

IEEE Std 1490™-2003
(Revision of
IEEE Std 1490-1998)

IEEE Standards

1490™

IEEE Guide

Adoption of PMI Standard

**A Guide to the Project Management
Body of Knowledge**

IEEE Computer Society

Sponsored by the
Software Engineering Standards Committee



Published by
The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

24 May 2004

Print: SH95196
PDF: SS95196

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Full document details: IEEE 1490-2003

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Sponsor

Software Engineering Standards Committee
of the
IEEE Computer Society

Approved 26 April 2004

American National Standards Institute

Approved 10 December 2003

IEEE-SA Standards Board

Abstract: The subset of the Project Management Body of Knowledge that is generally accepted is identified and described in this guide. *Generally accepted* means that the knowledge and practices described are applicable to most projects most of the time, and that there is widespread consensus about their value and usefulness. It does not mean that the knowledge and practices should be applied uniformly to all projects without considering whether they are appropriate.

Keywords: body of knowledge, project, project management

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Print: ISBN 0-7381-3893-2 SH95196
PDF: ISBN 0-7381-3894-0 SS95196

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Introduction

(This introduction is not part of IEEE Std 1490-2003, IEEE Guide—Adoption of PMI Standard—A Guide to the Project Management Body of Knowledge.)¹

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Contents

1.	Overview.....	1
2.	References.....	1
3.	IEEE Adoption implementation considerations	2
3.1	Terminology correlation	2

IEEE Guide

Adoption of PMI Standard

A Guide to the Project Management Body of Knowledge

1. Overview

IEEE Std 1490™-2003 is an adoption of PMI, A Guide to Project Management Body of Knowledge (Guide to PMBOK).

2. References

This standard may be used separately from, or in conjunction with, one or more of the following publications. When the following standards are superseded by an approved revision, the revision shall apply.

IEEE/EIA 12207.0-1996, IEEE/EIA Standard—Industry Implementation of ISO/IEC 12207: 1995, Standard for Information Technology—Software life cycle processes.

IEEE/EIA 12207.1-1997, IEEE/EIA Guide—Industry Implementation of ISO/IEC 12207: 1995, Standard for Information Technology—Software life cycle processes—Life cycle data.

IEEE/EIA 12207.2 -1997, IEEE/EIA Guide—Industry Implementation of ISO/IEC 12207: 1995, Standard for Information Technology—Software life cycle processes—Implementation considerations.

IEEE Std 610.12™-1990 (R 2002), IEEE Standard Glossary of Software Engineering Terminology.^{1,2}

IEEE Std 1028™-1997 (R 2002), IEEE Standard for Software Reviews.

IEEE Std 1044™-1993 (R 2002), IEEE Standard Classification for Software Anomalies.

IEEE Std 1045™-1992 (R 2002), IEEE Standard for Software Productivity Metrics.

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IEEE Std 1058™-1998, IEEE Standard for Software Project Management Plans.

IEEE Std 1074™-1997, IEEE Standard for Developing Software Life Cycle Processes.

3. IEEE Adoption implementation considerations

3.1 Terminology correlation

The purpose of this clause is to correlate key terminology in the Guide to PMBOK and IEEE Software Engineering Standards. Three key terms are examined: Life cycle, process, and project.

3.1.1 Life cycle

3.1.1.1 project life cycle: A collection of generally sequential project phases whose name and number are determined by the control needs of the organization or organizations involved in the project. (PMI, Guide to PMBOK).

3.1.1.2 software life cycle: The period of time that begins when a software project is conceived and ends when the software is no longer available for use. (IEEE Std 610.12-1990).

Both definitions have a time dimension. The scope of the PMI definition is limited to a specific project. The PMI definition focuses on the control aspect of the project, whereas the scope of the IEEE definition includes the entire life of the software. The IEEE definition focuses on the software product and its role.

3.1.2 Process

3.1.2.1 Process: A series of actions bringing about a result. (PMI, Guide to PMBOK)

3.1.2.2 process: A set of interrelated activities, which transforms inputs into outputs. (IEEE/EIA 12207.0-1996).

NOTE—The term “activities” covers use of resources.

Conceptually, the two definitions are the same.

3.1.3 Project

3.1.3.1 project: A temporary endeavor undertaken to create a unique product or service. (PMI, Guide to PMBOK).

3.1.3.2 software project: The set of work activities, both technical and managerial, required to satisfy the terms and conditions of a project agreement. A software project should have specific starting and ending dates, well-defined objectives and constraints, established responsibilities, and a budget and schedule. A software project may be self-contained or may be part of a larger project. In some cases, a software project may span only a portion of the software development cycle. In other cases, a software project may span many years and consist of numerous subprojects, each being a well defined and self-contained software project. (IEEE Std 1058, 1998 Edition)

At the conceptual level both terms have similar semantics. The PMI definition focuses on the essence of a project. The IEEE definition includes a description of the characteristics of a project.

A Guide to the Project Management Body of Knowledge (PMBOK® Guide)

- ☐ START
- ☐ CONTENTS
- ☐ LIST OF FIGURES
- ☐ PREFACE
- ☐ CHAPTER 1
- ☐ CHAPTER 2
- ☐ CHAPTER 3
- ☐ CHAPTER 4
- ☐ CHAPTER 5
- ☐ CHAPTER 6
- ☐ CHAPTER 7
- ☐ CHAPTER 8
- ☐ CHAPTER 9
- ☐ CHAPTER 10
- ☐ CHAPTER 11
- ☐ CHAPTER 12
- ☐ APPENDICES
- ☐ GLOSSARY
- ☐ INDEX

A Guide to the Project Management Body of Knowledge (PMBOK® Guide)

2000 Edition

Project Management Institute
Newtown Square, Pennsylvania USA

Library of Congress Cataloging-in-Publication Data

A guide to the project management body of knowledge (PMBOK® guide).--2000 ed.

p. cm.

Includes bibliographical references and index.

ISBN 1-880410-22-2 (alk. paper)--ISBN 1-880410-23-0 (pbk. : alk. paper)

1. Industrial project management. I. Title: PMBOK® guide. II. Project Management Institute.

HD69.P75 G845 2001

658.4'04--dc21

00-051727

CIP

ISBN: 1-880410-23-0 (paperback)

ISBN: 1-880410-22-2 (hardcover)

ISBN: 1-880410-25-7 (CD-ROM)

Published by: Project Management Institute, Inc.

Four Campus Boulevard

Newtown Square, Pennsylvania 19073-3299 USA

Phone: 610-356-4600 or Visit our website: www.pmi.org

E-mail: pmihq@pmi.org

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Printed and bound by Automated Graphic Systems, White Plains, Maryland, USA.

10 9 8 7 6 5 4 3 2 1

Contents

List of Figures	vii
Preface to the 2000 Edition	ix
Section I—The Project Management Framework	1
Chapter 1—Introduction	3
1.1 Purpose of This Guide	3
1.2 What Is a Project?	4
1.3 What Is Project Management?	6
1.4 Relationship to Other Management Disciplines	9
1.5 Related Endeavors	10
Chapter 2—The Project Management Context	11
2.1 Project Phases and the Project Life Cycle	11
2.2 Project Stakeholders	16
2.3 Organizational Influences	18
2.4 Key General Management Skills	21
2.5 Social-Economic-Environmental Influences	26
Chapter 3—Project Management Processes	29
3.1 Project Processes	29
3.2 Process Groups	30
3.3 Process Interactions	32
3.4 Customizing Process Interactions	37
3.5 Mapping of Project Management Processes	38
Section II—The Project Management Knowledge Areas	39
Chapter 4—Project Integration Management	41
4.1 Project Plan Development	42
4.2 Project Plan Execution	46
4.3 Integrated Change Control	47
Chapter 5—Project Scope Management	51
5.1 Initiation	53
5.2 Scope Planning	55
5.3 Scope Definition	57
5.4 Scope Verification	61
5.5 Scope Change Control	62
Chapter 6—Project Time Management	65
6.1 Activity Definition	65
6.2 Activity Sequencing	68
6.3 Activity Duration Estimating	71
6.4 Schedule Development	73
6.5 Schedule Control	79
Chapter 7—Project Cost Management	83
7.1 Resource Planning	85
7.2 Cost Estimating	86
7.3 Cost Budgeting	89
7.4 Cost Control	90

Chapter 8—Project Quality Management	95
8.1 Quality Planning	97
8.2 Quality Assurance	101
8.3 Quality Control	102
Chapter 9—Project Human Resource Management	107
9.1 Organizational Planning	108
9.2 Staff Acquisition	112
9.3 Team Development	114
Chapter 10—Project Communications Management	117
10.1 Communications Planning	119
10.2 Information Distribution	121
10.3 Performance Reporting	122
10.4 Administrative Closure	125
Chapter 11—Project Risk Management	127
11.1 Risk Management Planning	129
11.2 Risk Identification	131
11.3 Qualitative Risk Analysis	133
11.4 Quantitative Risk Analysis	137
11.5 Risk Response Planning	140
11.6 Risk Monitoring and Control	144
Chapter 12—Project Procurement Management	147
12.1 Procurement Planning	149
12.2 Solicitation Planning	152
12.3 Solicitation	153
12.4 Source Selection	155
12.5 Contract Administration	156
12.6 Contract Closeout	158
 Section III—Appendices	 161
Appendix A—The Project Management Institute Standards-Setting Process	163
Appendix B—Evolution of PMI's <i>A Guide to the Project Management Body of Knowledge</i>	167
Appendix C—Contributors and Reviewers of <i>PMBOK® Guide</i> 2000 Edition	175
Appendix D—Notes	179
Appendix E—Application Area Extensions	181
Appendix F—Additional Sources of Information on Project Management	185
Appendix G—Summary of Project Management Knowledge Areas	189
 Section IV—Glossary and Index	 193
Glossary	195
Index	211

List of Figures

Figure 1–1.	Overview of Project Management Knowledge Areas and Project Management Processes	8
Figure 1–2.	Relationship of Project Management to Other Management Disciplines	9
Figure 2–1.	Sample Generic Life Cycle	13
Figure 2–2.	Representative Life Cycle for Defense Acquisition, per US DODI 5000.2 (Final Coordination Draft, April 2000)	14
Figure 2–3.	Representative Construction Project Life Cycle, per Morris	15
Figure 2–4.	Representative Life Cycle for a Pharmaceuticals Project, per Murphy	16
Figure 2–5.	Representative Software Development Life Cycle, per Muench	17
Figure 2–6.	Organizational Structure Influences on Projects	19
Figure 2–7.	Functional Organization	20
Figure 2–8.	Projectized Organization	21
Figure 2–9.	Weak Matrix Organization	22
Figure 2–10.	Balanced Matrix Organization	22
Figure 2–11.	Strong Matrix Organization	23
Figure 2–12.	Composite Organization	23
Figure 3–1.	Links among Process Groups in a Phase	31
Figure 3–2.	Overlap of Process Groups in a Phase	31
Figure 3–3.	Interaction between Phases	31
Figure 3–4.	Relationships among the Initiating Processes	32
Figure 3–5.	Relationships among the Planning Processes	33
Figure 3–6.	Relationships among the Executing Processes	35
Figure 3–7.	Relationships among the Controlling Processes	36
Figure 3–8.	Relationships among the Closing Processes	37
Figure 3–9.	Mapping of Project Management Processes to the Process Groups and Knowledge Areas	38
Figure 4–1.	Project Integration Management Overview	42
Figure 4–2.	Coordinating Changes Across the Entire Project	48
Figure 5–1.	Project Scope Management Overview	52
Figure 5–2.	Sample Work Breakdown Structure for Defense Material Items	58
Figure 5–3.	Sample Work Breakdown Structure Organized by Phase	59
Figure 5–4.	Sample Work Breakdown Structure for Wastewater Treatment Plant	60
Figure 6–1.	Project Time Management Overview	66
Figure 6–2.	Network Logic Diagram Drawn Using the Precedence Diagramming Method	69
Figure 6–3.	Network Logic Diagram Drawn Using the Arrow Diagramming Method	70
Figure 6–4.	PERT Duration Calculation for a Single Activity	76
Figure 6–5.	Project Network Diagram with Dates	77
Figure 6–6.	Bar (Gantt) Chart	78
Figure 6–7.	Milestone Chart	79
Figure 7–1.	Project Cost Management Overview	84
Figure 7–2.	Illustrative Cost Baseline Display	90
Figure 8–1.	Project Quality Management Overview	96
Figure 8–2.	Cause-and-Effect Diagram	99
Figure 8–3.	Sample Process Flowchart	100
Figure 8–4.	Control Chart of Project Schedule Performance	104
Figure 8–5.	Pareto Diagram	105

Figure 9-1.	Project Human Resource Management Overview	108
Figure 9-2.	Responsibility Assignment Matrix	111
Figure 9-3.	Illustrative Resource Histogram	112
Figure 10-1.	Project Communications Management Overview	118
Figure 10-2.	Illustrative Graphic Performance Report	124
Figure 10-3.	Illustrative Tabular Performance Report	124
Figure 11-1.	Project Risk Management Overview	128
Figure 11-2.	Rating Impacts for a Risk	136
Figure 11-3.	Probability-Impact Matrix	137
Figure 11-4.	Cost Estimates and Ranges from the Risk Interview	139
Figure 11-5.	Examples of Commonly Used Probability Distributions	140
Figure 11-6.	Decision Tree Analysis	141
Figure 11-7.	Cost Risk Simulation	142
Figure 12-1.	Project Procurement Management Overview	148



Preface to the 2000 Edition

This document supersedes the Project Management Institute's (PMI®) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, published in 1996.

The scope of the project to update the 1996 publication was to:

- Add new material reflecting the growth of the knowledge and practices in the field of project management by capturing those practices, tools, techniques, and other relevant items that have become generally accepted. (*Generally accepted* means being applicable to most projects most of the time and having widespread consensus about their value and usefulness.)
- Add clarification to text and figures to make this document more beneficial to users.
- Correct existing errors in the predecessor document.

To assist users of this document, who may be familiar with its predecessor, we have summarized the major differences here.

1. *Throughout the document, we clarified that projects manage to requirements, which emerge from needs, wants, and expectations.*
2. *We strengthened linkages to organizational strategy throughout the document.*
3. *We provided more emphasis on progressive elaboration in Section 1.2.3.*
4. *We acknowledged the role of the Project Office in Section 2.3.4.*
5. *We added references to project management involving developing economies, as well as social, economic, and environmental impacts, in Section 2.5.4.*
6. *We added expanded treatment of Earned Value Management in Chapter 4 (Project Integration Management), Chapter 7 (Project Cost Management), and Chapter 10 (Project Communications Management).*
7. *We rewrote Chapter 11 (Project Risk Management). The chapter now contains six processes instead of the previous four processes. The six processes are Risk Management Planning, Risk Identification, Qualitative Risk Analysis, Quantitative Risk Analysis, Risk Response Planning, and Risk Monitoring and Control.*
8. *We moved scope verification from an executing process to a controlling process.*
9. *We changed the name of Process 4.3 from Overall Change Control to Integrated Change Control to emphasize the importance of change control throughout the entirety of the project.*
10. *We added a chart that maps the thirty-nine Project Management processes against the five Project Management Process Groups and the nine Project Management Knowledge Areas in Figure 3-9.*
11. *We standardized terminology throughout the document from “supplier” to “seller.”*
12. *We added several Tools and Techniques:*
 - Chapter 4 (Project Integration Management)
 - ◆ Earned Value Management (EVM)
 - ◆ Preventive Action

- *Chapter 5 (Project Scope Management)*
 - ◆ *Scope Statement Updates*
 - ◆ *Project Plan*
 - ◆ *Adjusted Baseline*
- *Chapter 6 (Project Time Management)*
 - ◆ *Quantitatively Based Durations*
 - ◆ *Reserve Time (contingency)*
 - ◆ *Coding Structure*
 - ◆ *Variance Analysis*
 - ◆ *Milestones*
 - ◆ *Activity Attributes*
 - ◆ *Computerized Tools*
- *Chapter 7 (Project Cost Management)*
 - ◆ *Estimating Publications*
 - ◆ *Earned Value Measurement*
- *Chapter 8 (Project Quality Management)*
 - ◆ *Cost of Quality*
- *Chapter 10 (Project Communications Management)*
 - ◆ *Project Reports*
 - ◆ *Project Presentations*
 - ◆ *Project Closure*
- *Chapter 11 (Project Risk Management— this chapter is rewritten)*

The body of knowledge of the project management profession continues to grow, and PMI intends to update the *PMBOK® Guide* on a periodic basis. Therefore, if you have any comments about this document or suggestions about how this document can be improved, please send them to:

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SECTION I

THE PROJECT MANAGEMENT FRAMEWORK

1. Introduction
2. The Project Management Context
3. Project Management Processes

Chapter 1

Introduction

The *Project Management Body of Knowledge* (PMBOK®) is an inclusive term that describes the sum of knowledge within the profession of project management. As with other professions such as law, medicine, and accounting, the body of knowledge rests with the practitioners and academics that apply and advance it. The full project management body of knowledge includes knowledge of proven traditional practices that are widely applied, as well as knowledge of innovative and advanced practices that have seen more limited use, and includes both published and unpublished material.

This chapter defines and explains several key terms and provides an overview of the rest of the document. It includes the following major sections:

- 1.1 Purpose of This Guide**
- 1.2 What Is a Project?**
- 1.3 What Is Project Management?**
- 1.4 Relationship to Other Management Disciplines**
- 1.5 Related Endeavors**

1.1 PURPOSE OF THIS GUIDE

Project management is an emerging profession. The primary purpose of this document is to identify and describe that subset of the PMBOK® that is generally accepted. *Generally accepted* means that the knowledge and practices described are applicable to most projects most of the time, and that there is widespread consensus about their value and usefulness. Generally accepted does not mean that the knowledge and practices described are or should be applied uniformly on all projects; the project management team is always responsible for determining what is appropriate for any given project.

This document is also intended to provide a common lexicon within the profession and practice for talking and writing about project management. Project management is a relatively young profession, and while there is substantial commonality around what is done, there is relatively little commonality in the terms used.

This document provides a basic reference for anyone interested in the profession of project management. This includes, but is not limited to:

- Senior executives.
- Managers of project managers.
- Project managers and other project team members.
- Project customers and other project stakeholders.
- Functional managers with employees assigned to project teams.
- Educators teaching project management and related subjects.
- Consultants and other specialists in project management and related fields.
- Trainers developing project management educational programs.

As a basic reference, this document is neither comprehensive nor all inclusive. Appendix E discusses application area extensions while Appendix F lists sources of further information on project management.

This document is also used by the Project Management Institute as a basic reference about project management knowledge and practices for its professional development programs including:

- Certification of Project Management Professionals (PMP®).
- Accreditation of educational programs in project management.

1.2 WHAT IS A PROJECT?

Organizations perform work. Work generally involves either operations or projects, although the two may overlap. Operations and projects share many characteristics; for example, they are:

- Performed by people.
- Constrained by limited resources.
- Planned, executed, and controlled.

Projects are often implemented as a means of achieving an organization's strategic plan. Operations and projects differ primarily in that operations are ongoing and repetitive while projects are temporary and unique. A project can thus be defined in terms of its distinctive characteristics—a *project is a temporary endeavor undertaken to create a unique product or service*. *Temporary* means that every project has a definite beginning and a definite end. *Unique* means that the product or service is different in some distinguishing way from all other products or services. For many organizations, projects are a means to respond to those requests that cannot be addressed within the organization's normal operational limits.

Projects are undertaken at all levels of the organization. They may involve a single person or many thousands. Their duration ranges from a few weeks to more than five years. Projects may involve a single unit of one organization or may cross organizational boundaries, as in joint ventures and partnering. Projects are critical to the realization of the performing organization's business strategy because projects are a means by which strategy is implemented. Examples of projects include:

- Developing a new product or service.
- Effecting a change in structure, staffing, or style of an organization.
- Designing a new transportation vehicle.
- Developing or acquiring a new or modified information system.
- Constructing a building or facility.
- Building a water system for a community in a developing country.
- Running a campaign for political office.
- Implementing a new business procedure or process.

1.2.1 Temporary

Temporary means that every project has a definite beginning and a definite end. The end is reached when the project's objectives have been achieved, or when it becomes clear that the project objectives will not or cannot be met, or the need for the project no longer exists and the project is terminated. Temporary does not necessarily mean short in duration; many projects last for several years. In every case, however, the duration of a project is finite; projects are not ongoing efforts.

In addition, temporary does not generally apply to the product or service created by the project. Projects may often have intended and unintended social, economic, and environmental impacts that far outlast the projects themselves. Most projects are undertaken to create a lasting result. For example, a project to erect a national monument will create a result expected to last centuries. A series of projects and/or complementary projects in parallel may be required to achieve a strategic objective.

The objectives of projects and operations are fundamentally different. The objective of a project is to attain the objective and close the project. The objective of an ongoing nonprojectized operation is normally to sustain the business. Projects are fundamentally different because the project ceases when its declared objectives have been attained, while nonproject undertakings adopt a new set of objectives and continue to work.

The temporary nature of projects may apply to other aspects of the endeavor as well:

- The opportunity or market window is usually temporary—most projects have a limited time frame in which to produce their product or service.
- The project team, as a team, seldom outlives the project—most projects are performed by a team created for the sole purpose of performing the project, and the team is disbanded when the project is complete.

1.2.2 Unique Product, Service, or Result

Projects involve doing something that has not been done before and which is, therefore, *unique*. A product or service may be unique even if the category to which it belongs is large. For example, many thousands of office buildings have been developed, but each individual facility is unique—different owner, different design, different location, different contractors, and so on. The presence of repetitive elements does not change the fundamental uniqueness of the project work. For example:

- A project to develop a new commercial airliner may require multiple prototypes.
- A project to bring a new drug to market may require thousands of doses of the drug to support clinical trials.
- A real estate development project may include hundreds of individual units.
- A development project (e.g., water and sanitation) may be implemented in five geographic areas.

1.2.3 Progressive Elaboration

Progressive elaboration is a characteristic of projects that integrates the concepts of temporary and unique. Because the product of each project is unique, the characteristics that distinguish the product or service must be progressively elaborated. *Progressively* means “proceeding in steps; continuing steadily by increments,”

while *elaborated* means “worked out with care and detail; developed thoroughly” (1). These distinguishing characteristics will be broadly defined early in the project, and will be made more explicit and detailed as the project team develops a better and more complete understanding of the product.

Progressive elaboration of product characteristics must be carefully coordinated with proper project scope definition, particularly if the project is performed under contract. When properly defined, the scope of the project—the work to be done—should remain constant even as the product characteristics are progressively elaborated. The relationship between product scope and project scope is discussed further in the introduction to Chapter 5.

The following two examples illustrate progressive elaboration in two different application areas.

Example 1. Development of a chemical processing plant begins with process engineering to define the characteristics of the process. These characteristics are used to design the major processing units. This information becomes the basis for engineering design, which defines both the detail plant layout and the mechanical characteristics of the process units and ancillary facilities. All of these result in design drawings that are elaborated to produce fabrication drawings (construction isometrics). During construction, interpretations and adaptations are made as needed and subject to proper approval. This further elaboration of the characteristics is captured by *as-built* drawings. During test and turnover, further elaboration of the characteristics is often made in the form of final operating adjustments.

Example 2. The product of an economic development project may initially be defined as: “Improve the quality of life of the lowest income residents of community X.” As the project proceeds, the products may be described more specifically as, for example: “Provide access to food and water to 500 low income residents in community X.” The next round of progressive elaboration might focus exclusively on increasing agriculture production and marketing, with provision of water deemed to be secondary priority to be initiated once the agriculture component is well under way.

1.3 WHAT IS PROJECT MANAGEMENT?

Project management is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements. Project management is accomplished through the use of the processes such as: initiating, planning, executing, controlling, and closing. The project team manages the work of the projects, and the work typically involves:

- Competing demands for: scope, time, cost, risk, and quality.
- Stakeholders with differing needs and expectations.
- Identified requirements.

It is important to note that many of the processes within project management are iterative in nature. This is in part due to the existence of and the necessity for progressive elaboration in a project throughout the project life cycle; i.e., the more you know about your project, the better you are able to manage it.

The term *project management* is sometimes used to describe an organizational approach to the management of ongoing operations. This approach, more properly called *management by projects*, treats many aspects of ongoing operations as projects to apply project management techniques to them. Although an

understanding of project management is critical to an organization that is managing by projects, a detailed discussion of the approach itself is outside the scope of this document.

Knowledge about project management can be organized in many ways. This document has two major sections and twelve chapters, as described below.

1.3.1 The Project Management Framework

Section I, The Project Management Framework, provides a basic structure for understanding project management.

Chapter 1, **Introduction**, defines key terms and provides an overview of the rest of the document.

Chapter 2, **The Project Management Context**, describes the environment in which projects operate. The project management team must understand this broader context—managing the day-to-day activities of the project is necessary for success but not sufficient.

Chapter 3, **Project Management Processes**, describes a generalized view of how the various project management processes commonly interact. Understanding these interactions is essential to understanding the material presented in Chapters 4 through 12.

1.3.2 The Project Management Knowledge Areas

Section II, The Project Management Knowledge Areas, describes project management knowledge and practice in terms of their component processes. These processes have been organized into nine knowledge areas, as described below and as illustrated in **Figure 1-1**.

Chapter 4, **Project Integration Management**, describes the processes required to ensure that the various elements of the project are properly coordinated. It consists of project plan development, project plan execution, and integrated change control.

Chapter 5, **Project Scope Management**, describes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully. It consists of initiation, scope planning, scope definition, scope verification, and scope change control.

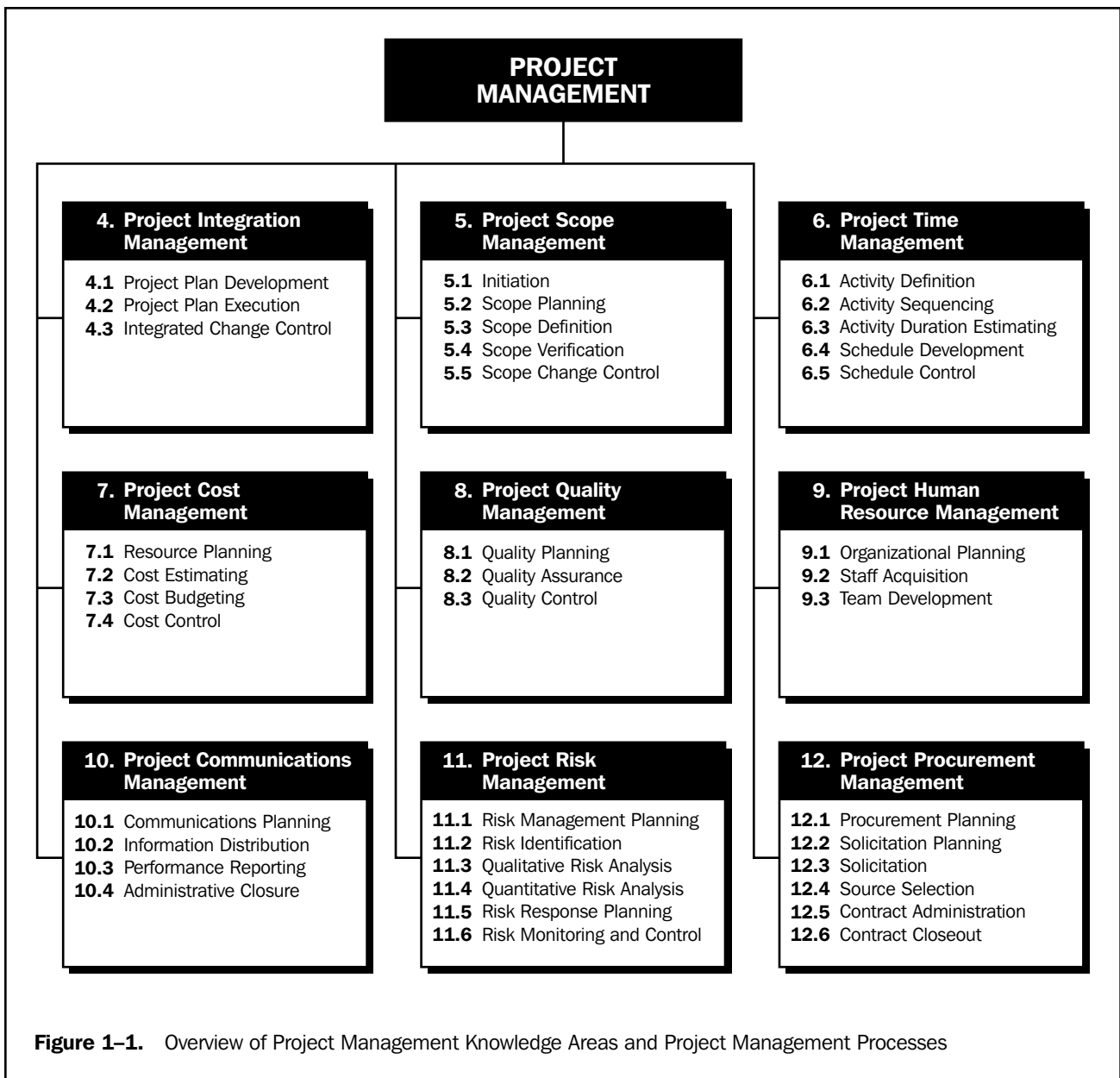
Chapter 6, **Project Time Management**, describes the processes required to ensure timely completion of the project. It consists of activity definition, activity sequencing, activity duration estimating, schedule development, and schedule control.

Chapter 7, **Project Cost Management**, describes the processes required to ensure that the project is completed within the approved budget. It consists of resource planning, cost estimating, cost budgeting, and cost control.

Chapter 8, **Project Quality Management**, describes the processes required to ensure that the project will satisfy the needs for which it was undertaken. It consists of quality planning, quality assurance, and quality control.

Chapter 9, **Project Human Resource Management**, describes the processes required to make the most effective use of the people involved with the project. It consists of organizational planning, staff acquisition, and team development.

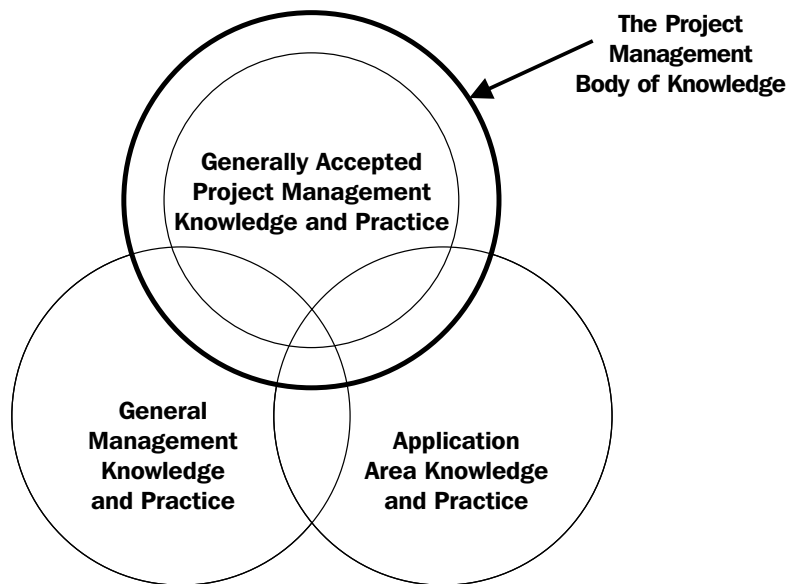
Chapter 10, **Project Communications Management**, describes the processes required to ensure timely and appropriate generation, collection, dissemination,



storage, and ultimate disposition of project information. It consists of communications planning, information distribution, performance reporting, and administrative closure.

Chapter 11, **Project Risk Management**, describes the processes concerned with identifying, analyzing, and responding to project risk. It consists of risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, and risk monitoring and control.

Chapter 12, **Project Procurement Management**, describes the processes required to acquire goods and services from outside the performing organization. It consists of procurement planning, solicitation planning, solicitation, source selection, contract administration, and contract closeout.



This figure is a conceptual view of these relationships.
The overlaps shown are not proportional.

Figure 1-2. Relationship of Project Management to Other Management Disciplines

1.4 RELATIONSHIP TO OTHER MANAGEMENT DISCIPLINES

Much of the knowledge needed to manage projects is unique to project management (e.g., critical path analysis and work breakdown structures). However, the PMBOK® does overlap other management disciplines, as illustrated in **Figure 1-2**.

General management encompasses planning, organizing, staffing, executing, and controlling the operations of an ongoing enterprise. General management also includes supporting disciplines such as law, strategic planning, logistics, and human resources management. The PMBOK® overlaps or modifies general management in many areas—organizational behavior, financial forecasting, and planning techniques, to name just a few. Section 2.4 provides a more detailed discussion of general management.

Application areas are categories of projects that have common elements significant in such projects, but are not needed or present in all projects. Application areas are usually defined in terms of:

- Functional departments and supporting disciplines, such as legal, production and inventory management, marketing, logistics and personnel.
- Technical elements, such as software development, pharmaceuticals, water and sanitation engineering, or construction engineering.
- Management specializations, such as government contracting, community development, or new product development.
- Industry groups, such as automotive, chemicals, agriculture, or financial services.

Appendix E includes a more detailed discussion of project management application areas.

1.5 RELATED ENDEAVORS

Certain types of endeavors are closely related to projects. There is often a hierarchy of strategic plan, program, project, and subproject, in which a program consisting of several associated projects will contribute to the achievement of a strategic plan. These related undertakings are described below.

Programs. A *program* is a group of projects managed in a coordinated way to obtain benefits not available from managing them individually (2). Many programs also include elements of ongoing operations. For example:

- The “XYZ airplane program” includes both the project or projects to design and develop the aircraft, as well as the ongoing manufacturing and support of that craft in the field.
- Many electronics firms have *program managers* who are responsible for both individual product releases (projects) and the coordination of multiple releases over time (an ongoing operation).

Programs may also involve a series of repetitive or cyclical undertakings; for example:

- Utilities often speak of an annual “construction program,” a regular, ongoing operation that involves many projects.
- Many nonprofit organizations have a “fundraising program,” an ongoing effort to obtain financial support that often involves a series of discrete projects, such as a membership drive or an auction.
- Publishing a newspaper or magazine is also a program—the periodical itself is an ongoing effort, but each individual issue is a project.

In some application areas, program management and project management are treated as synonyms; in others, project management is a subset of program management. This diversity of meaning makes it imperative that any discussion of *program* management versus *project* management be preceded by agreement on a clear and consistent definition of each term.

Subprojects. Projects are frequently divided into more manageable components or subprojects. *Subprojects* are often contracted to an external enterprise or to another functional unit in the performing organization. Examples include:

- Subprojects based on the project process, such as a single phase.
- Subprojects according to human resource skill requirements, such as the installation of plumbing or electrical fixtures on a construction project.
- Subprojects involving technology, such as automated testing of computer programs on a software development project.

Subprojects are typically referred to as projects and managed as such.

Project Portfolio Management. Project portfolio management refers to the selection and support of projects or program investments. These investments in projects and programs are guided by the organization’s strategic plan and available resources.

Chapter 2

The Project Management Context

Projects and project management operate in an environment broader than that of the project itself. The project management team must understand this broader context—managing the day-to-day activities of the project is necessary for success but not sufficient. This chapter describes key aspects of the project management context not covered elsewhere in this document. The topics included here are:

- 2.1 Project Phases and the Project Life Cycle**
- 2.2 Project Stakeholders**
- 2.3 Organizational Influences**
- 2.4 Key General Management Skills**
- 2.5 Social-Economic-Environmental Influences**

2.1 PROJECT PHASES AND THE PROJECT LIFE CYCLE

Because projects are unique undertakings, they involve a degree of uncertainty. Organizations performing projects will usually divide each project into several *project phases* to improve management control and provide for links to the ongoing operations of the performing organization. Collectively, the project phases are known as the *project life cycle*.

2.1.1 Characteristics of Project Phases

Each project phase is marked by completion of one or more deliverables. A *deliverable* is a tangible, verifiable work product such as a feasibility study, a detail design, or a working prototype. The deliverables, and hence the phases, are part of a generally sequential logic designed to ensure proper definition of the product of the project.

The conclusion of a project phase is generally marked by a review of both key deliverables and project performance to date, to a) determine if the project should continue into its next phase and b) detect and correct errors cost effectively. These phase-end reviews are often called *phase exits*, *stage gates*, or *kill points*.

Each project phase normally includes a set of defined deliverables designed to establish the desired level of management control. The majority of these items are related to the primary phase deliverable, and the phases typically take their names from these items: requirements, design, build, test, startup, turnover, and others, as appropriate. Several representative project life cycles are described in Section 2.1.3.

2.1.2 Characteristics of the Project Life Cycle

The project life cycle serves to define the beginning and the end of a project. For example, when an organization identifies an opportunity to which it would like to respond, it will often authorize a needs assessment and/or a feasibility study to decide if it should undertake a project. The project life-cycle definition will determine whether the feasibility study is treated as the first project phase or as a separate, standalone project.

The project life-cycle definition will also determine which transitional actions at the beginning and the end of the project are included and which are not. In this manner, the project life-cycle definition can be used to link the project to the ongoing operations of the performing organization.

The phase sequence defined by most project life cycles generally involves some form of technology transfer or handoff such as requirements to design, construction to operations, or design to manufacturing. Deliverables from the preceding phase are usually approved before work starts on the next phase. However, a subsequent phase is sometimes begun prior to approval of the previous phase deliverables when the risks involved are deemed acceptable. This practice of overlapping phases is often called *fast tracking*.

Project life cycles generally define:

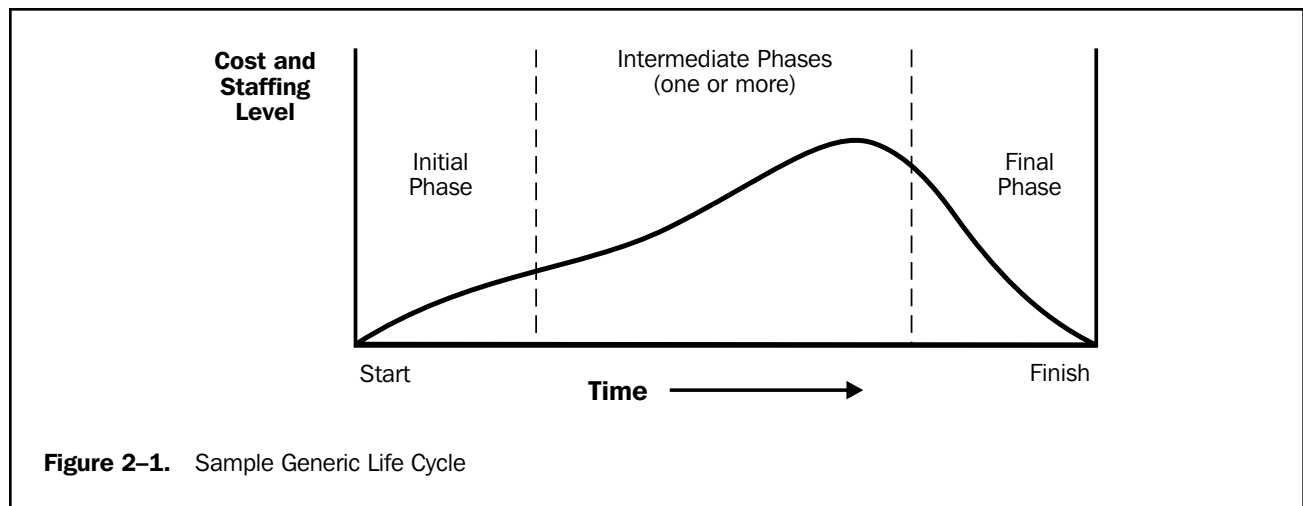
- What technical work should be done in each phase (e.g., is the work of the architect part of the definition phase or part of the execution phase?).
- Who should be involved in each phase (e.g., implementers who need to be involved with requirements and design).

Project life-cycle descriptions may be very general or very detailed. Highly detailed descriptions may have numerous forms, charts, and checklists to provide structure and consistency. Such detailed approaches are often called *project management methodologies*.

Most project life-cycle descriptions share a number of common characteristics:

- Cost and staffing levels are low at the start, higher toward the end, and drop rapidly as the project draws to a conclusion. This pattern is illustrated in **Figure 2-1**.
- The probability of successfully completing the project is lowest, and hence risk and uncertainty are highest, at the start of the project. The probability of successful completion generally gets progressively higher as the project continues.
- The ability of the stakeholders to influence the final characteristics of the project's product and the final cost of the project is highest at the start and gets progressively lower as the project continues. A major contributor to this phenomenon is that the cost of changes and error correction generally increases as the project continues.

Care should be taken to distinguish the *project* life cycle from the *product* life cycle. For example, a project undertaken to bring a new desktop computer to market is but one phase or stage of the product life cycle.



Although many project life cycles have similar phase names with similar deliverables required, few are identical. Most have four or five phases, but some have nine or more. Even within a single application area, there can be significant variations—one organization's software development life cycle may have a single design phase while another's has separate phases for functional and detail design.

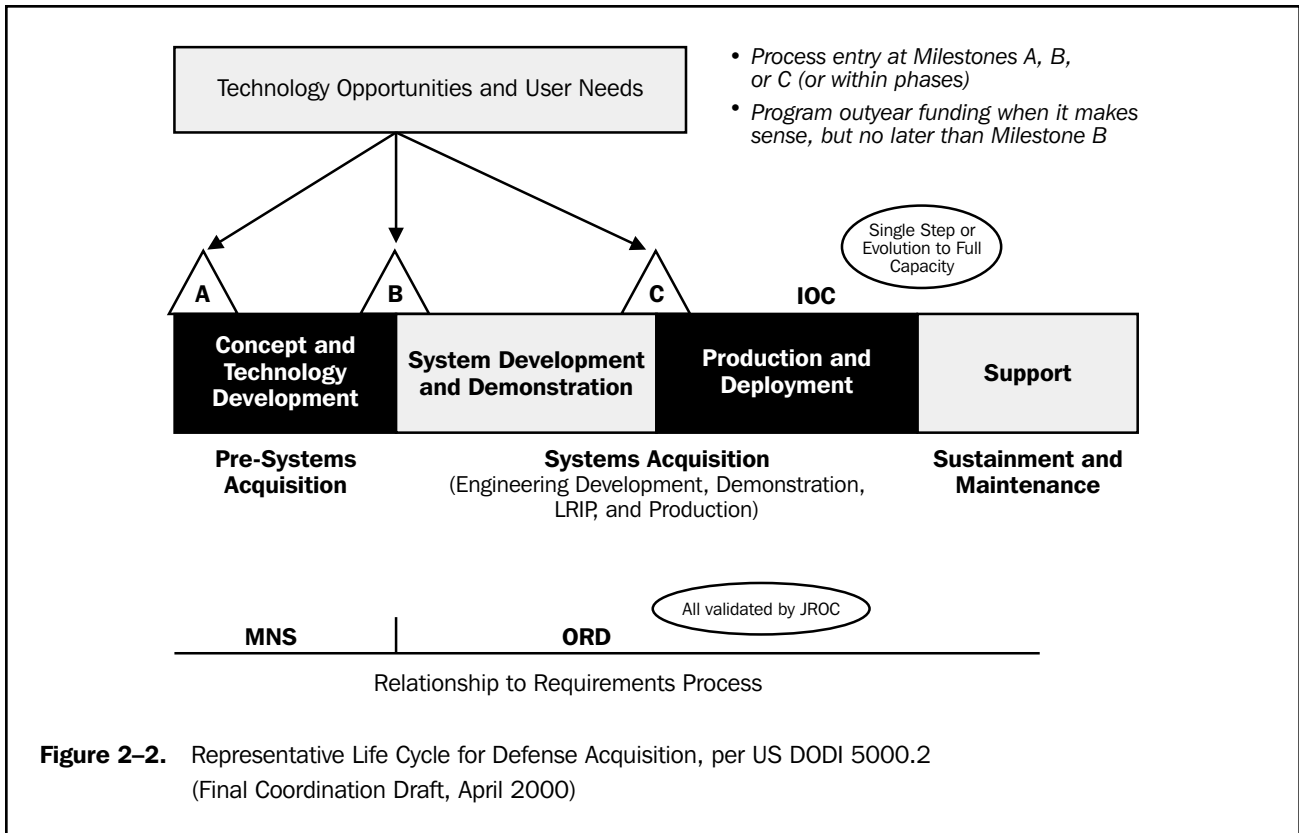
Subprojects within projects may also have distinct project life cycles. For example, an architectural firm hired to design a new office building is first involved in the owner's definition phase when doing the design, and in the owner's implementation phase when supporting the construction effort. The architect's design project, however, will have its own series of phases from conceptual development through definition and implementation to closure. The architect may even treat designing the facility and supporting the construction as separate projects with their own distinct phases.

2.1.3 Representative Project Life Cycles

The following project life cycles have been chosen to illustrate the diversity of approaches in use. The examples shown are typical; they are neither recommended nor preferred. In each case, the phase names and major deliverables are those described by the author for each of the figures.

Defense acquisition. The United States Department of Defense Instruction 5000.2 in Final Coordination Draft, April 2000, describes a series of acquisition milestones and phases as illustrated in **Figure 2-2**.

- Concept and technology development—paper studies of alternative concepts for meeting a mission need; development of subsystems/components and concept/technology demonstration of new system concepts. Ends with selection of a system architecture and a mature technology to be used.
- System development and demonstration—system integration; risk reduction; demonstration of engineering development models; development and early operational test and evaluation. Ends with system demonstration in an operational environment.
- Production and deployment—low rate initial production (LRIP); complete development of manufacturing capability; phase overlaps with ongoing operations and support.



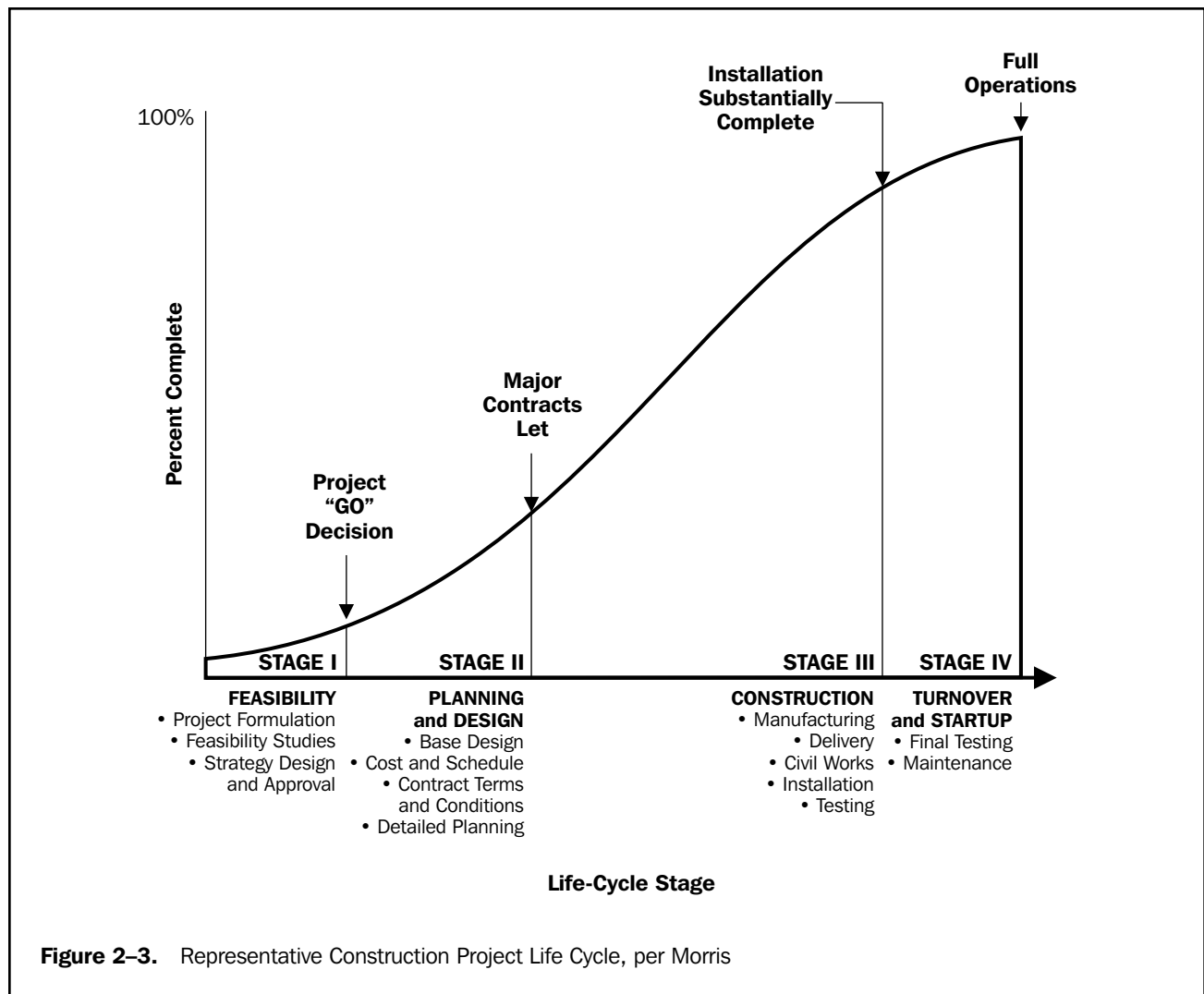
- **Support**—this phase is part of the *product* life cycle, but is really ongoing management. Various *projects* may be conducted during this phase to improve capability, correct defects, etc.

Construction. Adapted from Morris (1), describes a construction project life cycle, as illustrated in **Figure 2-3**.

- **Feasibility**—project formulation, feasibility studies, and strategy design and approval. A go/no-go decision is made at the end of this phase.
- **Planning and design**—base design, cost and schedule, contract terms and conditions, and detailed planning. Major contracts are let at the end of this phase.
- **Construction**—manufacturing, delivery, civil works, installation, and testing. The facility is substantially complete at the end of this phase.
- **Turnover and startup**—final testing and maintenance. The facility is in full operation at the end of this phase.

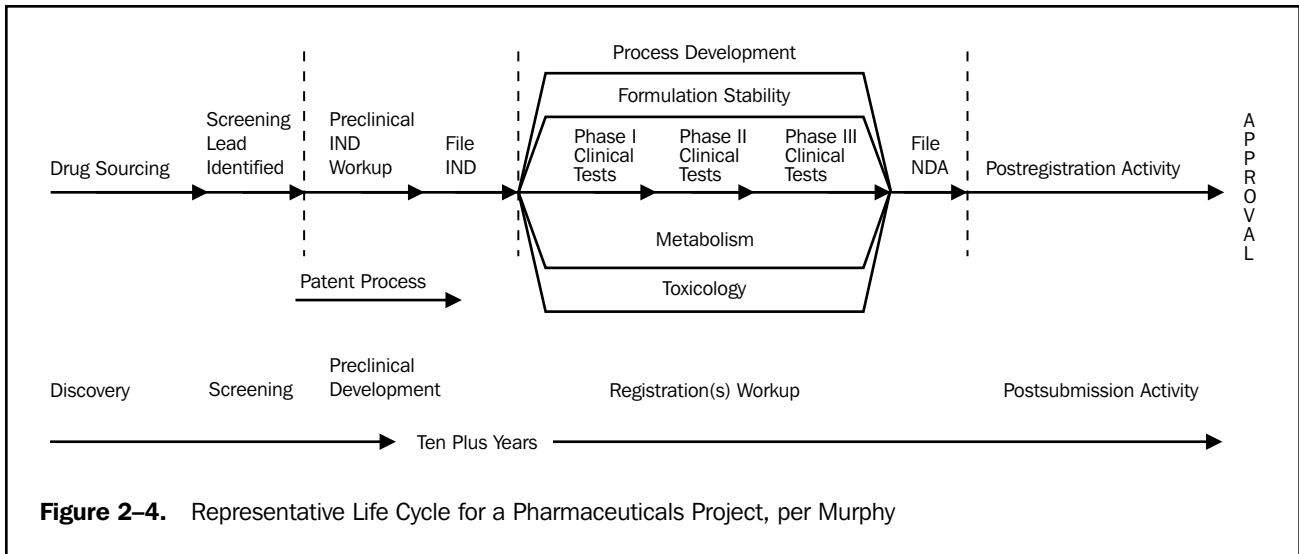
Pharmaceuticals. Murphy (2) describes a project life cycle for pharmaceutical new product development in the United States, as illustrated in **Figure 2-4**.

- **Discovery and screening**—includes basic and applied research to identify candidates for preclinical testing.
- **Preclinical development**—includes laboratory and animal testing to determine safety and efficacy, as well as preparation and filing of an Investigational New Drug (IND) application.
- **Registration(s) workup**—includes Clinical Phase I, II, and III tests, as well as preparation and filing of a New Drug Application (NDA).
- **Postsubmission activity**—includes additional work as required to support Food and Drug Administration review of the NDA.



Software development. There are a number of software life-cycle models in use such as the waterfall model. Muench, et al. (3) describe a spiral model for software development with four cycles and four quadrants, as illustrated in Figure 2-5.

- Proof-of-concept cycle—capture business requirements, define goals for proof of concept, produce conceptual system design and logic design, and construct the proof of concept, produce acceptance test plans, conduct risk analysis, and make recommendations.
- First-build cycle—derive system requirements, define goals for first build, produce logical system design, design and construct the first build, produce system test plans, evaluate the first build, and make recommendations.
- Second-build cycle—derive subsystem requirements, define goals for second build, produce physical design, construct the second build, produce subsystem test plans, evaluate the second build, and make recommendations.
- Final cycle—complete unit requirements and final design, construct final build, and perform unit, subsystem, system, and acceptance tests.



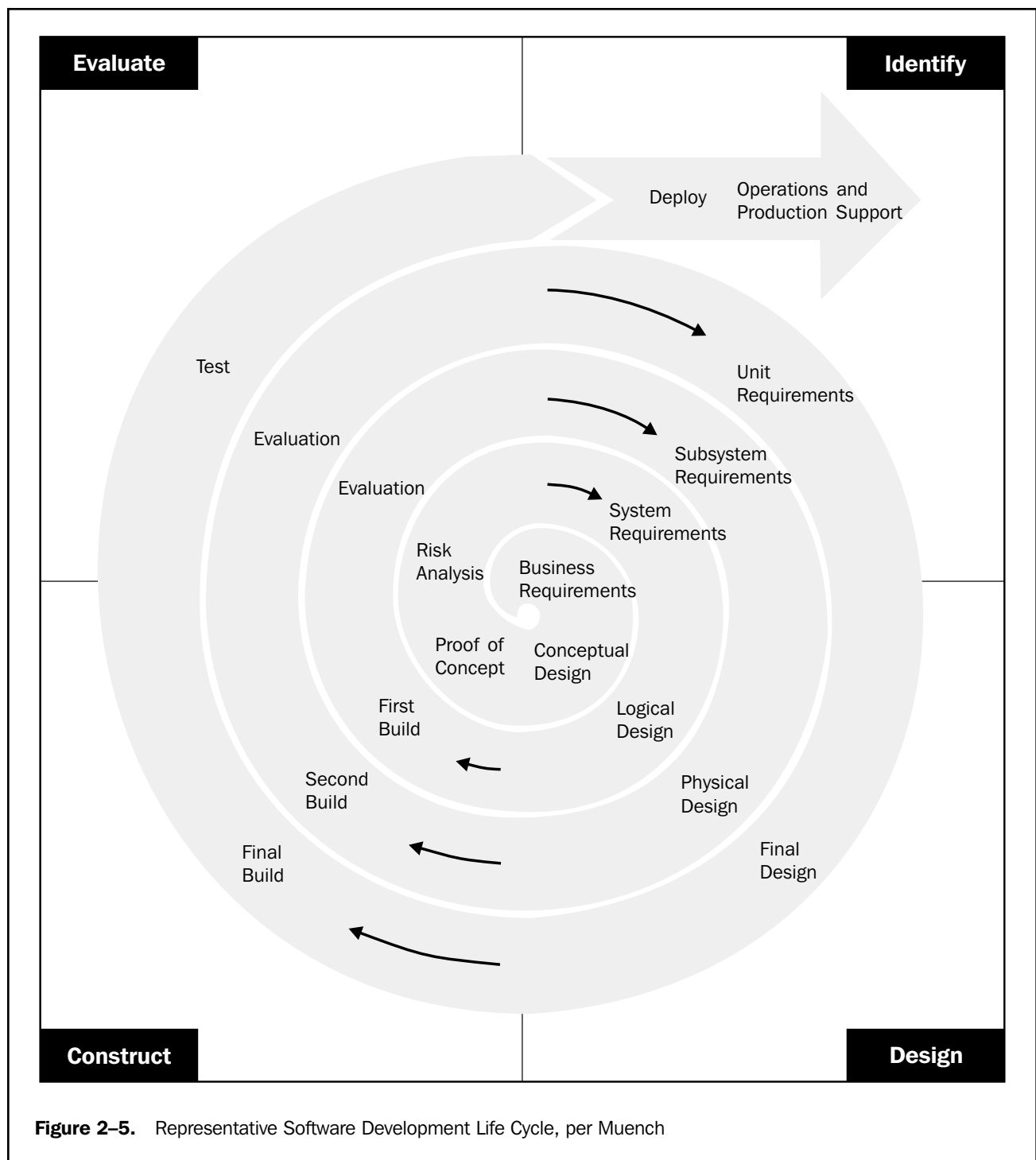
2.2 PROJECT STAKEHOLDERS

Project stakeholders are individuals and organizations that are actively involved in the project, or whose interests may be positively or negatively affected as a result of project execution or project completion; they may also exert influence over the project and its results. The project management team must identify the stakeholders, determine their requirements, and then manage and influence those requirements to ensure a successful project. Stakeholder identification is often especially difficult. For example, is an assembly-line worker whose future employment depends on the outcome of a new product-design project a stakeholder?

Key stakeholders on every project include:

- Project manager—the individual responsible for managing the project.
- Customer—the individual or organization that will use the project's product. There may be multiple layers of customers. For example, the customers for a new pharmaceutical product may include the doctors who prescribe it, the patients who take it, and the insurers who pay for it. In some application areas, *customer* and *user* are synonymous, while in others customer refers to the entity purchasing the project's results and users are those who will directly use the project's product.
- Performing organization—the enterprise whose employees are most directly involved in doing the work of the project.
- Project team members—the group that is performing the work of the project.
- Sponsor—the individual or group within or external to the performing organization that provides the financial resources, in cash or in kind, for the project.

In addition to these, there are many different names and categories of project stakeholders—internal and external, owners and funders, sellers and contractors, team members and their families, government agencies and media outlets, individual citizens, temporary or permanent lobbying organizations, and society at large. The naming or grouping of stakeholders is primarily an aid to identifying which individuals and organizations view themselves as stakeholders. Stakeholder roles and responsibilities may overlap, as when an engineering firm provides financing for a plant that it is designing.



Managing stakeholder expectations may be difficult because stakeholders often have very different objectives that may come into conflict. For example:

- The manager of a department that has requested a new management information system may desire low cost, the system architect may emphasize technical excellence, and the programming contractor may be most interested in maximizing its profit.

- The vice president of research at an electronics firm may define new product success as state-of-the-art technology, the vice president of manufacturing may define it as world-class practices, and the vice president of marketing may be primarily concerned with the number of new features.
- The owner of a real estate development project may be focused on timely performance, the local governing body may desire to maximize tax revenue, an environmental group may wish to minimize adverse environmental impacts, and nearby residents may hope to relocate the project.

In general, differences between or among stakeholders should be resolved in favor of the customer. This does not, however, mean that the needs and expectations of other stakeholders can or should be disregarded. Finding appropriate resolutions to such differences can be one of the major challenges of project management.

2.3 ORGANIZATIONAL INFLUENCES

Projects are typically part of an organization larger than the project—corporations, government agencies, health-care institutions, international bodies, professional associations, and others. Even when the project is the organization (joint ventures, partnering), the project will still be influenced by the organization or organizations that set it up. The maturity of the organization with respect to its project management systems, culture, style, organizational structure, and project management office can also influence the project. The following sections describe key aspects of these larger organizational structures that are likely to influence the project.

2.3.1 Organizational Systems

Project-based organizations are those whose operations consist primarily of projects. These organizations fall into two categories:

- Organizations that derive their revenue primarily from performing projects for others—architectural firms, engineering firms, consultants, construction contractors, government contractors, nongovernmental organizations, etc.
- Organizations that have adopted *management by projects* (see Section 1.3).

These organizations tend to have management systems in place to facilitate project management. For example, their financial systems are often specifically designed for accounting, tracking, and reporting on multiple simultaneous projects.

Nonproject-based organizations often lack management systems designed to support project needs efficiently and effectively. The absence of project-oriented systems usually makes project management more difficult. In some cases, nonproject-based organizations will have departments or other subunits that operate as project-based organizations with systems to match.

The project management team should be acutely aware of how the organization's systems affect the project. For example, if the organization rewards its functional managers for charging staff time to projects, then the project management team may need to implement controls to ensure that assigned staff members are being used effectively on the project.

Project Characteristics	Organization Structure	Functional	Matrix			Projectized
			Weak Matrix	Balanced Matrix	Strong Matrix	
Project Manager's Authority		Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Percent of Performing Organization's Personnel Assigned Full Time to Project Work		Virtually None	0–25%	15–60%	50–95%	85–100%
Project Manager's Role		Part-time	Part-time	Full-time	Full-time	Full-time
Common Titles for Project Manager's Role		Project Coordinator/ Project Leader	Project Coordinator/ Project Leader	Project Manager/ Project Officer	Project Manager/ Program Manager	Project Manager/ Program Manager
Project Management Administrative Staff		Part-time	Part-time	Part-time	Full-time	Full-time

Figure 2-6. Organizational Structure Influences on Projects

2.3.2 Organizational Cultures and Styles

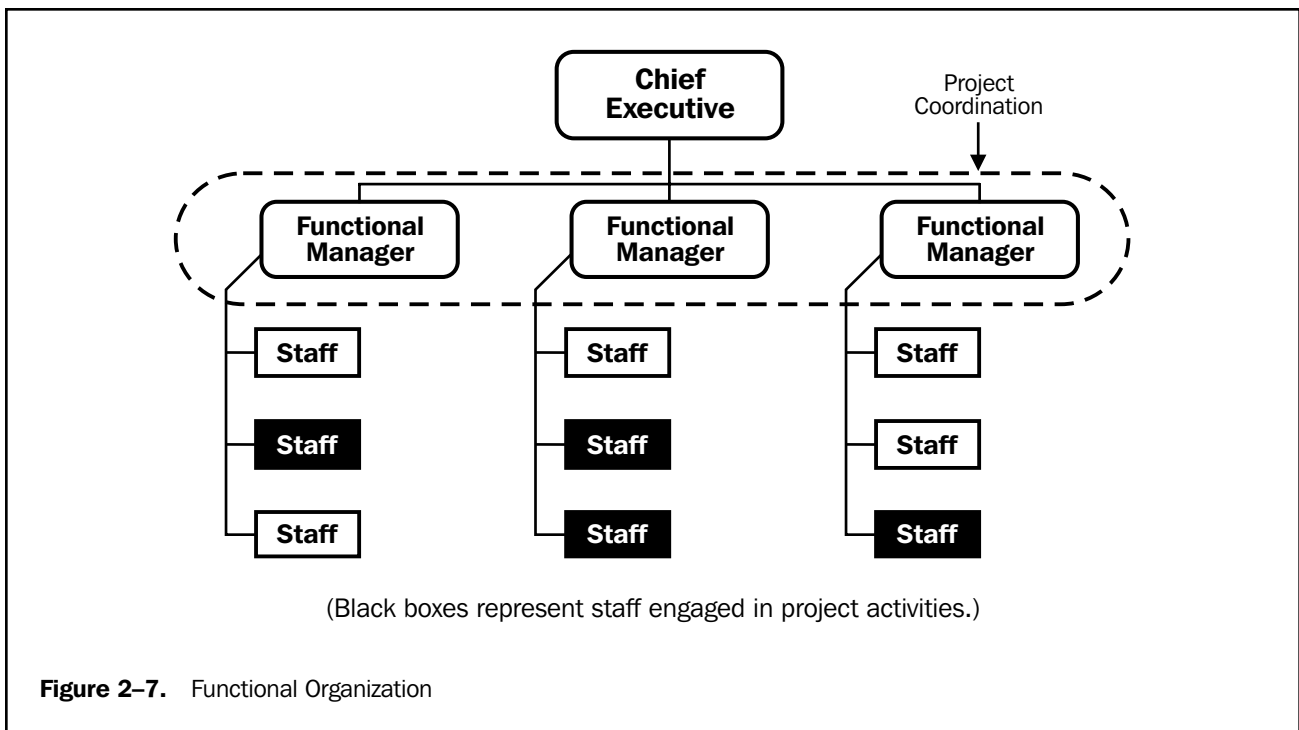
Most organizations have developed unique and describable cultures. These cultures are reflected in their shared values, norms, beliefs, and expectations; in their policies and procedures; in their view of authority relationships; and in numerous other factors. Organizational cultures often have a direct influence on the project. For example:

- A team proposing an unusual or high-risk approach is more likely to secure approval in an aggressive or entrepreneurial organization.
- A project manager with a highly participative style is apt to encounter problems in a rigidly hierarchical organization, while a project manager with an authoritarian style will be equally challenged in a participative organization.

2.3.3 Organizational Structure

The structure of the performing organization often constrains the availability of or terms under which resources become available to the project. Organizational structures can be characterized as spanning a spectrum from *functional* to *projectized*, with a variety of matrix structures in between. **Figure 2-6** shows key project-related characteristics of the major types of enterprise organizational structures. Project organization is discussed in Section 9.1, Organizational Planning.

The classic *functional organization*, shown in **Figure 2-7**, is a hierarchy where each employee has one clear superior. Staff members are grouped by specialty, such as production, marketing, engineering, and accounting at the top level, with engineering further subdivided into functional organizations that support the business of the larger organization (e.g., mechanical and electrical). Functional organizations still have projects, but the perceived scope of the project is limited to the boundaries of the function: the engineering department in a functional organization will do its work independent of the manufacturing or marketing departments.

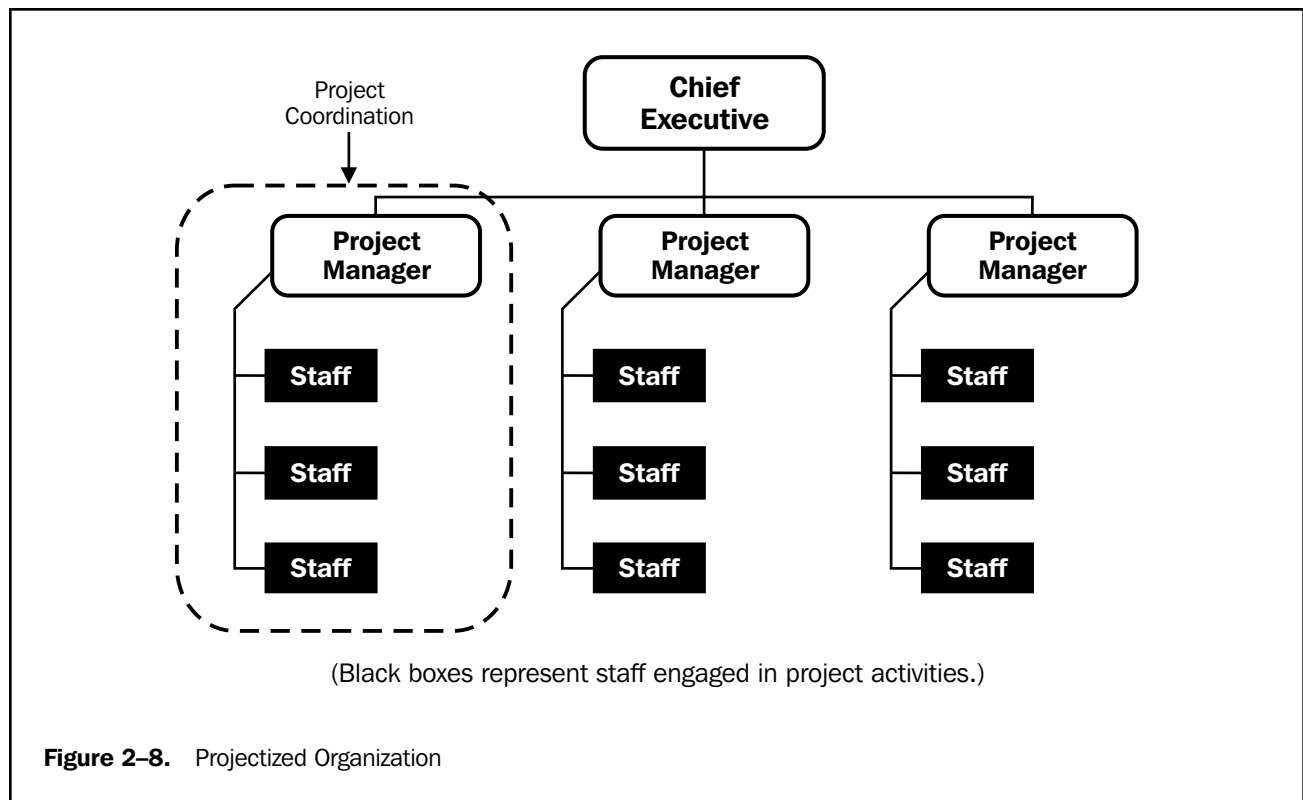


For example, when a new product development is undertaken in a purely functional organization, the design phase is often called a *design project* and includes only engineering department staff. If questions about manufacturing arise, they are passed up the hierarchy to the department head, who consults with the head of the manufacturing department. The engineering department head then passes the answer back down the hierarchy to the engineering project manager.

At the opposite end of the spectrum is the *projectized organization*, shown in **Figure 2-8**. In a projectized organization, team members are often collocated. Most of the organization's resources are involved in project work, and project managers have a great deal of independence and authority. Projectized organizations often have organizational units called departments, but these groups either report directly to the project manager or provide support services to the various projects.

Matrix organizations, as shown in **Figures 2-9** through **2-11**, are a blend of functional and projectized characteristics. Weak matrices maintain many of the characteristics of a functional organization, and the project manager role is more that of a coordinator or expeditor than that of a manager. In similar fashion, strong matrices have many of the characteristics of the projectized organization—full-time project managers with considerable authority and full-time project administrative staff.

Most modern organizations involve all these structures at various levels, as shown in **Figure 2-12**. For example, even a fundamentally functional organization may create a special project team to handle a critical project. Such a team may have many of the characteristics of a project in a projectized organization. The team may include full-time staff from different functional departments, it may develop its own set of operating procedures, and it may operate outside the standard, formalized reporting structure.



2.3.4 Project Office

There is a range of uses for what constitutes a project office. A project office may operate on a continuum from providing support functions to project managers in the form of training, software, templates, etc. to actually being responsible for the results of the project.

2.4 KEY GENERAL MANAGEMENT SKILLS

General management is a broad subject dealing with every aspect of managing an ongoing enterprise. Among other topics, it includes:

- Finance and accounting, sales and marketing, research and development, and manufacturing and distribution.
- Strategic planning, tactical planning, and operational planning.
- Organizational structures, organizational behavior, personnel administration, compensation, benefits, and career paths.
- Managing work relationships through motivation, delegation, supervision, team building, conflict management, and other techniques.
- Managing oneself through personal time management, stress management, and other techniques.

General management skills provide much of the foundation for building project management skills. They are often essential for the project manager. On any given project, skill in any number of general management areas may be required. This section describes key general management skills that are *highly likely to affect most projects* and that are not covered elsewhere in this document.

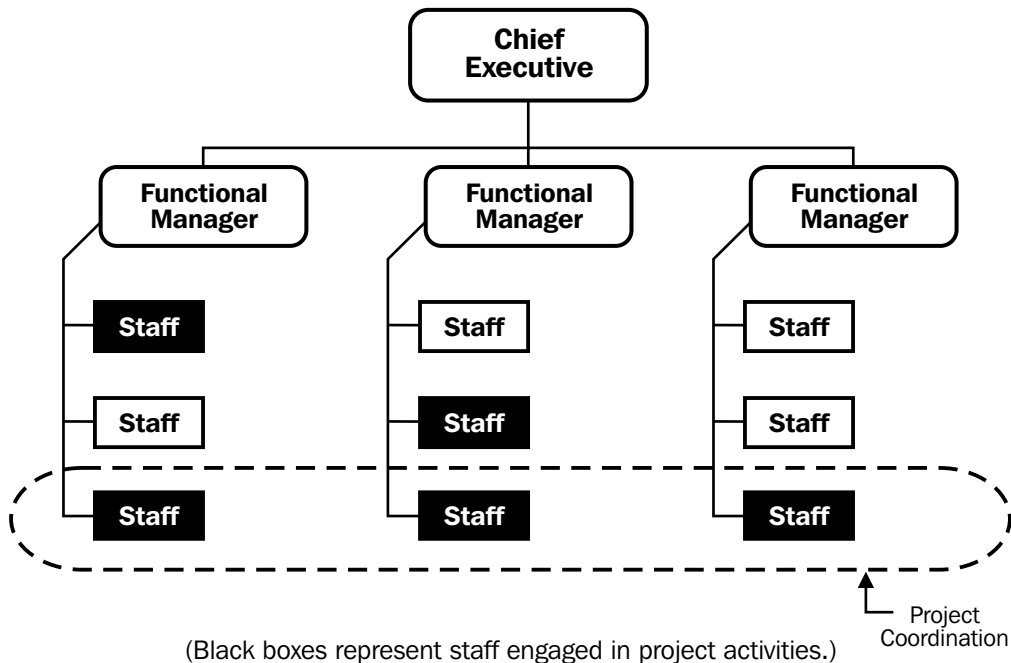


Figure 2-9. Weak Matrix Organization

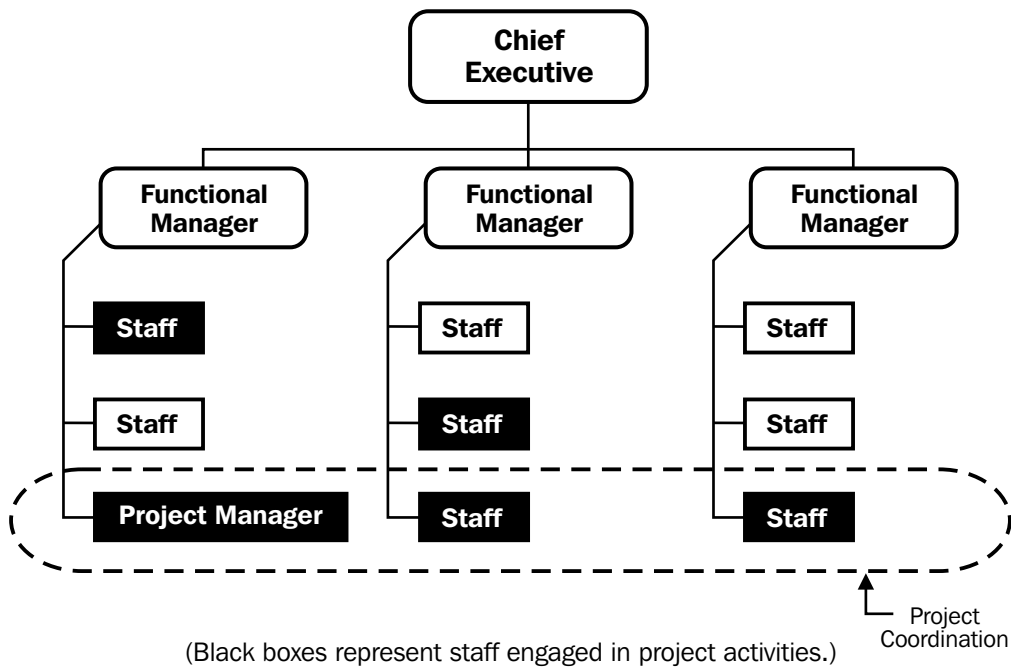
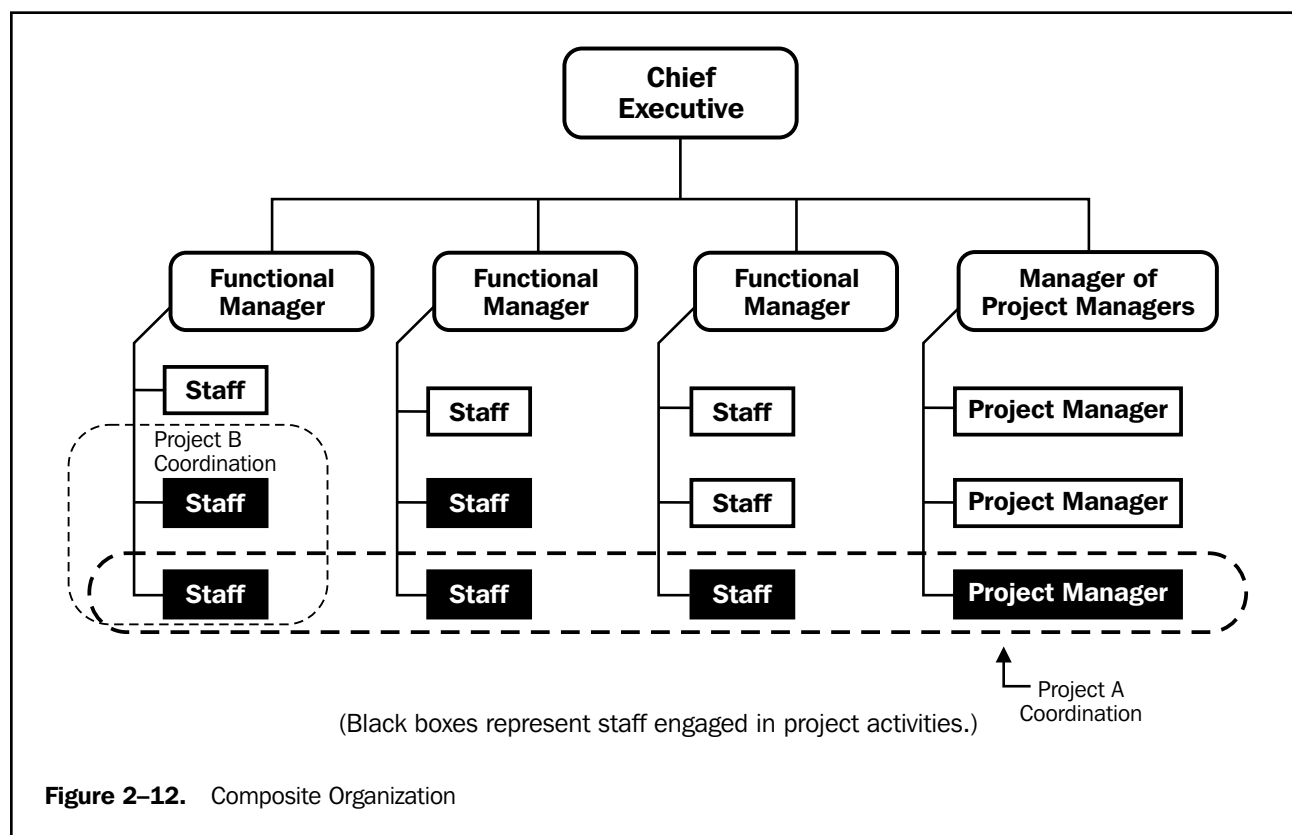
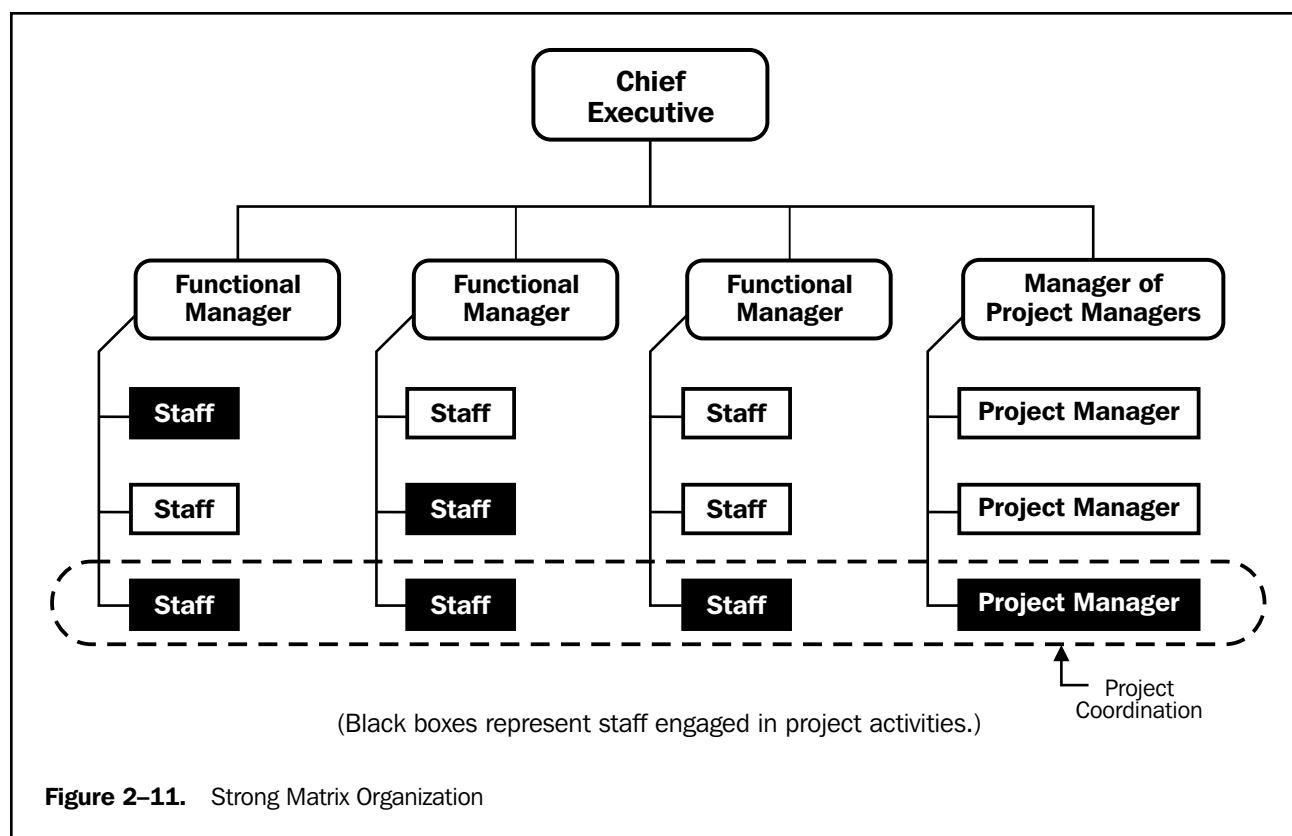


Figure 2-10. Balanced Matrix Organization



These skills are well documented in the general management literature, and their application is fundamentally the same on a project.

There are also many general management skills that are relevant only on certain projects or in certain application areas. For example, team member safety is critical on virtually all construction projects and of little concern on most software development projects.

2.4.1 Leading

Kotter (4) distinguishes between *leading* and *managing* while emphasizing the need for both: one without the other is likely to produce poor results. He says that managing is primarily concerned with “consistently producing key results expected by stakeholders,” while leading involves:

- Establishing direction—developing both a vision of the future and strategies for producing the changes needed to achieve that vision.
- Aligning people—communicating the vision by words and deeds to all those whose cooperation may be needed to achieve the vision.
- Motivating and inspiring—helping people energize themselves to overcome political, bureaucratic, and resource barriers to change.

On a project, particularly a larger project, the project manager is generally expected to be the project’s leader as well. Leadership is not, however, limited to the project manager: it may be demonstrated by many different individuals at many different times during the project. Leadership must be demonstrated at all levels of the project (project leadership, technical leadership, and team leadership).

2.4.2 Communicating

Communicating involves the exchange of information. The sender is responsible for making the information clear, unambiguous, and complete so that the receiver can receive it correctly. The receiver is responsible for making sure that the information is received in its entirety and understood correctly. Communicating has many dimensions:

- Written and oral, listening and speaking.
- Internal (within the project) and external (to the customer, the media, the public, etc.).
- Formal (reports, briefings, etc.) and informal (memos, ad hoc conversations, etc.).
- Vertical (up and down the organization) and horizontal (with peers and partner organization).

The general management skill of communicating is related to, but not the same as, Project Communications Management (described in Chapter 10). Communicating is the broader subject and involves a substantial body of knowledge that is not unique to the project context, for example:

- Sender-receiver models—feedback loops, barriers to communications, etc.
- Choice of media—when to communicate in writing, when to communicate orally, when to write an informal memo, when to write a formal report, etc.

- Writing style—active versus passive voice, sentence structure, word choice, etc.
- Presentation techniques—body language, design of visual aids, etc.
- Meeting management techniques—preparing an agenda, dealing with conflict, etc.

Project Communications Management is the application of these broad concepts to the specific needs of a project—for example, deciding how, when, in what form, and to whom to report project performance.

2.4.3 Negotiating

Negotiating involves conferring with others to come to terms with them or reach an agreement. Agreements may be negotiated directly or with assistance; mediation and arbitration are two types of assisted negotiation.

Negotiations occur around many issues, at many times, and at many levels of the project. During the course of a typical project, project staff is likely to negotiate for any or all of the following:

- Scope, cost, and schedule objectives.
- Changes to scope, cost, or schedule.
- Contract terms and conditions.
- Assignments.
- Resources.

2.4.4 Problem Solving

Problem solving involves a combination of problem definition and decision-making.

Problem definition requires distinguishing between causes and symptoms. Problems may be internal (a key employee is reassigned to another project) or external (a permit required to begin work is delayed). Problems may be technical (differences of opinion about the best way to design a product), managerial (a functional group is not producing according to plan), or interpersonal (personality or style clashes).

Decision-making includes analyzing the problem to identify viable solutions, and then making a choice from among them. Decisions can be made or obtained (from the customer, from the team, or from a functional manager). Once made, decisions must be implemented. Decisions also have a time element to them—the “right” decision may not be the “best” decision if it is made too early or too late.

2.4.5 Influencing the Organization

Influencing the organization involves the ability to “get things done.” It requires an understanding of both the formal and informal structures of all the organizations involved—the performing organization, customer, partners, contractors, and numerous others, as appropriate. Influencing the organization also requires an understanding of the mechanics of power and politics.

Both power and politics are used here in their positive senses. Pfeffer (5) defines power as “the potential ability to influence behavior, to change the course of events, to overcome resistance, and to get people to do things that they would not otherwise do.” In similar fashion, Eccles et al. (6) say that “politics is about getting collective action from a group of people who may have quite different interests. It is about being willing to use conflict and disorder creatively. The negative sense, of course, derives from the fact that attempts to reconcile these interests result in power struggles and organizational games that can sometimes take on a thoroughly unproductive life of their own.”

2.5 SOCIAL-ECONOMIC-ENVIRONMENTAL INFLUENCES

Like general management, *socioeconomic influences* include a wide range of topics and issues. The project management team must understand that current conditions and trends in this area may have a major effect on its project: a small change here can translate, usually with a time lag, into cataclysmic upheavals in the project itself. Of the many potential socioeconomic influences, several major categories that frequently affect projects are described briefly below.

2.5.1 Standards and Regulations

The International Organization for Standardization (ISO) differentiates between standards and regulations as follows (7):

- A *standard* is a “document approved by a recognized body, that provides, for common and repeated use, rules, guidelines, or characteristics for products, processes or services with which compliance is not mandatory.” There are numerous standards in use covering everything from thermal stability of hydraulic fluids to the size of computer diskettes.
- A *regulation* is a “document, which lays down product, process or service characteristics, including the applicable administrative provisions, with which compliance is mandatory.” Building codes are an example of regulations.

Care must be used in discussing standards and regulations since there is a vast gray area between the two; for example:

- Standards often begin as guidelines that describe a preferred approach, and later, with widespread adoption, become *de facto* regulations (e.g., the use of the Critical Path Method for scheduling major construction projects).
- Compliance may be mandated at different levels (e.g., by a government agency, by the management of the performing organization, or by the project management team).

For many projects, standards and regulations (by whatever definition) are well known, and project plans can reflect their effects. In other cases, the influence is unknown or uncertain and must be considered under Project Risk Management (described in Chapter 11).

2.5.2 Internationalization

As more and more organizations engage in work that spans national boundaries, more and more projects span national boundaries as well. In addition to the traditional concerns of scope, cost, time, and quality, the project management team must also consider the effect of time-zone differences, national and regional holidays, travel requirements for face-to-face meetings, the logistics of teleconferencing, and often volatile political differences.

2.5.3 Cultural Influences

Culture is the “totality of socially transmitted behavior patterns, arts, beliefs, institutions, and all other products of human work and thought” (8). Every project must operate within a context of one or more cultural norms. This area of influence includes political, economic, demographic, educational, ethical, ethnic, religious, and other areas of practice, belief, and attitudes that affect the way that people and organizations interact.

2.5.4 Social-Economic-Environmental Sustainability

Virtually all projects are planned and implemented in a social, economic, and environmental context, and have intended and unintended positive and/or negative impacts. Organizations are increasingly accountable for impacts resulting from a project (e.g., accidental destruction of archeological sites in a road construction project), as well as for the effects of a project on people, the economy, and the environment long after it has been completed (e.g., a roadway can facilitate the access to and destruction of a once pristine environment).

Chapter 3

Project Management Processes

Project management is an integrative endeavor—an action, or failure to take action, in one area will usually affect other areas. The interactions may be straightforward and well understood, or they may be subtle and uncertain. For example, a scope change will almost always affect project cost, but it may or may not affect team morale or product quality.

These interactions often require tradeoffs among project objectives—performance in one area may be enhanced only by sacrificing performance in another. The specific performance tradeoffs may vary from project to project and organization to organization. Successful project management requires actively managing these interactions. Many project management practitioners refer to the project triple constraint as a framework for evaluating competing demands. The project triple constraint is often depicted as a triangle where either the sides or corners represent one of the parameters being managed by the project team.

To help in understanding the integrative nature of project management, and to emphasize the importance of integration, this document describes project management in terms of its component processes and their interactions. This chapter provides an introduction to the concept of project management as a number of interlinked processes, and thus provides an essential foundation for understanding the process descriptions in Chapters 4 through 12. It includes the following major sections:

- 3.1 Project Processes**
- 3.2 Process Groups**
- 3.3 Process Interactions**
- 3.4 Customizing Process Interactions**
- 3.5 Mapping of Project Management Processes**

3.1 PROJECT PROCESSES

Projects are composed of processes. A *process* is “a series of actions bringing about a result” (1). Project processes are performed by people and generally fall into one of two major categories:

- *Project management processes* describe, organize, and complete the work of the project. The project management processes that are applicable to most projects, most of the time, are described briefly in this chapter and in detail in Chapters 4 through 12.
- *Product-oriented processes* specify and create the project's product. Product-oriented processes are typically defined by the project life cycle (discussed in Section 2.1) and vary by application area (discussed in Appendix E).

Project management processes and product-oriented processes overlap and interact throughout the project. For example, the scope of the project cannot be defined in the absence of some basic understanding of how to create the product.

3.2 PROCESS GROUPS

Project management processes can be organized into five groups of one or more processes each:

- Initiating processes—authorizing the project or phase.
- Planning processes—defining and refining objectives and selecting the best of the alternative courses of action to attain the objectives that the project was undertaken to address.
- Executing processes—coordinating people and other resources to carry out the plan.
- Controlling processes—ensuring that project objectives are met by monitoring and measuring progress regularly to identify variances from plan so that corrective action can be taken when necessary.
- Closing processes—formalizing acceptance of the project or phase and bringing it to an orderly end.

The process groups are linked by the results they produce—the result or outcome of one often becomes an input to another. Among the central process groups, the links are iterated—planning provides executing with a documented project plan early on, and then provides documented updates to the plan as the project progresses. These connections are illustrated in **Figure 3-1**. In addition, the project management process groups are not discrete, one-time events; they are overlapping activities that occur at varying levels of intensity throughout each phase of the project. **Figure 3-2** illustrates how the process groups overlap and vary within a phase.

Finally, the process group interactions also cross phases such that closing one phase provides an input to initiating the next. For example, closing a design phase requires customer acceptance of the design document. Simultaneously, the design document defines the product description for the ensuing implementation phase. This interaction is illustrated in **Figure 3-3**.

Repeating the initiation processes at the start of each phase helps to keep the project focused on the business need that it was undertaken to address. It should also help ensure that the project is halted if the business need no longer exists, or if the project is unlikely to satisfy that need. Business needs are discussed in more detail in the introduction to Section 5.1, Initiation.

It is important to note that the actual inputs and outputs of the processes depend upon the phase in which they are carried out. Although **Figure 3-3** is drawn with discrete phases and discrete processes, in an actual project there will be many overlaps. The planning process, for example, must not only provide details

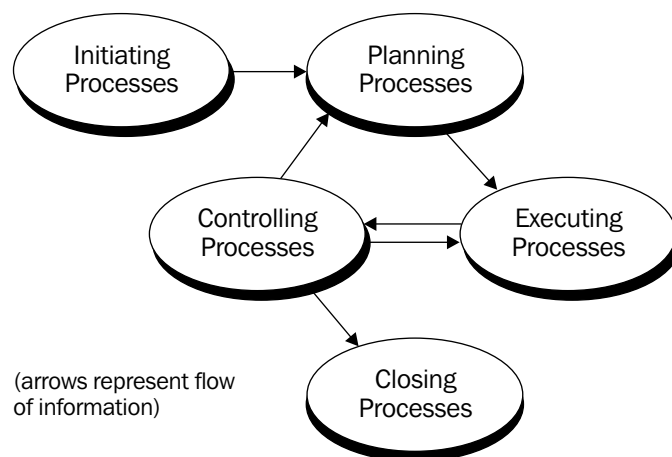


Figure 3–1. Links among Process Groups in a Phase

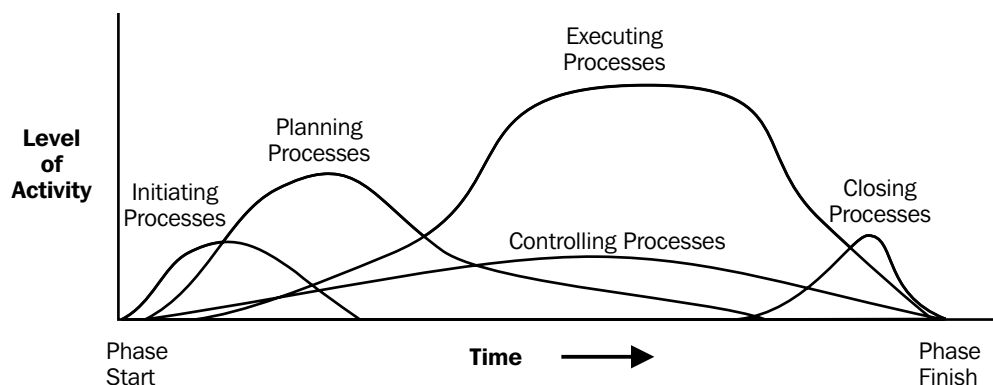


Figure 3–2. Overlap of Process Groups in a Phase

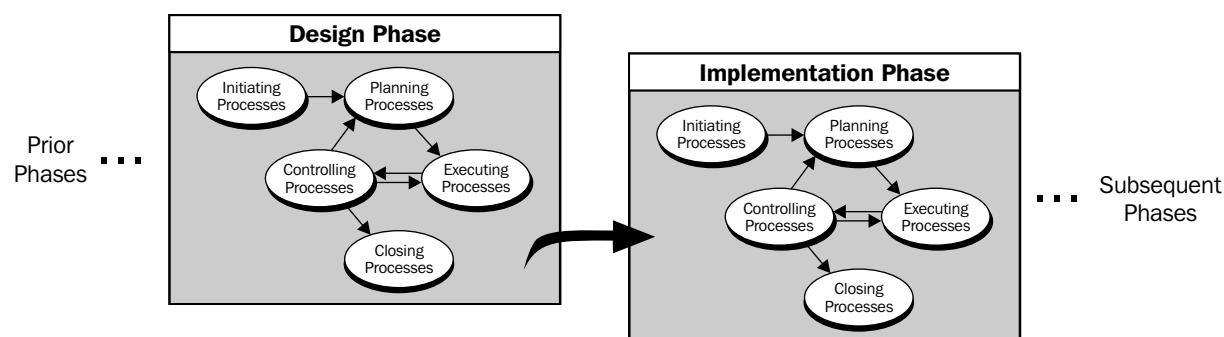
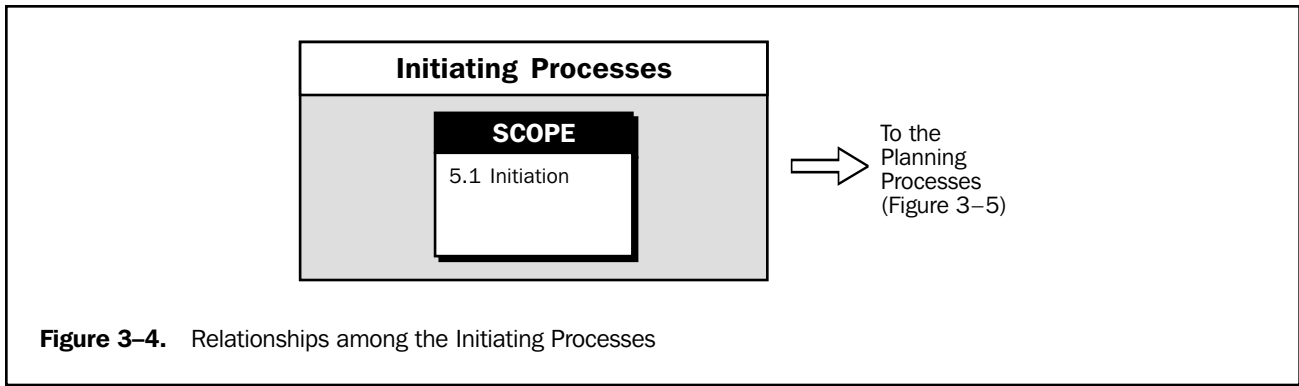


Figure 3–3. Interaction between Phases



of the work to be done to bring the current phase of the project to successful completion, but must also provide some preliminary description of work to be done in later phases. This progressive detailing of the project plan is often called *rolling wave planning*, indicating that planning is an iterative and ongoing process.

Involving stakeholders in the project phases generally improves the probability of satisfying customer requirements and realizes the *buy-in* or shared ownership of the project by the stakeholders, which is often critical to project success.

3.3 PROCESS INTERACTIONS

Within each process group, the individual processes are linked by their inputs and outputs. By focusing on these links, we can describe each process in terms of its:

- Inputs—documents or documentable items that will be acted upon.
- Tools and techniques—mechanisms applied to the inputs to create the outputs.
- Outputs—documents or documentable items that are a result of the process.

The project management processes common to most projects in most application areas are listed here and described in detail in Chapters 4 through 12. The numbers in parentheses after the process names identify the chapter and section where each is described. The process interactions illustrated here are also typical of most projects in most application areas. Section 3.4 discusses customizing both process descriptions and interactions.

3.3.1 Initiating Processes

Figure 3-4 illustrates the single process in this process group.

- Initiation (5.1)—authorizing the project or phase is part of project scope management.

3.3.2 Planning Processes

Planning is of major importance to a project because the project involves doing something that has not been done before. As a result, there are relatively more processes in this section. However, the number of processes does not mean that project management is primarily planning—the amount of planning performed should be commensurate with the scope of the project and the usefulness of the information developed. Planning is an ongoing effort throughout the life of the project.

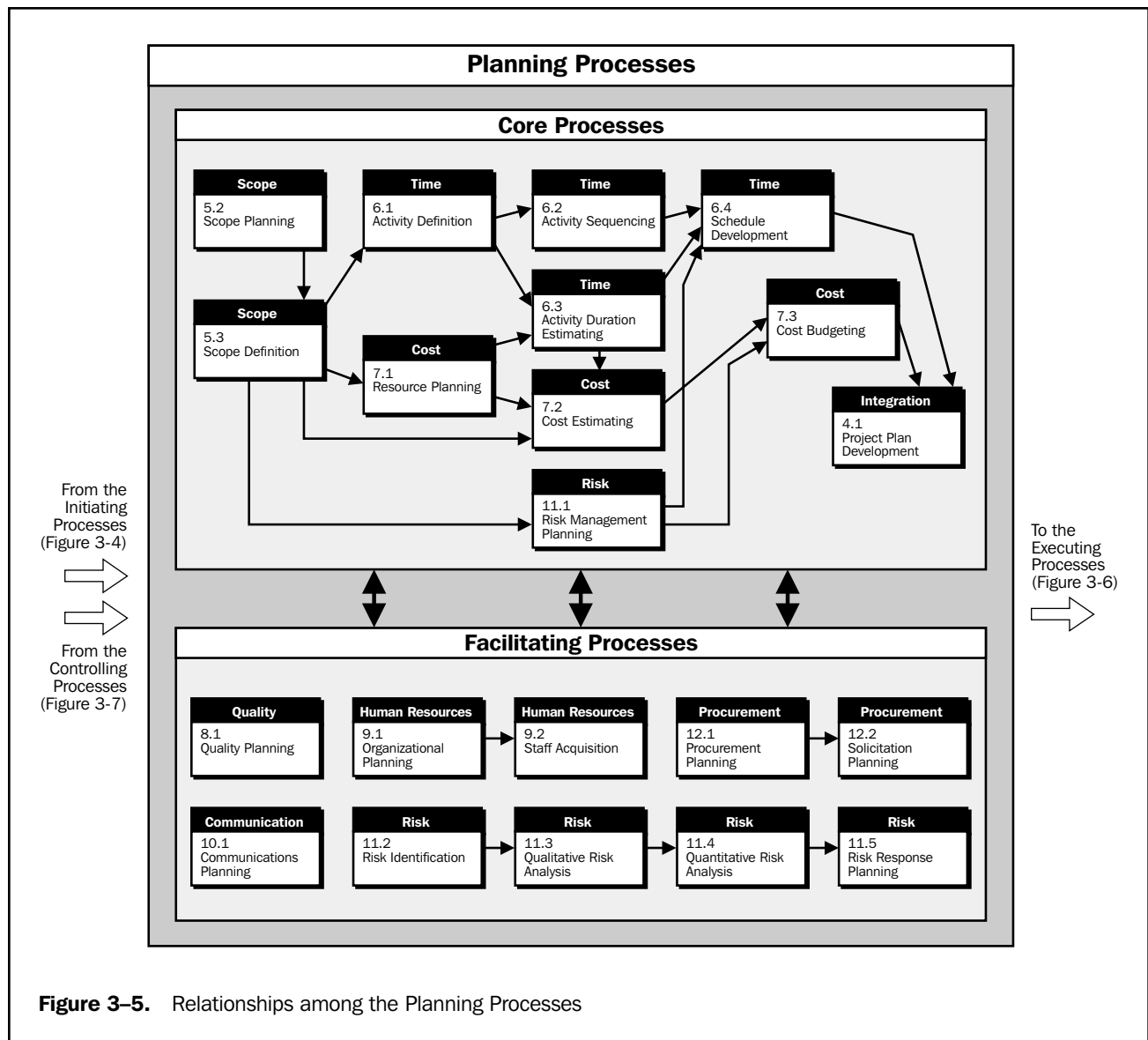


Figure 3-5. Relationships among the Planning Processes

The relationships among the project planning processes are shown in **Figure 3-5** (this chart is an explosion of the ellipse labeled “Planning Processes” in **Figure 3-1**). These processes are subject to frequent iterations prior to completing the project plan. For example, if the initial completion date is unacceptable, project resources, cost, or even scope may need to be redefined. In addition, planning is not an exact science—two different teams could generate very different plans for the same project.

Core processes. Some planning processes have clear dependencies that require them to be performed in essentially the same order on most projects. For example, activities must be defined before they can be scheduled or costed. These *core planning processes* may be iterated several times during any one phase of a project. They include:

- Scope Planning (5.2)—developing a written scope statement as the basis for future project decisions.
- Scope Definition (5.3)—subdividing the major project deliverables into smaller, more manageable components.
- Activity Definition (6.1)—identifying the specific activities that must be performed to produce the various project deliverables.
- Activity Sequencing (6.2)—identifying and documenting interactivity dependencies.
- Activity Duration Estimating (6.3)—estimating the number of work periods that will be needed to complete individual activities.
- Schedule Development (6.4)—analyzing activity sequences, activity durations, and resource requirements to create the project schedule.
- Risk Management Planning (11.1)—deciding how to approach and plan for risk management in a project.
- Resource Planning (7.1)—determining what resources (people, equipment, materials, etc.) and what quantities of each should be used to perform project activities.
- Cost Estimating (7.2)—developing an approximation (estimate) of the costs of the resources required to complete project activities.
- Cost Budgeting (7.3)—allocating the overall cost estimate to individual work packages.
- Project Plan Development (4.1)—taking the results of other planning processes and putting them into a consistent, coherent document.

Facilitating processes. Interactions among the other planning processes are more dependent on the nature of the project. For example, on some projects, there may be little or no identifiable risk until after most of the planning has been done and the team recognizes that the cost and schedule targets are extremely aggressive and thus involve considerable risk. Although these *facilitating processes* are performed intermittently and as needed during project planning, they are not optional. They include:

- Quality Planning (8.1)—identifying which quality standards are relevant to the project and determining how to satisfy them.
- Organizational Planning (9.1)—identifying, documenting, and assigning project roles, responsibilities, and reporting relationships.
- Staff Acquisition (9.2)—getting the human resources needed assigned to and working on the project.
- Communications Planning (10.1)—determining the information and communications needs of the stakeholders: who needs what information, when will they need it, and how will it be given to them.
- Risk Identification (11.2)—determining which risks are likely to affect the project and documenting the characteristics of each.
- Qualitative Risk Analysis (11.3)—performing a qualitative analysis of risks and conditions to prioritize their effects on project objectives.
- Quantitative Risk Analysis (11.4)—measuring the probability and impact of risks and estimating their implications for project objectives.
- Risk Response Planning (11.5)—developing procedures and techniques to enhance opportunities and to reduce threats to the project's objectives from risk.