GAROLD D. OBERLENDER

PROJECT MANAGEMENT FOR ENGINEERING AND CONSTRUCTION

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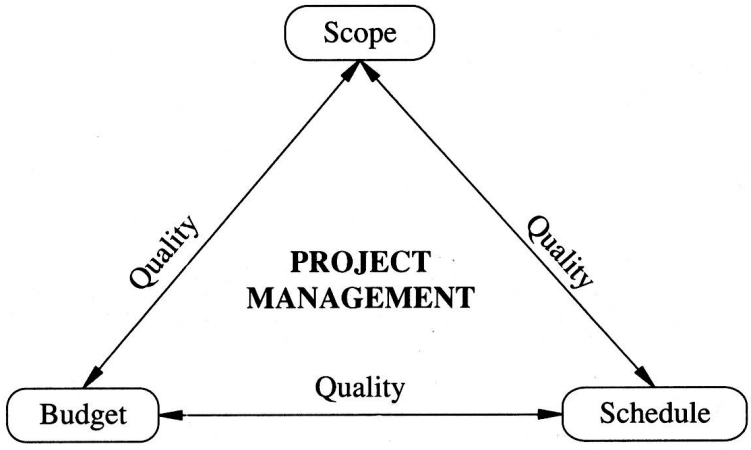
PROJECT MANAGEMENT FOR ENGINEERING AND CONSTRUCTION

Garold D. Oberlender, Ph.D., P.E.
Professor of Civil Engineering
Oklahoma State University



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ABOUT THE AUTHOR

Garold D. Oberlender is professor and coordinator of the graduate program in Construction Engineering and Management in the School of Civil Engineering at Oklahoma State University. He received his Ph.D. in civil engineering from the University of Texas at Arlington. Dr. Oberlender has conducted research and presented seminars on a variety of topics related to construction engineering and project management. A civil engineer with more than twenty-five years of experience, Dr. Oberlender has been a consultant to numerous companies in the application of computers in the design and construction of projects. He is coauthor with Robert L. Peurifoy of *Estimating Construction Costs, 4/e*. Dr. Oberlender is a registered professional engineer and a member of the American Society of Civil Engineers, the National Society of Professional Engineers, the American Society for Engineering Education, and the Project Management Institute.

PREFACE

This book presents the principles and techniques of managing engineering and construction projects from the original plan, through design and construction, to completion. It emphasizes project management during the early stages of project development because the ability to influence the quality, cost, and schedule of a project can best be achieved during the early stages of development. Most books discuss project management during construction, after the scope of work is fully defined, the budget is fixed, and the completion date is firm. It is then too late to make any significant adjustments to the project to improve quality, cost, or schedule to benefit the owner.

Although each project is unique, there is certain information that must be identified and organized at the beginning of a project, before any work is started. Numerous tables and graphs are presented and discussed throughout this book to provide guidelines for management of the three basic components of a project: scope, budget, and schedule. The importance of achieving project quality to meet the owner's satisfaction is an integral part of project management. An entire chapter is devoted to the topic of total quality management.

The intended audience of this book is students of university programs in engineering and construction. It is also intended for persons in industry who aid the owner in the feasibility study, coordinate the design effort, and witness construction in the field. A common example is used throughout this book to illustrate project management of the design and construction process.

This book is based on the author's experience in working with hundreds of project managers in the engineering and construction industry. Much of the information in this book is based on formal and informal discussions with these project managers, who are actively involved in the practice of project management. Although the author has observed that no two project managers operate exactly the same, there are common elements that apply to all projects and all project managers. The author presents these common elements of effective project management that have been successfully applied in practice.

The author has referenced numerous publications related to project management. At the end of each chapter there is a list of references related to the subjects that

are discussed. The author would like to thank the Construction Industry Institute for permission to use the contents of its publications and research findings related to project management, and The Construction Specification Institute for its permission to reproduce the titles and numbers of CSI Masterformat, which has become the industry standard for classification of information related to engineering and construction.

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The author would like to thank the many project managers in industry who have shared their successes, and problems, and who have influenced the author's thoughts in the development of this book. Finally, the author greatly appreciates the patience and tolerance of his wife, Jana, and three sons, Dan, Tim, and Ron, for their support during the writing and editing phases in producing this finished book.

Garold D. Oberlender

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CHAPTER 1

INTRODUCTION

PURPOSE OF THIS BOOK

The purpose of this book is to present the principles and techniques of project management beginning with the conceptual phase by the owner, through coordination of design and construction, to project completion.

Experienced project managers agree that the procedures used for project management vary from company to company and even among individuals within a company. Although each manager develops his or her own style of management, and each project is unique, there are basic principles that apply to all project managers and projects. This book presents these principles and illustrates the basic steps, and sequencing of steps, to develop a work plan to manage a project through each phase from conceptual development to completion.

Project management requires teamwork among the three principal contracting parties: the owner, designer, and contractor. The coordination of the design and construction of a project requires planning and organizing a team of people who are dedicated to a common goal of completing the project for the owner. Even a small project involves a large number of people who work for different organizations. The key to a successful project is the selection and coordination of people who have the ability to detect and solve problems to complete the project.

Throughout this book the importance of management skills is emphasized to enable the user to develop his or her own style of project management. The focus is to apply project management at the beginning of the project, when it is first approved. Too often the formal organization to manage a project is not developed until the beginning of the construction phase. This book presents the information that must be assembled

and managed during the development and engineering design phase to bring a project to successful completion for use by the owner.

The intended audience of this book is students enrolled in university programs in engineering and construction. It is also intended for the design firms which aid the owner in the feasibility study, coordinate the design effort, and witness construction in the field. This book is also for persons in the owner's organization who are involved in the design and construction process.

ARRANGEMENT OF THIS BOOK

A discussion of project management is difficult because there are many ways a project can be handled. The design and/or construction of a project can be performed by one or more parties. Regardless of the method that is used to handle a project, the management of a project generally follows these steps:

Step 1: Project Definition (to meet the needs of the end user)
Intended use by the owner after completion of construction
Conceptual configurations and components to meet the intended use

Step 2: Project Scope (to meet the project definition)
Define the work that must be accomplished
Identify the quantity, quality, and tasks that must be performed

Step 3: Project Budgeting (to match the project definition and scope)
Define the owner's permissible budget
Determine direct and indirect costs plus contingencies

Step 4: Project Planning (the strategy to accomplish the work)
Select and assign project staffing
Identify the tasks required to accomplish the work

Step 5: Project Scheduling (the product of scope, budgeting, and planning)
Arrange and schedule activities in a logical sequence
Link the costs and resources to the scheduled activities

Step 6: Project Tracking (to ensure the project is progressing as planned)
Measure work, time, and costs that are expended
Compare "actual" to "planned" work, time, and cost

Step 7: Project Close-Out (final completion to ensure owner satisfaction)
Final testing, inspection, and payment
Turn over of the project to the owner

These steps describe project management in its simplest form. In reality, there is considerable overlap between the steps, because any one step may affect one or more other steps. For example, budget preparation overlaps project definition and scope development. Similarly, project scheduling relates project scope and budget to project tracking and control.

The topic of project management is further complicated because the responsibility for these steps usually involves many parties. Thus, the above steps must all be integrated together to successfully manage a project. Subsequent chapters of this book describe each of these steps.

Chapter 1 defines general principles related to project management. These basic principles must be fully understood because they apply to all of the remaining chapters. Many of the problems associated with project management are caused by the failure to apply the basic management principles that are presented in Chapter 1.

Chapter 2, Project Initiation, presents material that is generally performed by the owner. However, the owner may contract the services of a design organization to assist with the feasibility study of a project. The project manager should be involved at the project development or marketing phase to establish the scope. This requires input from experienced technical people that represent every aspect of the proposed project.

Chapter 3, Project Budgeting, applies to all parties in a project: the owner, designer, and contractor. The budget must be linked to the quantity, quality, and schedule of work to be accomplished. A change in scope or schedule almost always affects budget, so the project manager must continually be alert to changes in a project and to relate any changes to the budget.

Chapter 4, Development of the Work Plan, applies to the project manager who is responsible for the management of the design effort. Generally, he or she is employed by the professional design organization which may be an agency of the owner or under contract by the owner to perform design services. The material presented in this chapter is important because it establishes the work plan which is the framework for guiding the entire project effort. The information in this chapter relates to all of the steps and to all of the chapters of this book.

Chapter 5, Project Scheduling, provides the base against which all activity is measured. It relates the work to be accomplished to the people who will perform the work as well as to the budget and schedule. Project scheduling can not be accomplished without a well-defined work plan that is described in Chapter 4, and it forms the basis for Project Tracking described in Chapter 6.

Chapter 6, Project Tracking, can not be accomplished without a well-defined work plan as described in Chapter 4, and a detailed schedule as described in Chapter 5. This chapter is important because there is always a tendency for scope growth, cost overrun, or schedule delays. A control system must simultaneously monitor the three basic components of a project: the work accomplished, the budget, and the schedule. These components must be collectively monitored, not as individual components, because a change in any one component usually will affect the other two components.

Chapter 7, Design Coordination, applies to the project manager of the design organization. The quality, cost, and schedule of a project is highly dependent on the effectiveness of the design effort. The end result of the design process is to produce plans and specifications in a timely manner that meet the intended use of the project by the owner. The product of the design must be within the owner's approved budget and schedule, and must be constructable by the construction contractor.

Chapter 8, Construction Phase, is important because most of the cost of a project is expended in the construction phase, and the quality of the final project is highly dependent upon the quality of work that is performed by the construction contractor. Most of the books that have been written on project management have been directed toward a project in the construction phase. This book emphasizes project management

from the initial conception of the project by the owner, through coordination of design and development of the construction documents, and into the construction phase until project close out.

Chapter 9, Project Close Out, discusses the steps required to complete a project and turn it over to the owner. This is an important phase of a project because the owner will have expended most of the budget for the project, but will not receive any benefits from the expenditures until it is completed and ready for use. Also it is sometimes difficult to close a project because there are always many small items that must be finished.

Chapter 10, Tips for Making Things Happen, addresses the human aspects of project management. Although the primary emphasis of this book is on the techniques of project management; it is people who ensure the successful completion of a project.

Chapter 11, Total Quality Management, presents the management philosophy that has gained much attention in the engineering and construction industry in recent years. Most of the attention has been attributed to the success of TQM in the manufacturing and electronics industries. However, many of the topics related to TQM are applicable to good project management of design and construction.

DEFINITION OF A PROJECT

A project consists of three components: scope, budget, and schedule. When a project is first assigned to a project manager, it is important that all three of these components be clearly defined. Throughout this book, the term *Scope* represents the work to be accomplished, i.e., the quantity and quality of work. *Budget* refers to costs, measured in dollars and/or labor-hours of work. *Schedule* refers to the logical sequencing and timing of the work to be performed. The quality of a project must meet the owner's satisfaction and is an integral part of project management as illustrated in Figure 1-1.

The source of many problems associated with a project is failure to properly define the project scope. Too often the focus is just on budget or schedule. Not only should the scope, budget, and schedule be well defined, but each must be linked together since one affects the other, both individually and collectively.

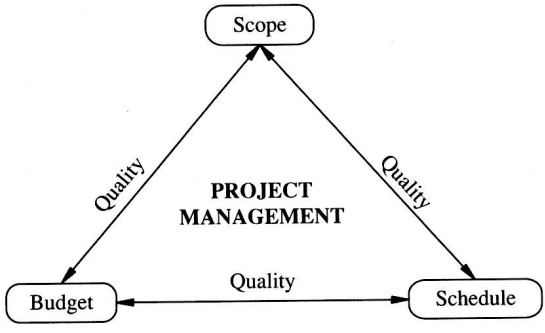

FIGURE 1-1
Quality is an integral part of Scope, Budget, and Schedule.