

How to Select and Work Effectively with Consulting Engineers

>> GETTING THE BEST PROJECT



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

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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

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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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CONTENTS

FOREWORD	ix
1 THE PRACTICE OF ENGINEERING	1
2 CLASSIFICATION OF ENGINEERING SERVICES	9
3 SELECTING THE ENGINEER	19
4 METHODS OF CHARGING FOR CONSULTING SERVICES.....	35
5 TOTAL PROJECT COST	47
6 CONTRACTS FOR ENGINEERING SERVICES	57
APPENDIX 1 EJCDC CONTRACT DOCUMENTS	67
APPENDIX 2 ENGINEER SELECTION PROCESS: TYPICAL FORMS.....	69
APPENDIX 3 FREQUENTLY ASKED QUESTIONS	75
GLOSSARY	81
INDEX	91

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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.

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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

¹ASCE. (2010). *Report card for America's infrastructure*, <<http://www.infrastructurereportcard.org/>> (Sept. 21, 2011).

²ASCE. (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 Ethics⁴ 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

⁴ASCE. (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

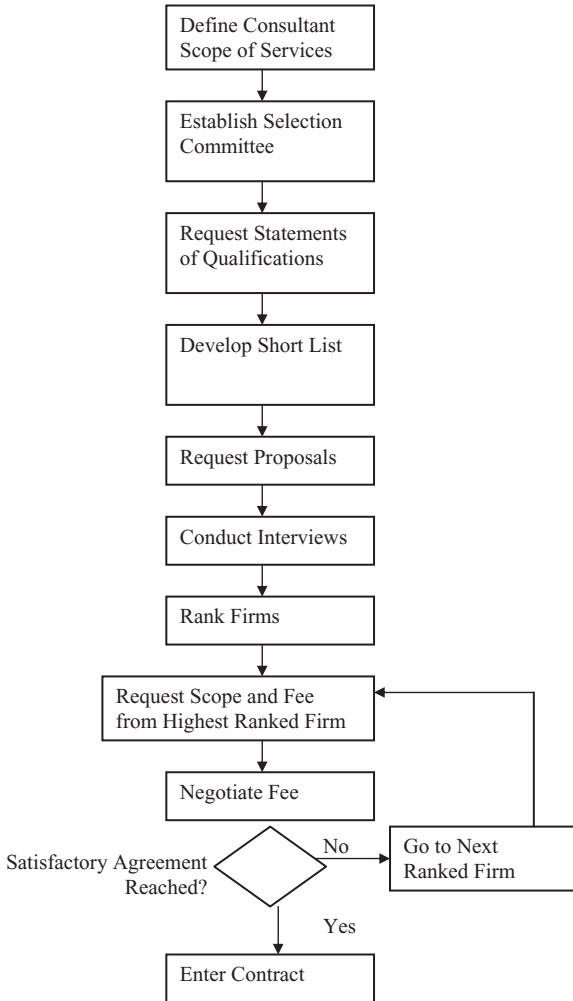


Fig. 3-1. Qualifications-based selection process

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.