Project Management

PROJECT MANAGEMENT The Managerial Process

Clifford F. Gray

Oregon State University

Erik W. Larson

Oregon State University



McGraw-Hill Higher Education

A Division of The McGraw-Hill Companies

PROJECT MANAGEMENT The Managerial Process

Copyright ©2000 by The McGraw-Hill Companies, Inc. All rights reserved. Printed in the United States of America. Except as permitted under the United States Copyright Act of 1976, no part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written permission of the publisher.

This book is printed on acid-free paper.

3 4 5 6 7 8 9 0 DOW/DOW 9 0 9 8 7 6 5 4 3 2 1

ISBN 0-07-365812-X

Vice president/Editor-in-Chief: Michael W. Junior

Publisher: Jeffrey J. Shelstad

Senior sponsoring editor: Scott Isenberg
Developmental editor: Wanda J. Zeman
Senior marketing manager: Colleen J. Suljic
Project manager: Margaret Rathke Bogovich
Senior production supervisor: Lori Koetters
Designer: Jennifer McQueen Hollingsworth
Supplement coordinator: Betty Hadala
Compositor: ElectraGraphics, Inc.
Typeface: 10.5/12 Times Roman

Printer: R. R. Donnelley & Sons Company

Photos for Chapters 1, 2, 3, 5, 6, 7, 8, 9, 11, 12, and 14 are © Copyright 1999 PhotoDisc, Inc. All

rights reserved.

Cover image: © The Image Bank, Team Work Puzzle, Pierre Goavec

Library of Congress Cataloging-in-Publication Data

Gray, Clifford F.

Project management: the managerial process/Clifford F. Gray, Erik W. Larson.

p. cm. — (The Irwin/McGraw Hill series, operations and decision sciences)

Includes bibliographical references and index.

ISBN 0-07-365812-X

1. Industrial project management. 2. Time management. 3. Risk

management. I. Larson, Erik W., 1952- . II. Title.

III. Series: Irwin/McGraw Hill series in operations and decision sciences.

HD69.P75G72 2000

659.4'04—dc21

99-27905

PROJECT MANAGEMENT

The Irwin/McGraw-Hill Series

Operations and Decision Sciences

OPERATIONS MANAGEMENT

Bowersox and Closs

Logistical Management: The Integrated Supply Chain Process

First Edition

Chase, Aquilano, and Jacobs

Production and Operations Management

Eighth Edition

Chu, Hottenstein, and Greenlaw

PROSIM for Windows

Third Edition

Cohen and Apte

Manufacturing Automation

First Edition

Davis, Aquilano, and Chase

Fundamentals of Operations Management

Third Edition

Dobler and Burt

Purchasing and Supply Management

Sixth Edition

Flaherty

Global Operations Management

First Edition

Fitzsimmons and Fitzsimmons

Service Management: Operations, Strategy, Information

Technology Second Edition

Gray and Larson

Project Management: The Managerial Process

First Edition

Hill

Manufacturing Strategy: Text & Cases

Third Edition

Hopp and Spearman

Factory Physics

Second Edition

Lambert and Stock

Strategic Logistics Management

Third Edition

Leenders and Fearon

Purchasing and Supply Chain Management

Eleventh Edition

Melnyk and Denzler

Operations Management

First Edition

Moses, Seshadri, and Yakir

HOM Operations Management Software for Windows

First Edition

Nahmias

Production and Operations Analysis

Third Edition

Nicholos

Competitive Manufacturing Management

First Edition

Pinedo and Chao

Operations Scheduling

First Edition

Sanderson and Uzumeri

Managing Product Families

First Edition

Schroeder

Operations Management: Contemporary Concepts and Cases

First Edition

Schonberger and Knod

Operations Management: Customer-Focused Principles

Sixth Edition

Simchi-Levi, Kaminsky, and Simchi-Levi

Designing and Managing the Supply Chain: Concepts, Strategies,

and Cases

First Edition

Stevenson

Production/Operations Management

Sixth Edition

Sterman

Business Dynamics: Systems Thinking and Modeling for a

Complex World

First Edition

Vollmann, Berry, and Whybark

Manufacturing Planning & Control Systems

Fourth Edition

Zipkin

Foundations of Inventory Management

First Edition

QUANTITATIVE METHODS AND MANAGEMENT SCIENCE

Bodily, Carraway, Frey, Pfeifer

Quantitative Business Analysis: Casebook

First Edition

Bodily Corrowov, Frey Pfeifer

'Quantitative Business Analysis: Text and Cases

First Edition

Bonini, Hausman, and Meridan

Quantitative Analysis for Business Decisions

Ninth Enten

Hesse

Managerial Spreadsheet Modeling and Analysis

First American Street

Hillier, Hillier, Lieberman

Introduction to Management Science: A Modeling and Case

Studies Approach with Spreadsheets

First Edition

ABOUT THE AUTHORS

CLIFFORD F. GRAY is professor emeritus of management at the College of Business, Oregon State University. He continues to teach undergraduate and graduate project management courses overseas and in the United States; he has personally taught more than 100 executive development seminars and workshops. His research and consulting interests have been divided equally between operations management and project management; he has published numerous articles in these areas, plus a text on project management. He has also conducted research with colleagues in the International Project Management Association. Cliff has been a member of the Project Management Institute since 1976 and was one of the founders of the Portland, Oregon, chapter. He has been the president of Project Management International, Inc. (a training and consulting firm specializing in project management) since 1977. He received his BA in economics and management from Millikin University, MBA from Indiana University, and doctorate in operations management from the College of Business, University of Oregon.

ERIK LARSON is professor and chairman of the department of management, marketing, and international business at the College of Business, Oregon State University. He teaches executive, graduate, and undergraduate courses on project management, organizational behavior, and leadership. His research and consulting activities focus on project management. He has published numerous articles on matrix management, product development, and project partnering. He has been a member of the Portland, Oregon, chapter of the Project Management Institute since 1984. In 1995 he worked as a Fulbright scholar with faculty at the Krakow Academy of Economics on modernizing Polish business education. He received a BA in psychology from Claremont McKenna College and a PhD in management from State University of New York at Buffalo.

To Mary, Kevin, and Robert C.F.G. To Ann, Mary, Rachel, and Tory E.L.

PREFACE

Our motivation for writing this text was to provide for our students a text built around a holistic, integrative view of project management. A holistic view of project management focuses on how projects contribute to the strategic goals of the organization. The linkages for integration include the process of selection of projects that best support organizational strategy and all the technical and managerial processes to complete those projects. The goals for prospective project managers are to clearly understand the role of a project in their organizations and to master project management tools/techniques and interpersonal skills necessary to orchestrate projects to completion.

The role of projects in organizations is receiving increasing attention. Projects are becoming the major tool for reaching the strategic goals of the organization. Given savage worldwide competition, many organizations have reorganized around a philosophy of innovation, renewal, and organizational learning to survive. This philosophy suggests an organization that is flexible and project driven. Project management has developed to the point where it is a professional discipline having its own body of knowledge and skills. Today it is nearly impossible to imagine anyone at any level in the organization who would not benefit from some degree of expertise in the process of managing projects.

AUDIENCE

This text is written for a wide audience. Students and prospective project managers will find the text useful to understand why organizations have developed a formal project management process to gain a competitive advantage. Readers will find the concepts and techniques discussed in enough detail to be immediately useful in new-project situations. Practicing project managers will find the text a useful guide and reference for typical problems that pop up. Managers will also find the text useful to understand the role of the project in the mission of their organization. Analysts will find the text useful in explaining the data needed and the operations of inherited or purchased software. Members of the Project Management Institute will find the text a use-

ful handbook when preparing for project management certification. People at all levels in the organization assigned to work on projects will find the text useful in providing the rationale behind project management tools and techniques and will gain insights on how to enhance their contributions to project success.

Our emphasis is not only on *how* the management process works, but more importantly *why* it works. The concepts, principles, and techniques are universally applicable. That is, the text does not specialize by project type—for example, construction, product development, large, small. Rather, the text is written for the individual who will be required to manage a variety of projects. In the case of some small projects, a few of the steps of the techniques can be omitted, but the conceptual framework applies to all organizations in which projects are important to survival. The approach can be used in pure project organizations such as construction, research organizations, and consultant engineering firms. Organizations that spend most of their daily effort producing products or services will find the text useful in managing the many small projects that are going on while the daily production continues.

CONTENT

The text addresses the major questions and issues the authors have encountered over their 50 combined years of teaching project management and consulting with practicing project managers in domestic and foreign environments. The following questions represent the issues and problems practicing project managers find consuming most of their effort: What is the strategic role of projects in contemporary organizations? How are projects prioritized? What organizational and managerial styles will improve chances of project success? How do project managers orchestrate the complex network of relationships involving vendors, subcontractors, project team members, senior management, functional managers, and customers that affect project success? What factors contribute to the development of a high-performance project team? What project management system can be set up to gain some measure of control? How do managers prepare for a new international project in a foreign culture? Can senior management change the organizational culture to support projects?

Project managers must deal with all these concerns to be effective. All of these issues and problems represent linkages to an integrative project management view. The chapter content of the text has been placed within an overall framework that integrates these topics in a holistic manner. Cases and snapshots are included from the experiences of practicing managers. The future for project managers appears to be promising. Careers will be determined by success in managing projects.

ACKNOWLEDGMENTS

The text includes contributions from numerous students, colleagues, friends, and managers gleaned from professional conversations. We want them to know we sincerely appreciate their counsel and suggestions. Almost every exercise, case, and example in the text is drawn from a real-world project. Special thanks to managers who graciously shared their current project as ideas for exercises, subjects for cases, and examples for the text. Shlomo Cohen, Pat Taylor, and John Wold, whose work is printed, are gratefully acknowledged. Special gratitude is due Robert Breitbarth of Interact Management, who shared invaluable insights on prioritizing projects. University students and managers deserve special accolades for identifying problems with earlier drafts of the text and exercises.

We would like to thank the reviewers of this book who contributed significantly to the final product. They include S. Narayan Bodapati, Southern Illinois University at Edwardsville; Warren J. Boe, University of Iowa; Burton Dean, San Jose State University; Kwasi Amoako-Gyampah, University of North Carolina–Greensboro; Owen P. Hall, Pepperdine University; Michael R. Godfrey, Winona State University; Bruce C. Hartman, University of Arizona; Richard Irving, York University; Robert T. Jones, DePaul University; Richard L. Luebbe, Miami University of Ohio; William Moylan, Lawrence Technological College of Business; Edward Pascal, University of Ottawa; James H. Patterson, Indiana University; Art Rogers, City University; Christy Strbiak, U.S. Air Force Academy; David A. Vaughan, City University; and Ronald W. Witzel, Keller Graduate School of Management.

In addition, we would like to thank our colleagues in the College of Business at Oregon State University for their support and help in completing this project. In particular, we recognize Carol Brown, Dan Brown, Ashok Chandrashekar, Jack Drexler, Dave Gobeli, Chandra Mishra, and Mary Alice Seville for their helpful comments and suggestions. Special thanks go to Karen Bruder, Ann Leen, and Eva Hofenbredl who helped prepare the manuscript. We also wish to thank the many students who helped us at different stages of this project, most notably Kitty Taghon, Nel Young, Rebecca Keepers, Katherine Knox, and Phong Duong. Mary Gray deserves special credit for editing and working under tight deadlines.

Finally, we want to extend our thanks to all the people at Irwin/McGraw-Hill for their efforts and support. We'd like to thank Scott Isenberg for championing the project during the early development stage and Wanda Zeman and Maggie Rathke Bogovich for managing the final development/production phase of the project.

Clifford F. Gray Erik W. Larson

NOTE TO STUDENT

You will find the content of this text highly practical, relevant, and current. The concepts discussed are relatively simple and intuitive. As you study each chapter we suggest you try to grasp not only *how* things work, but *why* things work. You are encouraged to use the text as a handbook as you move through the three levels of competency:

I know.

I can do.

I can adapt to new situations.

Project management is both people and technical oriented. Project management involves understanding the cause-effect relationships and interactions among the sociotechnical dimensions of projects. Improved competency in these dimensions will greatly enhance your competitive edge as a project manager.

The field of project management is growing in importance and at an exponential rate. It is nearly impossible to imagine a future management career that does not include management of projects. Résumés of managers will soon be primarily a description of the individual's participation in projects and their respective contributions.

Good luck on your journey through the text and on your future projects.

BRIEF CONTENTS

1.	MODERN PROJECT MANAGEMENT	3	10. MANAGING PROJECT TEAMS	293
2.	INTEGRATION OF ORGANIZATION STRATEGY WITH PROJECTS	23	11. PARTNERING: MANAGING INTERORGANIZATIONAL RELATIONS	331
3.	DEFINING THE PROJECT	61	12. PROGRESS AND PERFORMANCE	
4.	DEVELOPING A NETWORK PLAN	89	MEASUREMENT AND EVALUATION	359
5.	MANAGING RISK	139	13. PROJECT AUDIT AND CLOSURE	411
6.	REDUCING PROJECT TIME	169	14. INTERNATIONAL PROJECTS	433
7.	SCHEDULING RESOURCES	191	15. THE PROCESS OF PROJECT MANAGEMENT AND THE FUTURE	461
8.	ORGANIZATION	221		401
9.	LEADERSHIP: BEING AN EFFECTIVE PROJECT MANAGER	261		

TABLE OF CONTENTS

Preface

reface		Absence of a Priority System Linked	
1. MODERN PROJECT MANAGEMENT	3	to Strategy Creates Problems	29
What Is a Project?	4	Snapshot from Practice: The SAS Turnaround	30
The Importance of Project Management Snapshot from Practice: The Best Wireless Phone on the Market	7 8	Moving to an Effective Organizational Priority System	33
Snapshot from Practice: The Emergence of e.Schwab	11	A Generic Selection and Priority System Snapshot from Practice:	36
The Evolution of Project Management Systems	12	Y2K Projects	38
Project Management Today—An Integrativ Approach		Assessing the Effectiveness of the Priority System Over the Long Haul—The Balanced Scorecard Model	41
Summary Research Highlight: Chaos: Software Projects	16 17	Case Study: A Detailed Selection Priority Model from Practice	41
Text Overview	17	Summary	47
Review Questions	18	Review Questions	48
Exercises	19	Endnotes	48
Endnotes Case:	19	Bibliography <i>Case:</i>	49
South American Adventures Unlimited	20	Jarvis Communication Corporation Case:	50
2. INTEGRATION OF ORGANIZATION STRATEGY WITH PROJECTS	23	Hector Gaming Company Case:	51
The Strategic Management Process: An		Film Prioritization	52
Overview Research Highlight:	24	Appendix 2–1: Sample: Interface Poles and Propositivities	
Muddling	29	Sample: Interface Roles and Responsibilities of Key Players	57
			xiii

XIV TABLE OF CONTENTS

	Appendix 2–2:		Level of Detail for Activities	104
	Sample: Interview Questionnaire	58	Loose Ends	106
з.	DEFINING THE PROJECT	61	Extended Network Techniques to Come	
	Step 1: Defining the Project Scope	61	Closer to Reality	109
	Step 2: Establishing Project Priorities	63	Summary	114
	Snapshot from Practice:		Review Questions	115
	Scope Statement	64	Exercises	115
	Step 3: Creating the Work Breakdown	66	Endnotes	122
	Structure Snapshot from Practice:	66	Case:	
	Year 2000 Olympic Games—Sydney, Australia	67	Nightingale Project—A	122
	Step 4: Integrating the WBS with the		Case:	124
	Organization	71	Nightingale Project—B Appendix 4–1:	124
	Step 5: Coding the WBS for the		Computer Project Exercise, Part 2, Computer-	
	Information System	73	Controlled Conveyor Belt Project	125
	Project Rollup	74	Appendix 4–2:	
	Top-Down versus Bottom-Up Estimating	76	Activity-on-Arrow Method	125
	Estimating Costs and Developing Budgets	77	5. MANAGING RISK	139
	Level of Detail	80	Identifying and Assessing Project Risk	139
	Estimating Guidelines for Times, Costs,		Identifying Sources of Risk	140
	and Resources	81	Analyzing and Assessing Risk	141
	Summary	83	Snapshot from Practice:	171
	Review Questions	83	Semiquantitative Risk Approach	144
	Exercises	83	Responding to Risk	145
	Endnotes	83	Contingency Planning	146
	Case:		Snapshot from Practice:	
	Manchester United Soccer Club	84	Risk Management at the Top of the World	148
	Appendix 3–1: Computer Project Exercise, Part 1,		Establishing Contingency Reserves	151
	Computer-Controlled Conveyor Belt Project	86	Responsibility for Project Risks	153
4.	DEVELOPING A NETWORK PLAN	89	Change Control Management	153
	Developing the Project Network	89	Summary	155
	From Work Package to Network	90	Review Questions	156
	Constructing a Project Network	92	Exercises	156
	Activity-on-Node Fundamentals	94	Endnotes	156
	Snapshot from Practice:		Case:	
	The Yellow Sticky Approach (for Constructing of	ı	Alaska Fly-Fishing Expedition	157
	Project Network)	97	Case: Silver Fiddle Construction	158
	Start and Finish Network Computations	98	Case:	138
	Network Computation Process	98	Javacom LAN Project	159
	Snapshot from Practice:	102	Appendix 5–1:	
	The Critical Path	103	PERT and PERT Simulation	160
	How the Information of the Forward and Backward Pass Is Used	104	Case: International Capital, Inc.—Part A	165
	Dackward rass is USCU	104	тиетпанопан Сарнан. Inc.—Part A	100

6.	REDUCING PROJECT TIME	169	Snapshot from Practice:	
	Rationale for Reducing Project Time	169	Projectitis: The Dark Side to Project Teams	228
	Snapshot from Practice:		Snapshot from Practice:	221
	Responding to the Northridge Earthquake	170	Concurrent Engineering	231
	Project Time Reduction Procedure	172	Choosing the Appropriate Project Management Structure	234
	Constructing a Project Cost-Time Graph	174	Research Highlight:	234
	Practical Considerations	178	Relative Effectiveness of Different Project	
	Snapshot from Practice:		Management Structures	234
	I'll Bet You	180	Organizational Culture	236
	Summary	181	Implications of Organizational Culture for	
	Review Questions	182	Organizing Projects	240
	Exercises	182	Snapshot from Practice:	
	Endnotes	185	Matrix Problems at DEC	242
	Case:		Summary	243
	International Capital, Inc.—Part B	185	Review Questions	244
	Case:	105	Exercises	244
	Whitbread World Sailboat Race	185	Endnotes	245
7.	SCHEDULING RESOURCES	191	Case:	10/10/10
	The Problem	191	Moss and McAdams Accounting Firm	246
	Types of Project Constraints	192	Case: ORION Systems (A)	249
	Kinds of Resource Constraints	193	Case:	217
	Classification of a Scheduling Problem	194	ORION Systems (B)	252
	Resource Allocation Methods	195	Appendix 8–1:	
	Splitting/Multitasking	202	How Culture Is Created and Communicated	252
	The Critical Chain Approach	204	in Organizations	253
	Snapshot from Practice:	204	9. LEADERSHIP: BEING AN EFFECTIVE	
	United States Forest Service Resource		PROJECT MANAGER	261
	Shortage	206	Managing versus Leading a Project	261
	Benefits of Scheduling Resources	206	Managing Project Interfaces	262
	Assigning Project Work	207	Snapshot from Practice:	262
	Multiproject Resource Schedules	209	The Project Manager as Conductor	263
	Snapshot from Practice:		Influence as Exchange	266
	Multiple Project Resource Scheduling	210	Social Network Building	269
	Summary	211	Research Highlight: Improving the Performance of New-Product	
	Review Questions	211	Teams	273
	Exercises	211	Ethics and Project Management	277
	Endnotes	216	Building Trust: The Key to Exercising	211
	Case:		Influence	278
	Power Train, Ltd.	217	Qualities of an Effective Project Manager	279
	Appendix 7–1:		Snapshot from Practice:	-12
	Computer Project Exercise, Part 3	219	Profile of a Prospective Project Coordinator	280
8.	ORGANIZATION	221	Summary	282
	Project Management Structures	221	Review Questions	283

XVI TABLE OF CONTENTS

	Exercises	283	Snapshot from Practice:	
	Endnotes	284	Incentive System for a Partnering Project	341
	Case:		The Art of Negotiating	342
	Western Oceanography Institute	286	A Note on Managing Customer Relations	347
	Appendix 9–1:		Summary	349
	Code of Ethics for the Project Management	289	Review Questions	350
	Profession	289	Case:	
10.	MANAGING PROJECT TEAMS	293	Partnering—The Accounting Software	
	The Five-Stage Team Development Model	294	Installation Project	350
	Situational Factors Affecting Team		Exercises	351
	Development	295	Endnotes	352
	Research Highlight:		Appendix 11–1:	
	The Punctuated Equilibrium Model of Group	207	Contract Management	353
	Development	296	Snapshot from Practice:	
	Building High-Performance Project Teams	297	Can Partnering Work in the Public Sector?	355
	Snapshot from Practice: Managing Martians	300	. PROGRESS AND PERFORMANCE	
	Snapshot from Practice:	300	MEASUREMENT AND EVALUATION	359
	"Rat Fax" Galvanizes ELITE Team		Control Process	359
	at Newspaper	304	Monitoring Time Performance	361
	Snapshot from Practice:		Snapshot from Practice:	
	Managing Low-Priority Projects	309	Status Reports at Microsoft	363
	Managing Virtual Project Teams	316	An Integrated Cost/Schedule System	363
	Project Team Pitfalls	318	Developing a Status Report:	
	Summary	320	A Hypothetical Example	369
	Review Questions	320	Indexes	377
	Exercises	320	Forecasting Final Project Cost	379
	Endnotes	321	Other Control Issues	380
	Case:		Snapshot from Practice:	
	Kerzner Office Equipment	323	A Pseudo-Earned Value, Percent	
	Case:		Complete Approach	381
	Franklin Equipment, Ltd.	325	Summary	383
11.	PARTNERING: MANAGING		Review Questions	383
	INTERORGANIZATIONAL RELATIONS	331	Exercises	384
	Introduction to Project Partnering	332	Endnotes	399
	Snapshot from Practice:		Case:	
	The Kodak Orion Project	335	Scanner Project	399
	Preproject Activities—Setting the Stage		Case:	401
	for Successful Partnering	335	SOFTECH, Ltd.—Part A Case:	401
	Project Implementation—Sustaining		SOFTECH, Ltd.—Part B	402
	Collaborative Relationships	337	Appendix 12–1:	402
	Project Completion—Celebrating		Computer-Controlled	
	Success	339	Conveyor Belt Project	405
	Why Project Partnering Efforts		Part 4	405
	Succeed or Fail	339	Part 5	405

	Part 6	408	Snapshot from Practice:	
	Appendix 12–2:	400	Project Management X-Files	443
	Project Material Price and Usage Variance	408	Snapshot from Practice: Dealing with Customs	450
13.	PROJECT AUDIT AND CLOSURE	411	·	430
	The Project Audit Process	413	Selection and Training for International Projects	453
	The Audit Report	415	Summary	455
	Snapshot from Practice:		Review Questions	455
	Operation Eagle Claw	416		65.3
	Snapshot from Practice:		Exercises	456
	Lessons Learned: Bell Canada Business Transformation Project	418	Endnotes	456
			Case: AMEX, Hungary	457
	Project Closure	419	AMEA, Hungary	437
	Team, Team Member, and Project	422	15. THE PROCESS OF PROJECT	
	Manager Evaluations Research Highlight:	423	MANAGEMENT AND THE FUTURE	461
	Measures of Team Performance	425	Emergence of Project-Driven Organizations	461
	Snapshot from Practice:		Future, Positive Trends	462
	The 360-Degree Feedback	428	Snapshot from Practice:	
	Summary	428	The Project Management Program Office Snapshot from Practice:	464
	Review Questions	429	The International Space Station Project (ISS)	466
	Exercise	429	Unresolved Issues	468
	Endnotes	429	Snapshot from Practice:	
	Case:		Harvesting Project Leaders	470
	Maximum Megahertz Project	430	Career Paths in Project Management	470
14.	INTERNATIONAL PROJECTS	433	Conclusions	473
	Assessing the Motivation for International		Summary	473
	Projects	434	Endnotes	474
	Environmental Factors	434		
	Snapshot from Practice:		GLOSSARY	475
	The Filming of Apocalypse Now	437	ACRONYMS	190
	Project Site Selection	439	AUTORING	480
	Cross-Cultural Considerations:		PROJECT MANAGEMENT	
	A Closer Look	440	TOOL EQUATIONS	481
	Research Highlight:		INDEX	405
	Cross-Cultural Orientations	442	INDEX	483