Minimum Service.* In-depth studies and analyses by the consultant are not likely to be performed when professional services are bid or the owner does not specifically set this requirement in the RFP. The consultant selected by lowest bid may provide only the minimum services necessary to satisfy the owner's most basic scope of services.
- *Lack of Detail.* Engineering designs that meet only the basic scope of services may be minimal in completeness, with certain details left to the contractor. This produces a lower first-cost design but tends to add to the overall cost of the completed project. The lack of design details also can lead—and frequently does—to a greater number of change orders during construction and to contractor claims at a later date.

For these reasons, bidding for professional services is not recommended.

TWO-ENVELOPE SYSTEM

The *two-envelope system* involves submission of a technical proposal in one envelope and a price proposal in a second envelope. There are two procedures that the owner can use with a two-envelope system.

The owner can evaluate the technical proposals and select the best-qualified consultant based on that consultant's proposal. At that point in the selection procedure, the owner opens the price proposal submitted by the selected consultant in the second envelope and uses it as the basis for negotiation of contractual scope and fees. The second envelopes submitted by the unsuccessful candidates are returned unopened.

If the owner follows this procedure, the net effect is as outlined under the QBS procedure, provided that the owner and the best-qualified consultant have extensive discussions to reach complete agreement on the scope of services. After agreeing on scope, the price of services should be negotiated to reflect changes from the original scope used in the consultant's proposal.

A modification of this procedure involves selecting the best-qualified consultant based on that consultant's technical proposal but then opening all of the price proposals in the second envelopes. When this is done, the owner usually establishes in advance a relative weighting between the technical and the price proposals—for example, 80% technical, 20% price.

If both envelopes for all candidates are opened, a de facto bidding process has been instigated even with appropriate weightings for the technical and price elements. The technical proposal evaluations tend to be more subjective in nature in terms of points and scores. The price proposal evaluations, however, are generally quite objective and are driven by the bottom-line cost for the services. It is a rare occurrence when one technical proposal is so superior to the others that the natural tendency to pick the low price is no longer a factor.

The two-envelope system is not recommended. If used as intended, it is similar to the recommended QBS procedure except that all of the proposing consultants will incur considerable additional costs to prepare a comprehensive scope and price. This will discourage some consultants from participating. In addition, the expenditures to prepare a properly priced proposal are reflected in the consulting firms' overhead, which increases the firms' multipliers and, ultimately, the cost of the project to the owner (as discussed in Chapter 4).

Some owners have opted to request that a level of effort (labor hours delineated by categories of personnel to be used on the project) be included in the proposal. This gives the owner a relative sense for what the cost to deliver the consultant's proposed scope might be, but it is not a set price per se and leaves the actual pricing and agreement on it to the negotiation stage.

SUMMARY

Selecting the best-qualified firm is one of the most critical actions an owner undertakes in obtaining a quality final project. QBS is recommended for the best results, although some variations may be necessary for owners who must comply with specific procurement requirements. The selection process, as shown in Fig. 3-1, must include detailed discussions between the owner and the selected consultant to define both the project itself and the engineer's scope of services. A clear understanding of the contract terms by both parties is also essential for a successful project. For additional information on selecting a consultant, refer to ASCE Manual 73.[2]

[2] ASCE Manuals and Reports of Engineering Practice No. 73. (2000). *Quality in the constructed project: A guide for owners, designers, and constructors*, 2nd Ed. ASCE, Reston, VA.

CHAPTER 4

METHODS OF CHARGING FOR CONSULTING SERVICES

Charges for consulting services usually are computed by one of five methods:

1. *Multiplier*: Salary cost times multiplier, plus direct nonsalary expense;
2. *Hourly*: Hourly billing rate, plus reimbursable expenses and a "not to exceed" amount for specified services;
3. *Per diem*: Fixed charge per day;
4. *Cost plus, fixed fee* (CPFF); and
5. *Lump sum* or *fixed price*.

The first four methods are based on the consultant's costs to perform the services. They are referred to as *variable* methods throughout the remainder of this chapter. Variable reimbursement methods are particularly applicable to assignments in which the scope of services is not well defined. The lump-sum or fixed-price method is based on a specific deliverable and requires a well-defined project scope. Regardless of the payment method employed, the better the scope description outlines the expected services, the better the results and the less opportunity for future disagreement between the owner and the consultant. In addition, different payment methods may be used for different contract phases. For example, a variable compensation method may be used for programming or project definition, followed by a lump-sum or fixed-price fee for completing the design of the defined project. The method or combination of methods used depends on the nature, scope, and complexity of services required by the owner. The factors that support the use of one method over the others are summarized in Table 4-1.

Many factors dictate the engineering services required for specific projects. Several are presented in the following list. The graphs included in

Table 4-1. Summary of Considerations Supporting Each Method of Compensation

	Multiplier	Hourly	Per Diem	CPFF[a]	Lump Sum
Scope not well defined	x	x	x	x	
Scope well defined	x	x	x	x	x
Simplified accounting		x			x
Very short-duration assignment		x	x		x
Very complex job	x			x	x
On-site construction management services		x	x	x	

[a] CPFF, cost plus, fixed fee.

Chapter 5 show how reported fees vary as a function of construction cost without regard to the chosen payment method. The graphs are included to give a visual sense of how fees trend and should not be used to establish compensation. The wide range of factors that influence the amount of work required of the consultant causes fees to vary accordingly, and this is indicated by the scatter of values shown in the graphs in Chapter 5.

Factors influencing project cost may include the following:

- Degree of risk and liability exposure;
- Type of client: owner, investor, contractor, or developer;
- Number of submittals and reviews required by the owner and regulatory agencies;
- Number of meetings and presentations made to communities and community groups at the owner's request;
- Schedule: normal, accelerated, or delayed;
- Environmental and other regulatory permitting requirements;
- Complexity and number of disciplines and subconsultants involved;
- Type of construction: new, rehabilitative, or expansion;
- Site conditions;
- Project delivery system: design-bid-build (DBB), design-build (DB), design-build-operate-maintain (DBOM), etc.;
- The owner's experience in similar projects and decision-making process; and
- Other contract constraints.

When the scope of services is uncertain, variable reimbursement methods should be considered. As an option, fixed-price compensation for scope definition could also be considered. Survey results indicate that these methods are frequently used in conjunction with a "not-to-exceed" amount. In this case, the owner and the consultant should agree beforehand on an anticipated scope and a method for adjusting the not-to-exceed amount as warranted. One approach to dealing with uncertainty in the estimate is to include a contingency in the not-to-exceed amount. Another approach is to require the consultant to inform the owner when engineering costs are approaching a designated percent of budget and to provide an updated cost estimate for completion. Such a provision provides the owner and the consultant an opportunity to examine progress at that point and, if appropriate, to revise the not-to-exceed amount or the scope of remaining services.

The greatest challenge is identifying small changes that by themselves are insignificant but that create a significant change in scope when aggregated. This is often referred to as *scope creep*. This issue reinforces the need to ensure that scope creep is minimized.

Using the lump-sum method, the charge for engineering services is based entirely on the agreed-on scope of services. This method may be appropriate when the scope of services is well defined and the consultant's costs are within his or her control. Lump-sum projects are easy for the consultant and the owner to administer. Progress invoices are typically made monthly based on the percentage of services completed. The fixed-price method may be used for a complex project by breaking the project into multiple tasks or phases with a fixed price for each task or phase, determined sequentially as the detailed scope of each phase is mutually established.

VALUE PRICING

A consultant may have unique qualifications, expertise, and/or computer programs that the consultant has developed that materially decrease the time typically required for execution of a similarly scoped project. In some instances, the consultant's proposal might indicate that the project can be done easier, faster, safer, or at less cost to achieve the owner's objective. In other cases, the owner might want the consultant to undertake a project that requires an accelerated schedule, nonroutine services, or high-risk activities. Under these circumstances, charges for services may be based on *value pricing*. Value pricing reflects compensation that is not tied directly to the consultant's cost but, rather, is based on the consultant's unique qualifications or extenuating circumstances. Value-based agreements may be fixed-price or hourly, with a "not to exceed" price.

One of the more common value-pricing tasks is providing expert witness services. Expert witness services are usually provided by a senior-level individual with considerable experience and recognized expertise or license. Given a consultant's unique experience and expertise in an area, these services are often charged at a premium rate. One reason for the premium rate is that these individuals usually lead or participate in teams to execute projects within their firm, leveraging the productivity of multiple staff within the firm. When focused on an expert witness task, they are not available to provide other high-value services to the firm.

PAYMENT SCHEDULE

Regardless of the compensation method selected, the agreement should include the provision that payments will be made to the consultant as services are provided. For all methods, the owner and the consultant should discuss the normal payment schedule of the owner and may place an invoice submission schedule into the contract. Some government units and other owners may only issue checks once per month, so the owner and consultant should decide ahead of time what is the latest date during the month when the consultant may submit an invoice in order to be paid in that cycle. For each of the variable methods, these partial payments should be based on monthly invoices with payment due within a predetermined time after billing or at other stated times. For the fixed-price method, the partial payments should be due at stated intervals—usually once a month—during the performance of the services. These payments may be based on the consultant's statement of percent completion to date or on milestones achieved. Regardless of compensation method and payment schedule, the agreement between the consultant and owner also should contain provisions for inflation and delays (further discussed in Chapter 6). Agreements for cost-based methods should provide for reimbursement of all direct and indirect project costs, including, but not limited to, those foreseen when the agreement is negotiated. The list of reimbursable items should be as complete and detailed as possible.

RETAINAGE

Retainage is a practice often used for construction projects where payment for a portion of the value of the completed construction work is withheld or retained by the owner pending project completion and acceptance by the owner. Retainage provides an incentive for the contractor to complete the project expeditiously, promptly address construction issues, and close out the project with the owner. Because this practice is common

for construction, contractors and their subcontractors will factor a cost of money (i.e., interest) into their bids or negotiated construction cost.

Retainage is not typically used in professional services agreements, and consultants typically do not budget for them. Design services often extend over several months or years. Withholding a retainage disrupts the consultant's cash flow and increases the consultant's costs. In lieu of retainage, the contract should contain a clearly stated time period for performing the services and a provision for adjusting compensation if the project is delayed for reasons beyond the consultant's control. If the owner requires a retainage, the consultant will factor these additional costs into the overall cost for services.

ACCOUNTING RECORDS AND AUDITS

For services compensated through one of the variable methods, the owner may request that the consultant provide the accounting record necessary to document the consultant's actual time and expenses for the services provided, and may require the ability to audit the engineer's accounting records. This requires the consultant to maintain detailed hourly time records for principals, engineers, and other employees who devote time to the project. Applicable payroll records, together with receipts or other documents to substantiate chargeable expenditures, must be available for audit by the owner if required by contract. Computerized project accounting systems that many consulting firms use are able to generate project-specific time and expense reports. Often owners will request that support documentation for charges be included with each invoice. This increases the consultant's administrative costs associated with the project and may also increase review time by the owner. The consultant contract for services should clearly stipulate accounting records and formats required to be furnished to the owner.

CONSULTANT COSTS

To better understand compensation for services, it is helpful to understand the consultant's costs to provide those services. These costs fall into four general categories: salary cost, payroll burden, other direct costs, and general overhead.

Salary Cost

This is direct salary and includes salaries for partners or principals, as well as technical, professional, administrative, and clerical staff whose time is directly chargeable to the project.

Payroll Burden

This covers all costs associated with employee benefits (nonsalary expenses) and includes the following:

- Sick-leave contribution;
- Vacation pay;
- Holiday pay;
- Incentive pay;
- Bereavement leave pay;
- Unemployment and other payroll taxes;
- Contributions for social security and workers' compensation insurance;
- Retirement, medical, and other group benefits; and
- Other employee benefits.

Other Direct Costs

These are costs that are directly attributable to the specific project or services and are not included in the consultant's overhead. Examples of project-identifiable other direct costs include:

- Living and traveling expenses of principals and employees when away from the home office on business related to the project;
- Communications expenses, such as long-distance telephone, electronic communications, and special delivery charges for other than general correspondence;
- Expenses for services and equipment directly applicable to the project, such as specialized technical equipment, special legal and accounting services, commercial printing and binding, shipping, and similar services that are not applicable for inclusion in general overhead;
- Supplies, such as for reproduction (photocopying, plotting, and printing), charged to the owner's project, as distinguished from such supplies and expenses included in the consultant's overhead;
- Electronic plan room fees;
- Expenses for unusual insurance, specialized health and safety programs, and special clothing for projects with extraordinary risks, such as toxic and hazardous waste conditions;
- Expenses for graphic services and audio/visual equipment for public meetings;
- Permitting, filing, and review fees for project; and
- Expenses for subcontracted services from other consultants.

General Overhead

As with any business, consultants have overhead expense. The consultant's general overhead is expressed usually as a percentage of salary cost and includes the following indirect costs:

- Provisions for office expenses, including light, heat, telephone, depreciation, rental furniture, rent, drafting equipment and engineering instruments, automobile expenses, and office and drafting supplies not identifiable to a specific project;
- Taxes and insurance other than those included as salary cost, but excluding state and federal income taxes;
- Library and periodical expenses and other costs of keeping abreast of advances in engineering, such as attendance at technical and professional meetings and continuing education courses;
- Executive, administrative, accounting, legal, and clerical salaries and expenses (other than identifiable salaries included in salary costs and expenses that are directly charged to projects), plus salaries of partners and principals to the extent that they perform general executive and administrative services, as distinguished from technical or advisory services directly applicable to particular projects;
- Costs for new business development and marketing, including preparation of promotional materials, proposals, qualification statements, meetings, among others;
- Interest on borrowed capital for business expenses, covering accounts receivable and equipment purchases;
- Business development expenses, including salaries of principals and employees;
- Provision for lost productivity time of technical employees between assignments and for time of principals and employees on public service assignments; and
- Costs of acquiring and maintaining computers, developing software, and training staff when not billed as a direct project cost.

While not meant to be comprehensive, this list does provide an overview of the types of costs in each category. Consultants who provide services to governmental agencies are typically audited each year by an agency to determine the consultant's overhead rate based on applicable regulations. In the case of the U.S. government, the Federal Acquisition Regulations (FAR) determines what is included in the overhead rate. The government-audited overhead rate is usually less than the consultant's true overhead rate because some necessary business expenses are disallowed. For example, FAR excludes marketing and proposal development costs from overhead expense calculations. It also disallows certain

Table 4-2. Example of a Consultant's Costs to Provide Service

Item	Percentage of Salary[a]	$/Hour[a]
Salary	100	40.00
Payroll burden (benefits)	35	14.00
General overhead	140	56.00
Total (salary + payroll + overhead)	275	110.00
Profit (15% × 275)	41	16.50
Total with profit	316	126.50

[a] Percentage and dollar amounts are shown for illustrative purposes only and are not meant to reflect actual or recommended compensation amounts.

employee welfare costs necessary for a consultant to attract and maintain high-quality personnel. For variable compensation methods, the owner should reach an agreement with the consultant in advance on the specific costs included in each category.

PROFIT

In addition to salary costs, payroll burden, other direct costs, and general overhead, the consultant needs and is entitled to a profit. Profit includes a definable margin for contingencies, readiness to serve, knowledge, expertise, acceptance of risk, and return on investment. Without a profit, the consultant cannot invest in new technologies and equipment, support the community, provide for business growth, and reward employees. Profit usually is expressed as a percentage of salary cost, payroll burden, and general overhead (see example in Table 4-2).

SALARY-COST-TIMES-MULTIPLIER PLUS DIRECT NONSALARY EXPENSE

Compensation on the basis of the salary times an agreed-on multiplier is one approach to determining charges for consulting services. With this method, charges for services are based primarily on direct salaries. Therefore, the consultant and owner should agree on the salary ranges for each applicable classification of service, as well as on the time period for which they can be guaranteed. Salary escalation clauses or average salary rates for the anticipated performance period help to avoid future surprises, misunderstandings, and disputes.

The *direct-salary-times-multiplier* or, as it is frequently called, the *direct-labor multiplier* applies a multiplier to unburdened direct labor costs (direct

salaries without employee benefits). The multiplier includes salary cost, payroll burden, general overhead, and profit. In the example shown in Table 4-2, the multiplier would be 3.16 (316%). The size of the multiplier may vary with the type of services, the nature and experience of the consultant, the size of the consultant's firm, and the geographic location of its office. A higher profit and multiplier is typically applicable for services requiring extensive experience and special knowledge, involving expert testimony in legal proceedings, or providing services on high-risk projects. The multiplier may also increase with the experience and special capabilities of the consultant. The salary-times-multiplier method is appropriate where project scope is not well defined or is expected to change during progress of the project.

Direct nonsalary expenses normally are reimbursed by the owner at actual invoice cost plus an administration charge, or markup, to compensate for associated accounting, purchasing, contract administration, risk of liability, and such. Often the percent markup for subcontracted services and reimbursable expenses is in the range of 7% to 10%.

HOURLY BILLING RATE

The hourly billing rate method of compensation is similar to the salary-cost-times-multiplier method in that the hourly billing rate includes all direct personnel expenses, overhead, and profit. Other direct costs, as defined under the "Salary-Cost-Times-Multiplier" section, are a separate item for reimbursement—usually with an administrative charge. The consultant and the owner may elect to use this method of compensation on projects where the scope of service is not well defined or to simplify accounting and record keeping. In this method, the consultant and owner agree on stipulated billing rates for categories or specific individuals who will work on the project.

PER DIEM

The term *per diem* refers to the charge for consulting services by classification of employee for a standard day (typically an 8- or 10-hour day). Direct personal services as described in Chapter 2 are frequently charged on a per diem basis. This method is particularly well suited to expert witness or similar services and to other short-term engagements involving intermittent personal services. It is also used when significant travel may be required to attend project-related meetings.

When per diem services are furnished, the consultant should be compensated for all of the time devoted, including travel and standby time.

The per diem charge should be based not only on the complexity, risk, and importance of the services but also on the consultant's professional standing, expertise, and breadth of experience. The consultant is typically reimbursed for travel and subsistence costs and for other out-of-pocket expenses incurred while away from the home office.

For engagements where the consultant serves as an expert witness, a per diem charge is considered earned for each day of appearance. If the consultant is not called to testify or testifies only part of the day, the full per diem rate is still charged.

On occasion, the urgency of the engagement can require the consultant's time for periods longer than the normal day. In such cases an understanding should be reached with the owner and the per diem rate increased accordingly.

Per diem rates vary widely, depending on employee classification, regional location, and period of service. Consultation rates in connection with litigation and appearances before commissions and courts normally are higher than those charged for other services.

COST PLUS, FIXED FEE

Under a cost-plus, fixed-fee (CPFF) agreement, the consultant is reimbursed for the actual costs of all services plus supplies related to the project, including the following:

- Salary costs;
- Payroll burden;
- General overhead;
- Other direct costs; and
- Fixed fee (profit).

As a prerequisite to equitable negotiations, the cost-plus, fixed-fee basis requires that the owner and the consultant define and agree on the scope of services to be performed. This agreement forms the basis for the consultant to estimate costs and propose an equitable fixed-fee amount. The scope of services, cost estimate, and fixed fee should be incorporated into the agreement.

The cost-plus, fixed-fee method also can be used when the consultant is required to start before the detailed scope of services can be determined. In such cases, the following considerations apply:

- The general scale and intent of the project should be fairly well defined, even if the full scope is indeterminate. For example, the number, size, and character of buildings or other facilities; the types of utilities; and other such essential information should be available.

- The types of services to be performed by the consultant should be agreed on and fully set forth. The agreement also should provide for appropriate adjustments in the fixed fee in the event that the physical scope of the project, time of completion, or level of effort and services required are materially increased from those contemplated during the negotiations.

The fixed-fee amount varies depending on the complexity of the project, uncertainty of the project scope, and other factors that are not a direct function of project size. This amount is frequently calculated as a percentage of the anticipated salary costs, overhead, and direct nonsalary expenses.

LUMP SUM

The lump-sum or fixed-price method of compensation is used frequently for investigations and studies and for basic services on design projects where the scope and complexity of the assignment are clearly and fully defined. The fixed-price amount can be calculated as the sum total of estimated costs for salaries, overhead, and nonsalary expenses; an allowance for contingencies; interest on invested capital; readiness to serve; and a definable amount of profit. Lump-sum agreements often include defined compensation levels or lump-sum fees for each phase of a project. For example, in a design project the maximum compensation for preliminary design may be 35% of total compensation, with 75% of total compensation upon completion of final design, and 100% compensation when construction is complete.

A fixed-price agreement should contain a clearly stated time period for performing the services and a provision for adjusting compensation if the project is delayed for reasons beyond the consultant's control. For design services, there should be a provision for changes required after approval of the preliminary design, with a clear understanding of where the final approval authority lies.

SUMMARY

The most appropriate method of consultant compensation for a particular project or assignment will be determined by several factors. The owner and consultant should discuss these factors and jointly determine the compensation method that best reflects the scope and characteristics of the project.

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CHAPTER 5
TOTAL PROJECT COST

A major concern for owners throughout a project's planning, design, and construction phases is total project cost. The total project cost, which is often used to establish a project's budget, is composed of the following:

- Consultant's costs;
- Construction costs;
- Owner's costs; and
- Contingency allowance.

CONSULTANT'S COSTS

As discussed in Chapter 2, the consultant is often engaged to study and render a planning report on the proposed project, including alternative solutions, layouts, and locations, as well as initial estimates of the schedule and project cost. These reports may involve consideration of alternatives or phased implementation, which adds flexibility to the project.

In addition to direct engineering costs, the study and report phase may also include costs for field or traffic surveys, planning analyses, and geotechnical explorations. In recent years, governmental rules and regulations have dramatically increased the scope and cost of projects, as the costs of coordination, evaluation, implementation, and compliance with these rules and regulations have increased. Permit requirements may affect the overall schedule and cost by delaying the anticipated construction date and increasing the final project cost. Most recently, the focus on sustainability has added another element to project planning and budgeting. Depending on the owner's goals for the project, this may also be an

element of consideration. The extent of these additional cost considerations cannot always be identified during the study and report phase; sometimes they are not quantifiable until after final plans and specifications have been prepared.

During the final design and construction phases, additional field engineering, such as surveying and geotechnical services, may be needed. Special or additional services not identified in the preliminary engineering phase may be required by the owner or regulatory agencies, or they may be recommended by the consultant. The owner also may request that the consultant provide guidance on project start-up, commissioning, or preparing operation and maintenance manuals. In such cases, the updated scope of work and associated increase in cost should be determined and agreed on. These additional costs are then included in the consultant's compensation.

ESTIMATING CONSULTANT'S COSTS

In its 2008–2009 survey of consulting firm practices, ASCE queried members about trends in compensation for services. Consultants were asked to submit data on their completed projects, relating the costs of various phases of their services to the construction costs.

The information received was reviewed and compared to the results of a similar survey performed in 2000. ASCE found that the ability to predict a cost, or even an "average range" of costs, for any particular grouping of projects—basic, complex, or very complex—has become very difficult. As outlined in Chapter 4, the cost of consulting fees varies based on a number of variables—what is known, what is unknown, the nature of the services to be provided, the intended outcome of the project, and a host of other factors. It is, therefore, of utmost importance that a thorough understanding of the project be shared by the project owner and the consultant so that expectations related to project deliverables are clear.

In the previous edition of Manual 45 (2002), the information was divided into two main categories: new construction and modifications. The projects were also separated by level of complexity—average complexity and highly complex. The data were then plotted and two "best fit" curves were calculated and plotted on each of four graphs. The graphs showed the range of design fees received versus construction costs. They also showed the range for total fees received versus construction costs for both new and modified projects. The definitions used in those graphs and in the following graphs are as follows:

- "Design fees" cover preliminary and final design services only.
- "Total fees" cover investigations, studies, preliminary design, final design, construction services, and all other services necessary to complete the requested work, as agreed on.

Since that edition of Manual 45 was published, ASCE has received considerable feedback that the curves were being used as absolutes to establish consultant's fees. This did not allow for variations caused by the scope of work, complexity of the project, required agency reviews, owner's expectations for meetings and other communication, or indirect costs that include liability exposure and corresponding insurance costs. Those all vary—sometimes radically—from project to project. The curves were never intended as an absolute standard for fees but, rather, were intended to show what might be considered as a historical range of costs. The individual data points on the graphs showed the wide variation of consultant costs depending on the myriad factors mentioned here.

Rather than calculating and drawing best-fit curves in this edition of the manual, in the following graphs ASCE has overlaid the 2008–2009 information onto the previously reported data and found the variance of fees to be consistent, reinforcing that the fees are wholly dependent on the specific elements of work to be accomplished. Despite their limitations, the graphs have value in helping approximate design fees during early project planning. The graphs also graphically reinforce that fees are not absolute but, rather, are dependent on the specific work to be accomplished. Final compensation should always be negotiated after the scope of work and associated risks have been identified and have been clearly defined.[1]

The data illustrated in Figs. 5-1 through 5-8 relate to numerous projects of varying complexity and associated risk. Thus, a particular data point shown, or any interpolation between points, should not be used to establish compensation for future projects. However, these graphs could help in approximating the design fees and total fees for budgeting and comparison purposes.

Because projects vary in nature and scope, no individual historical cost information is provided in this manual for the study and report phase. However, this phase is important because its implementation determines the scope of the entire project and its ultimate capital and life-cycle cost.

[1] This survey is a compilation of historical information for the benefit of ASCE's members and others involved in design and construction, not a projection of future fees or costs. The survey was conducted in accordance with all applicable laws, including antitrust laws. The survey is limited to information voluntarily and confidentially submitted by survey respondents and should not be construed as representative of the entire field. ASCE makes no recommendations or suggestions for action regarding the use of the survey results, and all activities and use of information are subject to independent discretion and business judgment.

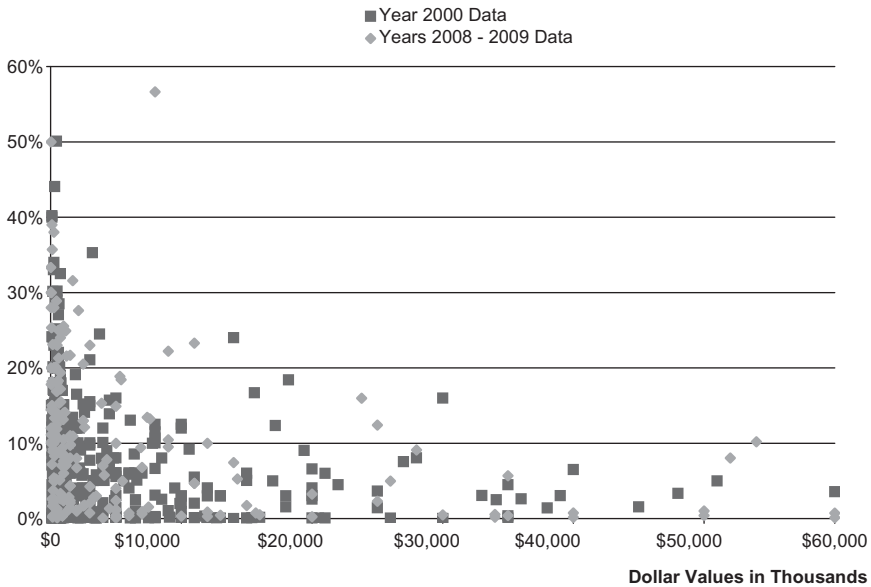

Fig. 5-1. Total fee percentage vs. new construction cost

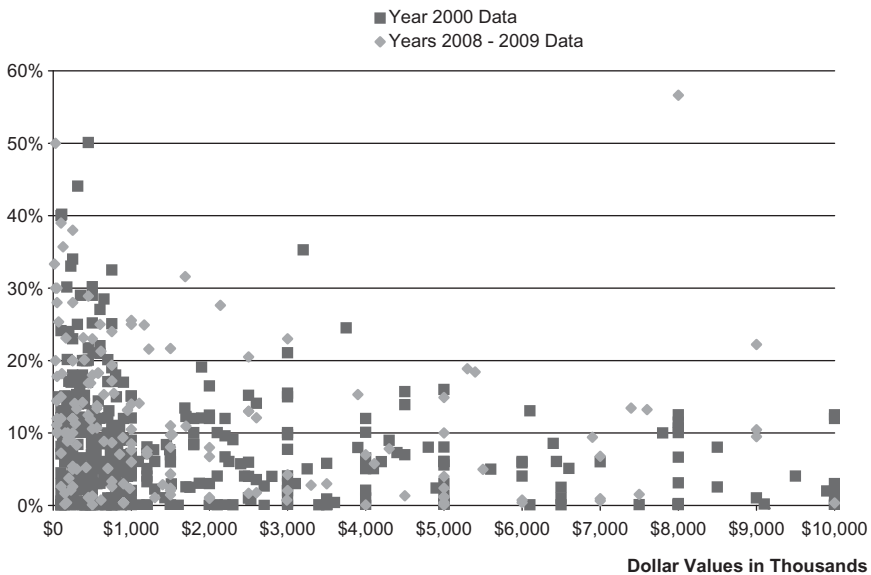

Fig. 5-2. Total fee percentage vs. new construction cost (expanded view of data in the lower cost range shown in Fig. 5-1)

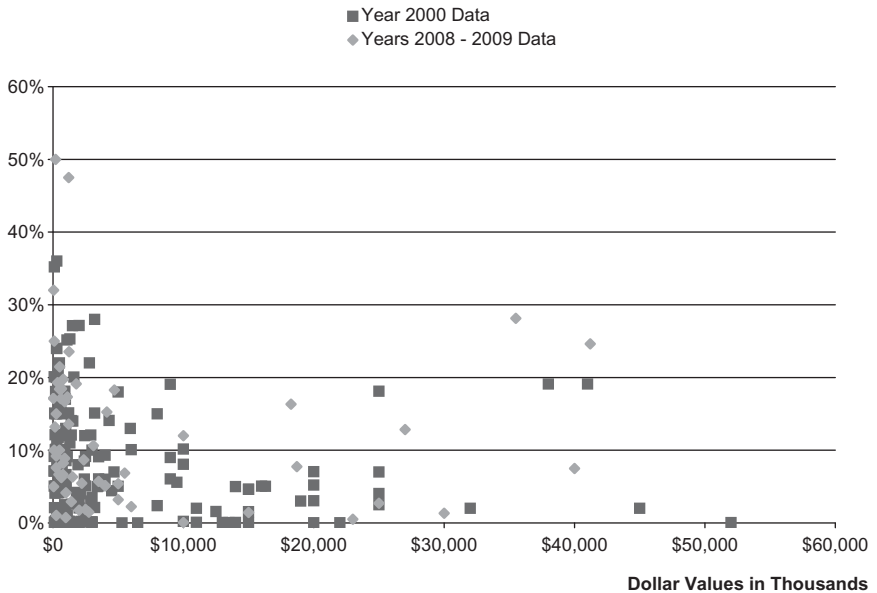

Fig. 5-3. Total fee percentage vs. construction modification cost

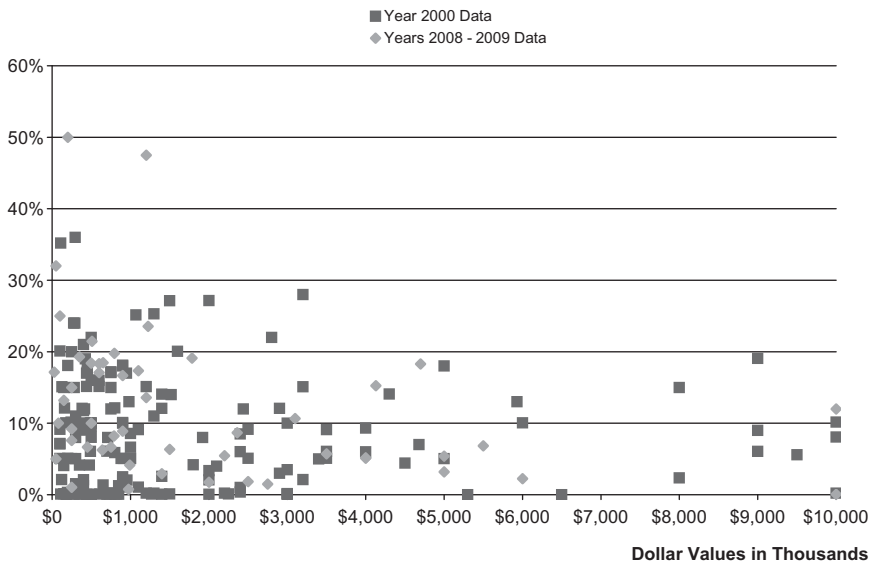

Fig. 5-4. Total fee percentage vs. construction modification cost (expanded view of data in the lower cost range shown in Fig. 5-3)

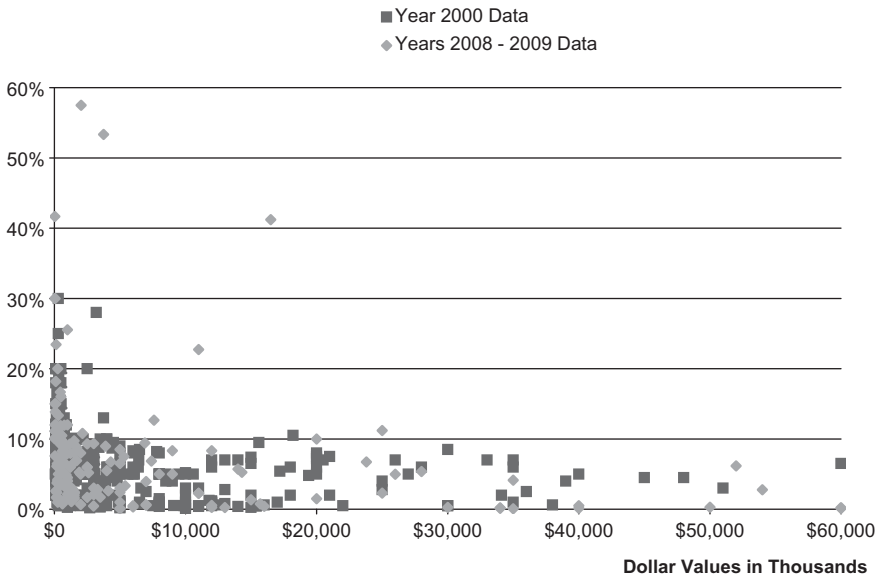

Fig. 5-5. Design fee percentage vs. new construction cost

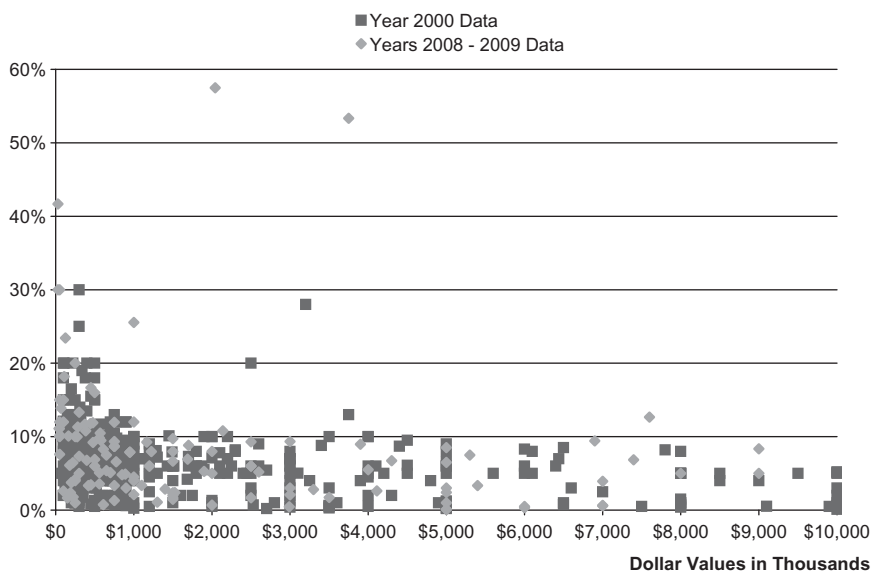

Fig. 5-6. Design fee percentage vs. new construction cost (expanded view of data in the lower cost range shown in Fig. 5-5)

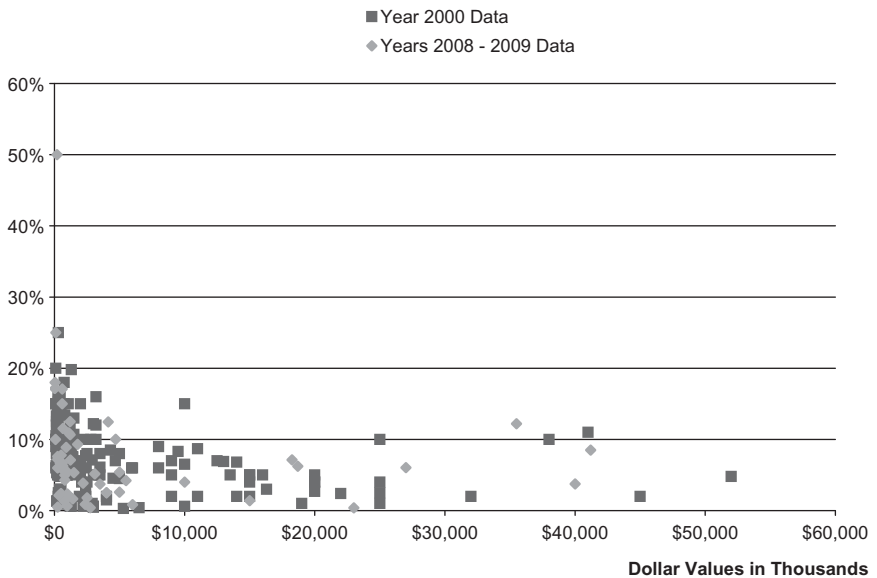

Fig. 5-7. Design fee percentage vs. construction modification cost

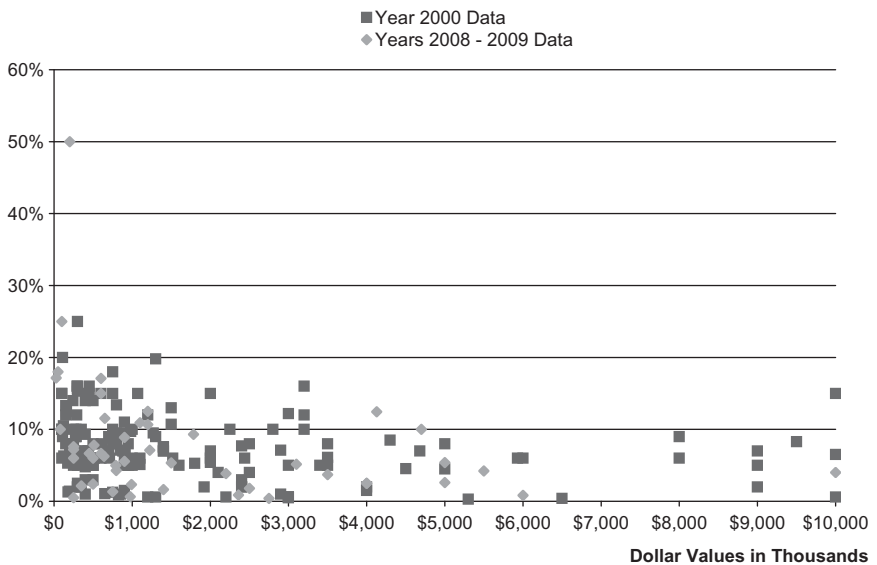

Fig. 5-8. Design fee percentage vs. construction modification cost (expanded view of data in lower cost range shown in Fig. 5-7)

CONSTRUCTION COSTS

A project's study and report phase usually includes a preliminary opinion of the construction costs and alternative approaches. These opinions of probable cost are based on the best information available, often taken from projects of similar scope and projected to an assumed future construction date. Such cost opinions are approximate because all factors affecting cost have not yet been confirmed. Owners must understand that the *opinion of probable cost* of the project calculated during the study and report phase is based on the conceptual level of engineering in the report and, as such, is a preliminary opinion. This cost should not be used to establish a final project budget or secure project funding without the inclusion of an appropriate contingency. In addition, the timing of the construction work must be considered because inflation and contributing material and labor costs will affect the total construction cost. For this reason, the opinion of probable construction cost at the study and report phase should be related to a recognized cost index. Other conditions being equal, cost opinions can be updated using the cost index if the project construction period is delayed.

One of the best sources of information on national and regional construction cost trends is the Construction Cost Index History published by the *Engineering News-Record* (ENR).[2] Using the year 1913 as a base of 100, recent national indexes are shown in Table 5-1.

Table 5-1. *Engineering News-Record* Construction Cost Index

Year	Average Index	% Increase from Preceding Year
2000	6,222	2.7
2001	6,342	1.9
2002	6,538	3.1
2003	6,694	2.4
2004	7,115	6.3
2005	7,446	4.6
2006	7,751	4.1
2007	7,966	2.8
2008	8,310	4.3
2009	8,570	3.1
2010	8,802	2.7

[2] *Engineering News-Record* annually compiles construction cost indexes. The indexes are also published on the ENR website, http://enr.construction.com/.

ENR cautions that the "construction cost indexes reflect wage rate and material price trends." They do not adjust for labor, job efficiency, material availability, competitive conditions management, mechanization, or other intangibles affecting construction costs.

Significant increases in previous cost opinions may be required when construction is delayed. Therefore, all opinions should specify the period for which they are valid. Recent history and current conditions, in addition to the long-term historical data, should be taken into account in preparing the opinion of probable cost.

Cost projections should be evaluated as part of a regular project planning and review process to confirm that costs have been updated appropriately, based on project elements. While the ENR Construction Cost Index is helpful, it may be necessary to apply a more specific inflation factor to a major element of the project. Specific material cost information is also available from ENR.

Land or right-of-way required for construction should be identified as early in the design phase as possible. Depending on the market, land costs or right-of-way and easement acquisition costs may increase substantially, even over a short period of time.

The time to complete land, right-of-way, or easement acquisition could potentially delay the start of construction, thereby adding to the total project cost.

OWNER'S COSTS

Owner's costs normally include such expenses as legal fees; land, right-of-way, or easement acquisition costs; administrative costs; staffing costs; liability and insurance costs; and financial costs, such as interest. These costs and others, including audits, the cost of issuing bonds, and interest on borrowed money during construction, are part of the total project cost and can be estimated best in cooperation with the consultant.

PROJECT CONTINGENCY ALLOWANCES

Because relatively few projects evolve exactly as planned, the total project cost should also include a contingency allowance to pay for unanticipated expenses that may occur during the design and the construction phases of the project. Including a sufficient contingency allowance in the preliminary feasibility evaluation minimizes the impact of unanticipated expenses. During the design phase, the contingency allowance may be higher, if the scope of services is less detailed, or lower, if the scope is concise.

As the project moves forward from the study and report phase through final design and finally to construction, more becomes known about project details and costs, and the contingency allowance can and should then be reduced.

To provide for unknowns or potential change orders during construction, contingencies should be routinely added to the consultant's construction cost opinion. It is common practice to add a minimum contingency allowance of 25% or more, based on size, risk, and complexity, to the preliminary opinion of probable cost at the completion of the study and report phase. The percentage added as a contingency allowance should be reduced as the design proceeds, based on additional detail, and should be able to be reduced to perhaps 10% to 15% at the completion of final design.

A construction contingency, required by some owners in order to award the project, is good practice because it ensures that budget is available for minor overruns. The amount of construction contingency varies by the size of the project, with 10% a starting point. Larger, more complex projects or projects with high-risk elements may require even higher contingencies.

By understanding that the consultant's opinion of probable cost is only that—an opinion based on what is known at the time—and by including appropriate contingencies as part of the overall budget, the owner will be better able to make decisions that are far less affected by unexpected additional fees and costs.

SUMMARY

Total capital costs for a project include consultant costs, construction costs, permit fees, owner costs, and contingency allowance. The opinion of probable project cost should be revised periodically by the consultant as the design progresses and as more information becomes known.

CHAPTER 6
CONTRACTS FOR ENGINEERING SERVICES

After the consultant has been selected using one of the methods described in Chapter 3 and agreement has been reached on the preliminary scope, schedule, and compensation, the client and selected consultant should formalize their agreement in a written contract. This chapter presents the items that should typically be considered in a contract and resources available to support that effort.

The terms of agreement between the consultant and the owner should be clearly expressed in a written, legally binding document signed by both parties before any work begins. Typical agreements contain two parts. The first part, the "Scope/Schedule/Fee" section, establishes issues that are unique to the project, including:

- Scope of design services to be provided;
- Schedule/time of performance for the contracting parties;
- Fee/compensation for professional services; and
- Owner's responsibilities.

The second part consists of the terms and conditions, typically referred to as *general conditions* or *provisions*. This section addresses common issues, such as procedures for amending the agreement, standards of performance, insurance coverage, allocation of risks, and termination.

CONTRACT DOCUMENTS

Standard forms of agreement and related documents that reflect current practice have been developed by ASCE in conjunction with other

professional societies that participate in the Engineers Joint Contract Documents Committee (EJCDC). The EJCDC documents are revised regularly and can be used verbatim or to confirm the adequacy of other documents. A complete listing of EJCDC documents and how to obtain them is available from ASCE Publications. See Appendix 1 for additional information about EJCDC documents. Other standard contract documents developed for civil engineering projects may also be available.

At present, different forms of contract documents are in use. Many owners prefer to customize them to accommodate specific projects and local laws and regulations. Federal agencies often require the use of their own forms, although some federal agencies actually use EJCDC contract documents as their standard forms. For contracts involving federal grants or loan funds, many contractual provisions are mandated by federal laws and policies. Nonfederal public agencies also may require the use of specific contract forms and documents. Private owners may use contractual documents of their own choice. Many consultants use standard forms of agreement that they have developed based on experience and that define such matters as generally accepted duties and obligations of the contracting parties and legal and liability considerations.

Some industrial clients, government agencies, or contractors may desire to procure professional services using their standard purchase order, the terms of which are generally not applicable and may result in uninsured liability. The terms and conditions of contracts developed through a purchase order are often one-sided in favor of the purchaser. In these cases the consultant should have the contract terms reviewed by his or her legal counsel, professional liability carrier, and/or accountant.

SCOPE OF SERVICES

Typical services provided by the consultant are listed in Chapter 2. The design agreement specifies the project phases and the professional services to be provided in each phase, subdivided into discrete, project-specific tasks. The mutually accepted definition of these tasks is referred to as the *scope of services*. The negotiated scope forms the basis for the schedule and fee for each phase.

Many factors determine which tasks will be in the consultant's scope of services, including the manner and timing of selecting the contractor and the owner's construction budget. For example, competitive bidding for construction services may require that the design be completed in greater detail than with negotiated pricing. If the contractor joins the project team during the design phase, the design scope might include more meetings with the contractor but fewer construction alternatives to

consider because the contractor can help guide the team to the most economical methods.

A well-executed scope of services is fundamental to a successful project. The owner and consultant benefit from quantifying the level of effort required to the greatest extent practical. This may include specifying the number of design alternatives to be explored, meetings, site visits, copies, and other deliverables. As a result, the expectations of each party are clarified, the risk of surprises is reduced, and the potential for disputes is minimized. The scope of services should also document the owner's values, goals, and objectives for the project.

Under most professional service agreements, the consultant is responsible for producing several documents that are among the end results of the tasks. These documents, which are outlined in the scope of services and thus included in the contract, are often called *deliverables*. The sequence of their delivery to the owner sets the consultant's schedule. They typically include such documents as schedules, preliminary project feasibility reports, cost estimates, life-cycle analyses, alternative investigations and other studies, project impacts on the environment or infrastructure, preliminary design and outline specifications, final design, construction activity reports, record drawings and final project reports, operating and maintenance manuals, and construction contract documents, including plans and specifications.

SCOPE CHANGE

During the course of a project, the owner may find it advantageous or necessary to change the scope of design services. The owner benefits from making these changes in consultation with the design professional so the modifications are clear, achievable, and matched with equitable compensation. When the scope changes repeatedly due to insufficiencies of the initial scope, scope creep occurs.

While changes in scope are often needed to achieve the desired project, scope creep generally has negative consequences. For the consultant, it can sometimes lead to uncompensated work; for the owner, it may lead to change orders. ASCE's 2003 Web seminar on scope creep reported the following: "Uncompensated scope creep can be an insidious, slow process that consumes budgets, disrupts schedules, frustrates project team members, and alienates clients. Examples of client-driven scope creep include conducting additional meetings, examining more alternatives, or providing new services. Consultant-driven scope creep might include using a sophisticated technique when a simple one would suffice, writing a full-blown report when a memorandum is sufficient, or preparing a

design-level cost estimate when a planning-level estimate would be adequate."[1]

PROCEDURES TO AMEND THE AGREEMENT

Projects proceed more smoothly when the professional services agreement includes procedures for changing the scope of services, schedule, and/or compensation. Change orders call on the owner to have a commonsense authorization procedure to help prevent disputes and delays. This procedure is typically included in the "Terms and Conditions" section of the agreement and should not affect the consultant's ability to continue working on the project. Changes are made in writing and approved as an amendment by authorized representatives of both parties.

CONTRACTS WITH SUBCONSULTANTS

The basic elements of the consulting practice are performed by a prime professional who has overall responsibility for planning and designing a project. In many situations, however, a geotechnical engineer, structural engineer, or other specialist may provide services not furnished by the prime professional. Specialists retained by the prime professional are known as *subconsultants*.

The scope of services provided by a subconsultant varies. Subconsultants may provide, among other things, full design services, investigations and reports in defined areas, or reviews of contract drawings. Sometimes subcontracting is used by the consultant to help achieve the owner's diverse goals. In any case, the subconsultant's services should be explicitly defined in the contract.

Typically, the subconsultant enters into a contract with the prime professional but could contract with the owner in certain situations. In either case, the relationship among the prime professional, subconsultant, and owner—and the responsibilities of each—must be clearly defined in each contract. When the subconsultant's contract is with the prime professional, the terms of the prime professional's contract with the owner should be specified to apply to the subconsultant's contract.

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[1]ASCE Web seminar on scope creep, prepared and presented by Dr. Stuart G. Walesh, 2003. Current webinars on this topic can be found on ASCE's Continuing Education website at http://www.asce.org/webinars.

PROVISION FOR INFLATION AND DELAYS

Inflation can substantially affect the consultant's cost of performing engineering services, as well as the cost of project construction. Thus, inflation must be considered when establishing the terms and payments for consulting services. This is especially important for agreements that extend over a prolonged period of time and for projects the initiation or completion of which are delayed due to factors beyond the consultant's control.

If the consultant's compensation is based on actual costs—for example, if compensation is based on salary costs times an agreed multiplier plus direct nonsalary expenses, or on a cost-plus, fixed-fee basis—then any increase in the cost of engineering services due to delays is automatically accommodated.

This automatic adjustment does not occur when compensation is based on specified hourly or per diem rates, a fixed-price contract, a salary-cost-times-multiplier, or a cost-plus, fixed-fee contract for which maximum compensation has been established. In such cases, additional contract provisions are required. For example:

- Agreements using specified hourly or per diem rates, or specifying a maximum allowable compensation, should stipulate the time period for which the rates will remain in effect, after which appropriate adjustments can be made for inflation.
- Fixed-price contracts should be negotiated based on an agreed project period, with provision for appropriate adjustment in compensation if the period is exceeded because of factors beyond the consultant's control. Whenever a maximum fee is stipulated, changes in scope necessitate an adjustment in the contract limit regardless of the type of contract.

Delays in construction projects that lead to extension of their anticipated completion date and work stoppage cost the owner money. Whether caused by the consultant, owner, or contractor, delays are generally detrimental, and the owner should include in the contract provisions that address project impacts due to delays. Some sources of possible delay are the consultant not meeting schedule, delayed approval of concepts and documents by the owner, or scope creep resulting in numerous change orders, as discussed earlier. Construction delays can result from errors or discrepancies in design drawings and delays in approval of working drawings by the consultant.

The owner can help reduce delays by selecting a qualified firm using qualifications-based selection (QBS) methods (discussed in Chapter 3) and negotiating a reasonable price to ensure timely, comprehensive, adequate

design. As mentioned earlier, the contract should define the mutually agreed-on scope of services and schedule for completion of the deliverables. The owner should then resist temptations to make unnecessary changes to the scope.

DOCUMENT OWNERSHIP

All documents, including drawings, computations, and specifications prepared or furnished by a consultant, are *instruments of service* for the specific project under contract. The consultant may retain an ownership and property interest in these documents, whether or not the project is completed, or he or she may transfer ownership to the owner when required by the contract. In either case, it is important that ownership of the documents be mutually agreed to and made a part of the contract prior to commencement of work. However, the documents are not intended for reuse on extensions of the project or for any other project without written verification or adaptation by the consultant. The contract should provide that the consultant is held harmless and indemnified by the owner should there be any reuse of the documents for other projects or extensions without the consultant's written permission.

Electronic documentation may be provided by the consultant as part of the contract deliverables. The ownership and reuse of certain portions of these electronic files should remain with the consultant. If the project includes electronic deliverables, the contractual agreement should address format and software compatibility issues to ensure efficient document transfer capability between the owner, consultant, subconsultants, and any contractors who may desire to use the electronic documents. The increasing requirement to use Building Information Modeling (BIM) software by some owners represents one particular example of this need to address compatibility, data sharing, and data management responsibilities.

Electronic documents should be secured because the file identity of the author or originating firm can be easily deleted or altered, leaving the origin of the computer file or document in doubt. Whenever computer-generated documents are shared, the contractual agreement between parties should specify in detail the intended use of any electronic deliverable and limit unintentional modifications. Appropriate disclaimers and warnings for any expressed use of the data should be clearly identified.

ASCE supports the use of digital, or electronic, signatures for sealing drawings *provided that adequate security measures are used* (see ASCE Policy Statement 492, Use of Electronic Signatures).[2] A digital signature is not a

[2]ASCE. (2011). "ASCE policy statements." <http://www.asce.org/policystatements> (Sept. 21, 2011).

digitized image of a handwritten signature; it is an electronic file that is encrypted in such a way that anyone can decode the file but not alter it.

ALTERNATIVE DISPUTE RESOLUTION

Alternative dispute resolution (ADR) is being used more frequently in the construction industry to avoid formal and more costly litigation through the courts. ADR procedures currently in use include both binding and nonbinding methods, such as mediation, arbitration, private judging, and dispute review boards. No single method is best for all situations. The method of resolution should be determined by the owner and consultant at the beginning of the project.

ADR relies on the premise that disputes arise because of differences of opinion on technical issues. Therefore, disputes should be resolved on the basis of nonbiased professionals using their technical expertise. Many ADR methods rely on the conciliatory approach to resolution. Lawsuits are an opposite approach. They immediately set up adversarial positions that usually polarize the disputants. Emotions rather than logic tend to dominate the negotiations. Ultimately, judges or juries, who possess little or no technical expertise on the issues, may resolve the dispute. The use of conciliatory ADR often provides the following benefits:

- Quicker resolution;
- Lower-cost resolution; and
- Nonadversarial proceedings.

With ADR, disputants often maintain a good working relationship after the dispute is resolved. However, even with ADR's advantages some people take issue with certain provisions of the arbitration process. Chief among these are the fact that it is an informal procedure; the rules of evidence do not apply; the decision is not subject to appeal to the courts on the merits of the dispute; there is no provision for discovery of information by the parties prior to the hearing; and according to some people, arbitrators tend to "split the difference" in the decision. Conversely, arbitration would not be effective if the decision could be appealed in court. One of the advantages of arbitration is that it is private, whereas a court trial is public.

The EJCDC includes recommended dispute resolution provisions in both its E-500 Standard Form of Agreement Between Owner and Engineer for Professional Services (Section 6.09) and C-700 Standard General Conditions of the Construction Contract (Section 16). The provisions potentially involve a two-step procedure, first requiring nonbinding mediation, followed, if necessary, by binding arbitration.

Provisions for dispute resolution should be included in the contract, preferably using a conciliatory rather than an adversarial method.

STANDARD OF CARE

Contracts may include language stipulating the standard of care the consultant will apply in the execution of the project. *Standard of care* is generally understood to mean that the consultant will strive to perform services in a manner consistent with the level of care and skill ordinarily exercised by members of the engineering profession practicing under similar circumstances in the project's locale. In addition, consultants should be responsible only for their own negligent acts, errors, and omissions.

RETAINAGE

Retainage, as discussed in Chapter 4, results in a financial burden for the consultant and higher overhead costs. However, if a governmental or other administrative code requires retainage, it is recommended that the contract specify a maximum amount to be retained. The contract also should state clearly that the retained funds earn interest in favor of the consultant.

PARTNERING

Since its inception on U.S. Army Corp of Engineers projects in the 1980s, partnering has been implemented successfully on thousands of projects and has come to be regarded as an important means of avoiding disputes and contributing to quality in the constructed project. *Partnering* is a relationship among stakeholders in a project—the owner, designer, and builder—that recognizes and acknowledges their common goals and potential risks. Contracts establish the legal relationships among stakeholders, while partnering establishes the working relationships. Partnering is built on trust, commitment, and equity. It requires a formal agreement on jointly developed mutual goals and project objectives. It requires prompt resolution of problems at the lowest level of authority.

Partnering enhances project quality by improving relationships and communication among project team members and results in improved management of risk, greater financial control (fewer claims and cost overruns), timely completion, increased job satisfaction and camaraderie among project participants, and reduced litigation. Partnering rejects the

"win-lose" paradigm in favor of "win-win" strategies. ASCE encourages partnering in construction contracts. Partnering is mandated by some agencies and is strongly supported by major participants in all three segments of the building industry—owners, contractors, and designers. For additional information, see ASCE Manual 73, Chapter 24.[3]

TERMINATION

Since there is always the possibility that a project could be terminated for a variety of reasons, the right of either party to terminate the contract prior to its completion, as well as the terms under which the agreement can be terminated, should be clearly stated in the contract. In the event of termination, the consultant should be compensated fully for the work performed. Work to be compensated may be greater than shown on routine reports to the owner because of preliminary work completed but not yet shown on the contract documents.

An agreed-on settlement figure should be based on the following:

- Work completed as of the most recent project report;
- Preliminary work done but not yet included on contract documents or on progress reports;
- Organization of all completed and partially completed work;
- Demobilization, including filing of all documents so that quick start-up can be done if the project is reinstated;
- Time and cost required to assess work completed and negotiate settlement with owner; and
- Release of retainage, if applicable.

Cooperation by both the owner and the consultant is absolutely necessary for a satisfactory resolution of the final compensation due to the consultant.

PERFORMANCE EVALUATION

At the completion of each stage or milestone of a project and after the project is completed, the owner should evaluate the consultant's performance. Intermediate evaluations should focus on determining whether

[3] ASCE Manuals and Reports of Engineering Practice No. 73. (2000). *Quality in the constructed project: A guide for owners, designers, and constructors*, 2nd Ed. ASCE, Reston, VA.

the project objectives being achieved meet the owner's goals so that immediate corrections can be made and unnecessary expenditures avoided. The owner should provide timely review and approval of interim project submittals.

The final written evaluation should include the following questions at a minimum:

- Did the consultant complete the project on time and within budget?
- Were the consultant's services satisfactory?
- Did the consultant relate satisfactorily to the owner and contractors?
- Did the consultant coordinate the services of subconsultants and/or subcontractors satisfactorily?
- Did the project manager effectively manage the overall project, including the design, schedule, budget, and construction management, and provide deliverables that met the owner's expectations?
- Were the services accurate and complete?
- Was the consultant's staff competent and professional?
- Did the consultant properly represent the owner at public meetings and other dealings with the general public?
- Would the owner retain the consultant on a future project?

Two or three people from the owner's staff should independently complete the evaluation form. It should then be provided to the consultant, and a meeting should be scheduled to discuss the evaluation. The owner and consultant should be candid in discussing the evaluation and reach an understanding on the performance. The owner may request a similar evaluation of the owner's own performance. Both the owner and the consultant should sign the evaluations.

SUMMARY

The elements of the contract for engineering services must be carefully written and thoroughly reviewed by both parties prior to signature. A clear understanding of each party's duties and responsibilities will avoid problems during the development of project documents and help ensure a healthy consultant-owner relationship.

For additional information on this subject, refer to ASCE Manual 73, Chapter 7.[4]

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[4] ASCE Manuals and Reports of Engineering Practice No. 73. (2000). *Quality in the constructed project: A guide for owners, designers, and constructors*, 2nd Ed. ASCE, Reston, VA.

APPENDIX 1
EJCDC CONTRACT DOCUMENTS

The Engineers Joint Contract Documents Committee (EJCDC) develops and updates fair and objective standard documents that represent the latest and best thinking in contractual relations among all parties involved in engineering design and construction projects. EJCDC includes the American Society of Civil Engineers (ASCE), the American Council of Engineering Companies (ACEC), the National Society of Professional Engineers (NSPE) Professional Engineers in Private Practice Division, the Associated General Contractors of America (AGC), and the participation of more than 15 other professional engineering design, construction, owner, legal, and risk management organizations. Documents can be ordered from ASCE.

CONTRACT DOCUMENT CATEGORIES

- Construction
- Design/Build
- Environmental Remediation
- Contract Document Collections
- Joint Venture, Peer Review, and Other Agreements
- Owner and Engineer
- Engineer and Subconsultant
- Funding Agency Editions
- Procurement

BENEFITS OF USING EJCDC CONTRACT DOCUMENTS

Each EJCDC contract document is prepared by experienced engineering design and construction professionals, owners, contractors,

professional liability and risk management experts, and legal counsel. EJCDC contract documents contain many advantages:

- Creation and peer-review by experienced industry experts;
- User-friendliness and easy customization (provided in Microsoft Word);
- Balanced and fair provisions; and
- Reduction of conflicts and litigation.

APPENDIX 2

ENGINEER SELECTION PROCESS: TYPICAL FORMS

Statement of Qualifications Evaluation Form
Statement of Qualifications Evaluation Summary Form
Reference Check Form
Letter to Consultants Not Selected for an Interview
Letter to Short-Listed Consultants
Interview Process Score Sheet

STATEMENT OF QUALIFICATIONS EVALUATION FORM

Evaluator: _____.

Project Identification: _____.

Consultant: _____.

Address: _____.

City/State/ZIP: _____.

Telephone: Contact: _____.

	Rating (1–5)[a]		Weight (1–10)[b]		Total
1. Firm's history and resource capability to perform required services	_____	×	_____	=	_____
2. Related consultant experiences	_____	×	_____	=	_____
3. Experience of project manager	_____	×	_____	=	_____

4. Qualifications of assigned personnel	_____	×	_____	=	_____
5. Ability to meet schedule	_____	×	_____	=	_____
6. Ability to meet project budget	_____	×	_____	=	_____
7. Approach to quality assurance/control	_____	×	_____	=	_____
8. Reference check	_____	×	_____	=	_____
			Grand Total		_____

[a] Rate firms from 1 to 5, with 1 being least favorable and 5 most favorable.
[b] Weight factors from 1 to 10, with 1 being least important and 10 most important.

Note: Additional item(s) may be added to meet the specific project requirements.

STATEMENTS OF QUALIFICATIONS EVALUATION SUMMARY FORM

Client: _____

Project Identification: _____

Enter each reviewer's grand total for each firm from the Statement of Qualifications Evaluation Form.

Consultants

	1	2	3	4	5	6	7	8	9	
Reviewer 1										
Reviewer 2										
Reviewer 3										
Reviewer 4										
Reviewer 5										
Reviewer 6										
Grand Totals										

Select the three highest-rated firms for future consideration.

REFERENCE CHECK FORM

Client: _____

Project Identification: _____

Consultant: _____

Reference Information: _____

Client: _____

Address: _____

Referred Project: _____

Contact Person: _____

1. When was the project completed?
2. Did the consultant listed on this form do the work?
3. Describe the services provided by the consultant.
4. Who was the staff person assigned to work with you on this project, and how satisfied were you with this person?
5. Was the project started on schedule?
6. Was the project completed as planned?
7. Were the budget, cost control, and financial administration within the planned controls and limitations?
8. How well did you (the client) and the consultant work as a team?
9. How well did the consultant work with other committees and public agencies?
10. How would you rate the consultant's performance on a scale of 1 to 5, with 1 being the least favorable and 5 being the most favorable?

LETTER TO CONSULTANTS NOT SELECTED FOR AN INTERVIEW

Re: Request for Statement of Qualifications
(*Project Identification*)

Dear:

The committee would like to express its appreciation to your firm for submitting your statement of qualifications for providing professional services for the proposed project.

After careful consideration of all firms submitting qualifications, the committee has made a decision to interview three firms.

For your information, the firms selected for further consideration are:

1.

2.

3.

We hope that your firm will continue to participate in our selection process for future projects.

Sincerely yours,

(The Committee Chairman)

LETTER TO SHORT-LISTED CONSULTANTS

Re: (*Project Identification*)

Dear:

The selection committee has selected your firm for further consideration to provide professional services for the referenced project. An interview with your firm will be held (*day, date, time*) at (*location*).

To assist you in preparing your presentation, the following items are attached:

- Copies of material relevant to the project;
- Copy of the interview score sheet that will be used by the selection committee; and
- (*Other items*)

You will be allowed 30 minutes for your presentation and 30 minutes to answer questions posed by the committee. Your project manager should be present at the interview and play a significant role in your presentation.

Following completion of the interview with the other short-listed firms, the committee will rank the firms in accordance with the attached score sheet. The highest ranked firm will then be requested to submit a cost proposal for the required services and to negotiate a contract. If contract terms cannot be reached, the second-highest ranked firm will be contacted.

For your information, the other short-listed firms are:

1.

2.

3.

The selection committee looks forward to hearing your presentation and appreciates your interest in providing professional services to our agency.

Sincerely,

(Selection Committee Chair)

INTERVIEW PROCESS SCORE SHEET

TEAM or INDIVIDUAL (Circle One) Evaluator: _____.

Project Identification: _____.

Consultant: _____.

Categories	Rating (1–5)[a]		Weight (1–10)[b]		Total
1. Related project experience	_____	×	_____	=	_____
2. Firm's ability and capacity to perform the work	_____	×	_____	=	_____
3. Key personnel assigned to the project	_____	×	_____	=	_____
4. Consultant approach to satisfy project requirements	_____	×	_____	=	_____
5. Project manager experience	_____	×	_____	=	_____
6. Management approach for cost control	_____	×	_____	=	_____
7. Proposed schedule	_____	×	_____	=	_____
8. Quality control program	_____	×	_____	=	_____
9. Outside consultants needed	_____	×	_____	=	_____
			Grand Total		_____

[a] Rate firms from 1 to 5, with 1 being least favorable and 5 most favorable.
[b] Weight factors from 1 to 10, with 1 being least important and 10 most important.

Note: Additional item(s) may be added to meet the specific project requirements.

APPENDIX 3
FREQUENTLY ASKED QUESTIONS

WHY DOES THE LATEST EDITION OF MANUAL 45 OMIT FEE CURVES?

Previous editions of Manual 45 included fee curves showing the fee received as a percentage of the construction cost. These curves were developed from historical data provided by survey respondents for the purpose of approximating fees during early project planning. However, the scope of work, complexity of assignments, and required agency submittals can vary radically from project to project, causing fees to vary significantly from the curves. Unfortunately, too often owners have not fully appreciated these limitations and used the curves to artificially constrain fees.

WHAT IS AN APPROPRIATE PROFIT RANGE?

Profit should, at a minimum, include a definable margin for the consultant's contingencies, readiness to serve, knowledge, expertise, and acceptance of risk. Although there is no established profit range, Chapter 4 of this edition of Manual 45 includes an example that sets the profit at 15%, expressed as a percentage of salary cost, payroll burden, and overhead. Some governmental agency owners may set limits on profit.

ALTHOUGH A FIRM'S QUALIFICATIONS ARE IMPORTANT IN THE SELECTION PROCESS, PROJECT OWNERS—FACING TIGHT BUDGET SITUATIONS—MAY CHOOSE TO SET A LIMIT ON THE SALARY MULTIPLIER AS A SELECTION FACTOR. WHAT OPTIONS MIGHT CONSULTING FIRMS CONSIDER IN ARRIVING AT A REALISTIC MULTIPLIER WHILE REMAINING COMPETITIVE IN THE QUALIFICATION AND SELECTION PROCESS?

This is the key question for many consultants. The multiplier must be set high enough to recover the consultant's costs or the firm will not be able to remain in business in the long term. The authors of Manual 45 believe the multiplier should be driven by the consultant's, not the project owner's, needs. The makeup of the multiplier should be transparent to the owner. Presenting excellent qualifications, a record of accomplishment, attention to customer service, ethical behavior, and professionalism should allow a consultant to remain competitive and maintain a reasonable multiplier.

WHAT RECOURSE DO I HAVE WHEN A CONSULTANT CHANGES KEY PERSONNEL?

Agreement during the negotiation process prior to initiating the design process should help ensure the owner's desires in terms of personnel assigned throughout the project. The owner should have the right to a reasonable explanation from the consultant, if requested, on why the key personnel were changed and should be allowed some input into which new key personnel will be assigned. The consultant will make every effort to uphold this agreement; however, it cannot be guaranteed that key personnel will not change, given the movement of personnel in the workplace, retirements, and other unforeseen circumstances. Provisions in the contract should address this possibility, such as by requiring that the owner have the right to review the qualifications of the person proposed to assume the role of a key team member and approve the selection. The contract agreement should include a definition of what the key personnel positions are and a list of the personnel assigned to those positions on the project.

WON'T REQUESTING BIDS FROM CONSULTANTS RESULT IN THE LOWEST FEE?

Requesting bids from consultants, while highly discouraged, will produce a range of fees. However, there are many reasons why bidding for consulting services often produces unsatisfactory results: (1) bidding

does not recognize professional judgment, which is the key difference between furnishing professional services and furnishing products; (2) it is virtually impossible to completely detail the scope of services required for an engineering project in advance without lengthy discussions and negotiations with the selected consultant. In an attempt to stay competitive while lacking specifics, the bidding firms must submit a price for the least effort envisioned. The resulting service performed will not necessarily suit the owner's needs or expectations; (3) in-depth studies and analyses by the consultant are not likely to be performed; and (4) the engineering designs are likely to be minimal in completeness, with the details left to the contractor.

When all these reasons are taken into consideration, it becomes clearer why attempts to minimize engineering fees through bidding is truly "penny wise but pound foolish." Engineering costs typically comprise less than 2% of the construction and life-cycle operating and maintenance costs of a project. Investing in the appropriate engineering up front has a major impact on minimizing these latter costs. Therefore, the incremental increase in fees to allow a thorough, high-quality design, as compared to a low bid, can pay for itself hundreds of times over.

ASCE supports qualifications-based selection (QBS) of professional engineers. Selection of professional engineers should result from competition based on the qualifications best suited to complete the project successfully in terms of performance, quality, and cost-effectiveness. Costs of these services, while important and meriting careful negotiations, are a minor portion of overall project costs and should be subordinate to professional qualifications and experience.

WHAT ARE THE KEY FACTORS IN SELECTING A CONSULTANT?

The following factors are important considerations in the selection process:

- The professional and ethical reputation of the consulting firm;
- Responsible employees licensed as professional engineers in the states in which they practice;
- Demonstrated qualifications and expertise in performing the services required for the project;
- Qualified staff available to provide the required services within the allotted time;
- Necessary financial resources to accomplish the assignment; and
- Having current technology, including computer software and hardware.

WHY MIGHT CONSULTANT FEES ESCALATE AS DESIGN PROGRESSES?

Most often, increases in the consultant's fees during the design effort are due to changes in the scope of services. Sometimes the owner realizes a need to expand the project and the associated design effort. Sometimes the consultant's studies show the possibility of reducing the project's life-cycle costs by performing more detailed engineering analysis. In both examples the investment in additional engineering helps the owner better achieve the goals and objectives for the project. However, sometimes engineering services increase when the scope of services lacks sufficient detail and/or is based on incomplete information. The unwanted escalation in costs due to this type of "scope creep" can largely be avoided by following the process described in this manual for selecting and retaining the consultant.

MAY I ASK ANOTHER CONSULTANT TO REVIEW PLANS DEVELOPED BY A DIFFERENT CONSULTANT—IN OTHER WORDS, GET A SECOND OPINION?

Peer reviews, plan reviews, and constructability reviews are among the ways that some owners obtain independent feedback on design concepts and documents that have been prepared for their projects. The Engineers Joint Contract Documents Committee (EJCDC, described in Appendix 1) offers a contract form to be used in contracting for project peer review services called Standard Form of Agreement Between Owner, Designer, and Peer Reviewers for Professional Services for Independent Project Peer Review. Key to ensuring that the second opinion is obtained and provided in an ethical and legal manner is consideration of the following:

1. *No Conflict of Interest.* The reviewing consultant or firm must not have any financial interest in the outcome of the review, nor any personal relationships that could influence or compromise the review process.
2. *Disclosure and Communication.* The consultant whose work is being reviewed should be informed of such, and in fact should be communicated with during the review to provide clarification and additional information about the design and analysis constraints, assumptions, considerations, and other aspects of the work that may not be reflected in the review documents. The consultant whose work is being reviewed should be compensated for the time required to coordinate and communicate with the reviewing consultant and any other costs associated with the review.

3. *Qualified Reviewer.* The consultant performing the review should be (and may be required by law to be) licensed in the state where the project is located and be competent in the areas of expertise required to perform the review.
4. *Canons and Codes of Professional Societies.* The peer reviewer should abide by the appropriate canons of the professional societies serving the discipline that concerns the work being reviewed. Most engineering societies have codes of ethics or rules of practice that include provisions concerning competency, objectivity, and conflicts of interest. Some, such as the National Society of Professional Engineers, specifically address reviewing the work of another engineer.

HOW DO I KNOW THE CONSULTANT I HIRE IS COMPETENT TO PERFORM MY JOB?

The engineer on the consultant's staff who is in responsible charge of the design effort on your project must be a licensed professional engineer in the state where the project resides. To become licensed, the engineer generally must have demonstrated competence through education, multiple years of on-the-job qualifying experience, and passage of an examination. Additionally, during the request for proposal (RFP) process the résumés of key personnel should be provided. A final step for the owner is to check references on the firm and personnel proposed.

WHAT IS A SUBCONSULTANT?

A subconsultant is a person (or organization) who has a direct contract with the design professional. Generally the subconsultant is a consulting firm hired by the prime consultant to perform a specialized task, such as foundation engineering, structural engineering, and so forth, required for completion of a project.

CAN'T ENGINEERING SERVICES BE PURCHASED LIKE ANY OTHER COMMODITY?

No. Engineering provides a professional service rather than a product. In fact, the services of the engineer are generally required to properly define the scope of services that will satisfy owners' goals and visions for their projects. Just as a physician must first diagnose a patient's illness before a range of treatments can be proposed, so must the consultant translate an owner's goals, vision, and expectations for a project into actions that must occur to complete that project.

HAVEN'T COMPUTERS REPLACED ENGINEERS FOR THE MOST PART?

Computers have taken over some of the more tedious computational tasks involved in the design of a project. They have not replaced engineers but, rather, have allowed the engineers to focus their energy on the parts of the process involving judgment, experience, conceptualization, and communication. Even with assistance of computer programs, the engineer must determine whether the assumptions embodied in the program are consistent with the project being designed and must input the correct data to produce the correct solution. While computers today can perform many discrete computational tasks, they cannot synthesize the owner's goals into a successful project, envision environmental and political consequences, judge appropriate levels of risk, describe a project's impacts to a planning commission, assess constructability of designs, or perform the majority of the effort involved in a successful project.

WHO OWNS THE DOCUMENTS?

Either the owner or the designer could own the documents, depending on the terms of the contract agreement. See more discussion of this in Chapter 6.

IS IT LEGAL TO ASK FOR A "DEPOSIT" OR PRELIMINARY PAYMENT FOR ENGINEERING DESIGN SERVICES?

It is not illegal to ask for a deposit; however, it is customary to bill for services after they are rendered, as is the case with most other professionals.

HOW SHOULD A SELECTION COMMITTEE CONDUCT THE ACTUAL EVALUATION AND RATING PROCESS?

In order to get the most open and honest impressions and ratings from each person on the selection committee, each member should evaluate the proposals independently based on the scoring system being used. Each member then brings his or her ratings to the full committee, presents them, and then participates in a group discussion to arrive at a consensus rating and/or score. The achievement of consensus through group dialog is very important. The committee should avoid simply averaging scores of the committee members because no two people will employ a numerical rating system in exactly the same way. Furthermore, effective selection committees allow for free and open commentary from everyone, without regard to position in the owner's organization, so that all viewpoints can be heard and fairly considered.

GLOSSARY

A

Addenda—Written or graphic instruments issued prior to the opening of bids that clarify, correct, or change the bidding requirements or the contract documents. These are not the same as modifications to an existing agreed-upon contract.

Additional Services—Tasks to be performed for or furnished to the owner by the engineer beyond the basic contract.

Agreement—Mutual understanding between two or more competent parties creating an obligation between those who enter into engagement with each other by a promise on either side.

Alternative Dispute Resolution (ADR)—The practice of involving nonbiased professionals using their technical expertise to resolve disagreements without formal and more costly litigation through the courts. ADR procedures currently in use include both binding and nonbinding methods, such as mediation, arbitration, private judging, and dispute review boards.

Appraisal—Valuation of property by the estimate of an authorized person.

Arbitration—The hearing and determination of a case in controversy by a person chosen by the parties involved or appointed under statutory authority.

B

Bid—A complete and properly signed proposal to perform construction required by contract documents, or a designated portion of the documents, for an amount or amounts stipulated in the documents. A bid is submitted in accordance with **Bidding Documents**.

Bidding Documents—Advertisement or invitation to bid, instructions to bidders, the bid form, and the proposed contract (including all addenda issued prior to the receipt of bids).

Building Information Modeling (BIM)—The process of generating a comprehensive repository for all building component data (geometry, spatial relationships, properties, quantities, and geographical information) to increase productivity in the design and construction process. The repository is normally represented by a three-dimensional model of the building, and the data are accessed by their geospatial position in the model, making spatial compatibility and conflicts more readily apparent.

C

Change Order—A written document for the constructor, signed by the owner and/or the owner's agent or representative, issued after execution of a contract authorizing a change in the work, an adjustment in the contract sum, or the contract time.

Civil Engineering (CE) Professional—A person who holds an engineering license acquired through the completion of requisite formal civil engineering education, civil engineering experiences, examinations, and other requirements as specified by an appropriate Board of Licensure. A person working as a CE professional is qualified to be professionally responsible for civil engineering work through the exercise of direct control and personal supervision of civil engineering activities and can comprehend and apply an advanced knowledge of widely applied engineering principles to the solution of complex problems.

Client—The person or organization by whom a consultant, engineer, and/or architect is employed, to whom they are responsible, and from whom they draw fees.

Codes—Regulations, ordinances, or statutory requirements of, or meant for adoption by, governmental units relating to construction and occupancy, adopted and administered for the protection of the public health, safety, and welfare.

Code of Ethics—Official statements prepared by organizations representing members of a profession that establish fundamental principles, canons, and guidelines of practice for the members of that profession.

Compensation—Payment for services, particularly wages, or remuneration, such as contract-stipulated fees.

Construction Contingency—Percentage added to the contractor's bid amount to ensure that there is budget available for minor overruns that may be encountered during construction. This contingency is based on

the size, risk, and complexity of the project. A minimum suggested contingency is 10%.

Construction Cost—The total monetary outlay to the client for the execution of the work authorized and handled in each separate phase of engineering services, excluding fees or other expenses for engineering and legal services, the price of land and rights-of-way, and legal and administrative expenses, but including the direct expenses to the client of all final construction contracts, and including all items of construction (including labor, materials, and equipment) required for the completed work (including extras).

Construction Manager—The prime professional on the job site; may be either the constructor or a member of the constructor's staff.

Consultant—A person (or entity) who provides specialized advice or services to an owner, design professional, or constructor.

Consulting Engineer—A licensed civil or structural engineer (or engineering firm) who is engaged by an architect or client or another engineer for the purpose of designing a project or part of a project. The consulting engineer advises the client on initial design options. Once the preferred design scheme is chosen, the consulting engineer ceases to advise and begins to develop the design, expanding it in detail after the client's approval.

Contingency Allowance—Percentage added to the basic **Opinion of Probable Cost** to allow for costs that cannot be predicted with certainty.

Contingency Basis—A means of providing professional services at reduced cost in expectation of favorable consideration for future projects.

Contract Documents—The owner/constructor agreement, the conditions of the contract (general, supplementary, and others), drawings, specifications, and all addenda issued prior to and all modifications issued after the execution of the contract, and any other items that may be specifically stipulated as being included.

Contractor—The person (or entity) with whom an owner enters into a written agreement covering construction work to be performed or furnished with respect to the project.

Cost Plus, Fixed Fee (CPFF)—A payment agreement in which the consulting engineer is reimbursed for the actual costs of all services and supplies related to the project, plus an agreed-upon fixed-fee amount.

D

Deliverable—A term used in project management to describe a tangible object or intangible action produced as a result of the project that is intended to be delivered to a customer (either internal or external). This

could be a report, document, server upgrade, or any element of an overall project.

Design-Bid-Build (DBB)—A construction project delivery method in which the client contracts separately for the design of a project and the construction of the project.

Design-Build (DB)—A construction contract delivery method in which the client has a design prepared to a concept stage and then allows a contractor to bid for the work at that stage. The contractor with a design partner will complete the design and construct the project. This delivery method does not necessarily save money but can save time if the client is willing to give up some control of the process. Under this approach the contractor also is given some flexibility over the details.

Design-Build-Operate-Maintain (DBOM)—Similar to **Design-Build (DB)** except that in addition to designing and constructing, the contractor team operates and maintains the project for an agreed-upon period of time. Examples include toll roads, transit projects, water/wastewater systems, and similar project types where the contractor collects the revenues to pay for part or all of the construction and operation costs and then turns the completed project over to the client in the future, for example, after 35 years.

Design Competition—The process through which a consultant is selected above competitors based on his or her proposal of an innovative approach to solving a client's needs.

Design Contingency—A percentage added to the base cost of design to allow for costs that cannot be predicted with certainty, such as additional testing, evaluation of actual conditions, change in scope, and/or response to updated information. This contingency is reduced as work progresses to final design. A minimum suggested contingency is 25%.

Direct Costs—The consultant's monetary outlay, excluding salaries and benefits, that can be attributed to a specific project, for example, travel and subconsultant expenses.

Direct Nonsalary Expenses—Living and traveling costs of principals and employees when away from the home office on business connected with the project; identifiable communications expenses, such as long-distance telephone, messaging, shipping and special postage charges other than for general correspondence; expenses for services and equipment directly applicable to the work; expenses for unusual insurance; and project-specific professional liability insurance.

Direct Salary Costs—Earnings plus fringe benefits for partners; principals; and all technical, professional, administrative, and clerical staff chargeable to the project. Fringe benefits include but may not be limited to sick leave, vacation, holiday and incentive pay, unemployment and other payroll taxes, social security, and workers' compensation, as well as retirement, medical, and other group benefits.

E

End User—The person or persons who will be operating, maintaining, and/or utilizing a facility after it is turned over to the owner.

Engineer of Record—The prime professional engineer or organization legally responsible for the engineering design.

Expert Witness—A nonbiased professional who provides testimony based on his or her technical expertise.

F

False-Work—Temporary framework used to support a building or structure during its construction.

Feasibility Study—(1) Study of the applicability or desirability of a project or design alternatives from the standpoint of advantages versus disadvantages; (2) study to determine the time at which it would be advantageous and practicable or desirable to undertake such a project; or (3) study to determine whether a plan is capable of being accomplished successfully.

Firm—A business unit or enterprise.

Force Account Construction—Force account is the payment method used for extra work if the contractor and the owner cannot agree on a unit price or lump-sum amount, or if those methods are impracticable. Force account payments cover labor, materials, and equipment. They may also cover other miscellaneous expenses.

H

Hourly Billing Rate—A method of payment in which all direct salary costs, overhead, and profit are charged to the client at a predetermined cost per hour.

I

Instructions to Bidders—Directions contained in the bidding documents for preparing and submitting bids for a construction project or designated portion of a project.

Instruments of Service—Design drawings and specifications produced by the consulting engineer for a project.

L

Life-Cycle Cost—The total expense incurred for developing, owning, operating, and maintaining a constructed project for its economic life, including its fuel and energy costs.

Lump Sum—A single-price bid determined and submitted by the engineer for a completed project, which includes costs for materials and work hours. The amount can be calculated as the sum total of estimated engineering costs for direct salary costs, direct nonsalary expenses, overhead, interest on invested capital, and a reasonable amount for profit. This method of compensation for basic services on certain design-type projects can also be computed as an appropriate percentage of estimated construction costs.

M

Mediation—A third-party intervention between conflicting parties to promote reconciliation, settlement, or compromise.

Multiplier (Direct Labor Multiplier)—A factor applied to the salary cost to compensate the consulting engineer for overhead expenses, interest on invested capital, and profit.

N

Negotiation—The action or process of conferring with another party so as to arrive at the settlement of some matter.

Not-to-Exceed Amount—A dollar amount agreed to by the owner and the consultant, which the engineering costs for a project cannot exceed without the owner's approval. Most often the not-to-exceed amount is used in conjunction with fee agreements based on hourly billing rate charges.

O

Open-End Contract—An agreement or contract to provide services where the quantity or contracted cost of the services is not specified and the buyer can procure any amount of services during the life of the contract. Typically, open-end contracts include a negotiated fee or hourly rate schedule for services and may have a specified upper limit on the total amount of services that can be procured through the contract. Services are typically implemented through individual task orders where the scope of services for a specific need is defined, and the purchase cost of the services is negotiated based on the required level of effort and the scheduled rates defined in the contract.

Opinion of Probable Construction Cost—The consulting engineers informal estimate (opinion) of the likely expense of construction of a specific proposed project.

Overhead—Business expenses (such as rent, heat, and insurance) not chargeable to a particular part of the work or project.

Owner—The individual (or group) who initiates a construction project and is responsible for financing the project.

P

Partnering—A working relationship among the stakeholders in a project (the owner, designer, and contractor) in which they recognize and acknowledge their common goals and potential risks.

Payroll Burden—All costs associated with employee benefits, typically expressed as a percentage of salary cost.

Peer Review—A structured, independent examination of an organization or project by a team of experts who are completely external to the subject under review and who have at least the same level of expertise and experience as those responsible for the project or practice.

Per Diem—The daily allowance or fee, normally based on an 8-hour day.

Prime Consultant (Prime Professional, Prime Engineer)—The design professional who has the overall responsibility for planning and designing a project.

Profit—The return received by the consultant on a project after all operating expenses have been met and includes a definable margin for contingencies, readiness to serve, knowledge, expertise, and acceptance of risk.

Program Management—The process of oversight and coordination of several related projects, often with the intention of improving an organization's performance. In practice and in its aims, it is often closely related to systems engineering.

Project Management—The contract delivery method typically used on large, complex projects in which a consultant is hired to coordinate all the activities necessary to complete a project. This could include bidding out the construction to a number of contractors and consultants and coordinating their results to provide the client with a completed package.

Q

Qualifications-Based Selection (QBS)—The method of choosing a design professional based on criteria of skills, experience, and expertise rather than cost.

R

Reimbursables—Expenses incurred directly in connection with the performance or furnishing of basic and additional services for the project for which the owner shall pay the engineer.

Rent-a-Judge—Method of dispute resolution contemplated by specific state statutes permitting the trial of certain types of civil cases by an individual whose decision carries the weight of a trial court decision and is appealable, as a trial court decision would be. Also referred to as "private judging."

Request for Proposal (RFP)— A petition to seek consultants for creating a "short list" of qualified consulting engineers for the purpose of selecting one for a specific project.

Request for Qualifications (RFQ)—A petition to determine the eligibility of a selected design professional in a specific area of expertise.

Retainage—The sum withheld from progress payments to the design professional or constructor according to the terms of owner/designer or owner/constructor agreements, until completion of the project.

Risk Management—The identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unforeseen events or to maximize the realization of opportunities.

S

Salary Cost—The direct monetary payout for personnel, excluding benefits.

Scope Creep—When the project changes repeatedly due to insufficiencies of the initial project goals (scope). It generally results in negative consequences in terms of delays, cost increases, frustration of project team members, and change orders.

Scope of Services—Definition of the project requirements.

Specifications—Those portions of the contract documents consisting of written technical descriptions of materials, equipment, construction systems, standards, and workmanship as applied to the work, as well as all applicable administrative details.

Standard of Care—Performance of services in a manner consistent with the level of skill ordinarily exercised by members of the engineering profession practicing under similar circumstances in the project's locale.

Start-Up—Preparing the project or facility for occupancy or use and testing the systems in that facility for operation.

Statement of Qualifications (SOQ)—The form or brochure that contains the credentials of a design professional.

Stipend—A fixed sum of money paid for services.

Subconsultant—The person (or organization) who has a direct contract with the design professional instead of the project owner.

Subcontractor—The person (or organization) who has a direct contract with the constructor instead of the project owner.

Supplier—A manufacturer, fabricator, distributor, material supplier, or vendor having a direct contract with the contractor or any subcontractor to furnish materials and/or equipment to be incorporated in the work by contractor or subcontractor.

Sustainable Development—A set of environmental, economic, and social conditions under which all of society has the capacity and opportunity to maintain and improve its quality of life indefinitely without degrading the quantity, quality, or availability of natural, economic, and social resources.

T

Turnkey—See **Design-Build**.

Two-Envelope System—The method of selecting a design professional in which the technical proposal is submitted in one envelope and the price proposal in a second envelope.

V

Value Engineering—An organized approach that efficiently identifies costs that do not contribute measurably to a project's quality, utility, durability, or appearance, or to the owner's requirements.

Value Pricing—A method of establishing a consultant's reimbursement based on the relative value of the product provided rather than the consultant's cost to provide the product. Quite often, value pricing reflects a premium rate based on the consultant's unique qualifications or extenuating circumstances.

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