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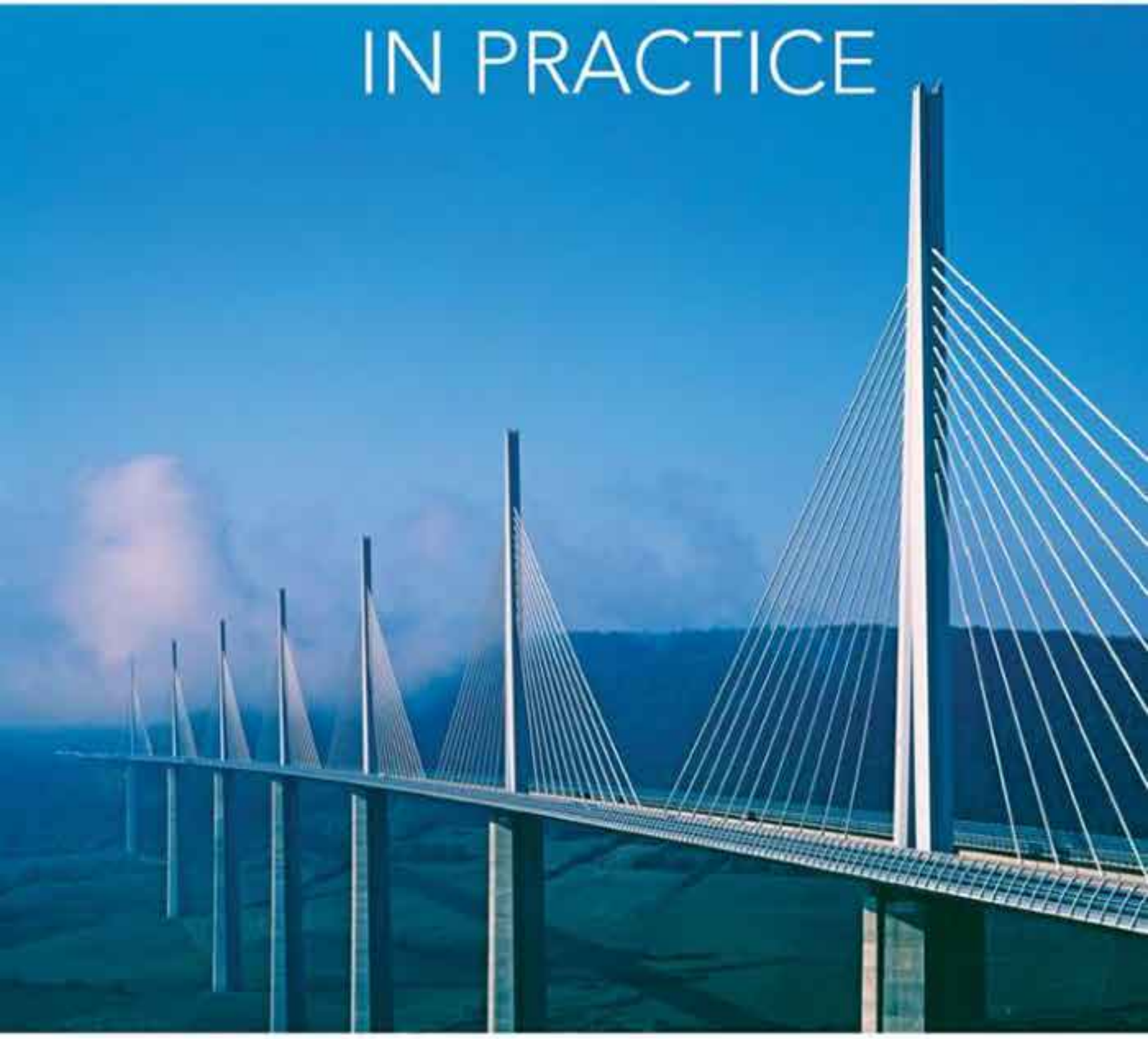

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PROJECT MANAGEMENT IN PRACTICE

Fifth Edition

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To Kiersten, Brandon, and Jeremy, my most successful projects.
J. R. M.

To Brianna and Sammy and Kacy, my most important
and rewarding projects.
S. M. S.

To Maggie, beloved daugther, valued colleague,
and treasured friend.
S. J. M. Jr.

To Dad: my teacher, my hero, . . . my friend.
M. M. S.

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PREFACE

THE APPROACH

Over the past several decades, more and more work has been accomplished through the use of projects and project management. The use of projects has been growing at an accelerated rate, and not just in engineering and information technology, but also in all the business disciplines: marketing, finance, human resources, accounting, operations, legal, and, of course, management. One of the most interesting areas of growth, however, has been in the use of projects to achieve the strategic goals of organizations. The exponential growth of membership in the Project Management Institute (PMI) is further convincing evidence, as are the sales of computer software devoted to project management. Several societal forces are driving this growth, and many economic factors are reinforcing it. We describe these in Chapter 1 of this book.

A secondary effect has also been a major contributor to the use of project activity. As the use of projects has grown, its very success as a way of getting complex activities carried out successfully has become well established. The result has been a striking increase in the use of projects to accomplish jobs that in the past would simply have been turned over to someone with the comment, "Take care of it."

What happened then was that some individual undertook to carry out the job with little or no planning, little or no assistance, few resources, and often with only a vague notion of what was really wanted. The simple application of routine project management techniques significantly improved the consistency with which the outcomes resembled what the organization had in mind when the chore was assigned. Later, this sort of activity came to be known as "enterprise project management," "management by projects," and several other names, all of which are described as the project-oriented organization.

Some of these projects were large, but most were quite small. Some were complex, but most were relatively straightforward. Some required the full panoply of project management techniques, but most did not. All of them, however, had to be managed and thus required a great many people to take on the role of project manager in spite of little or no education in the science or arcane art of project management.

One result was rising demand for education in project management. The number of college courses grew apace, as did the number of consulting firms offering seminars and workshops. Perhaps most striking was the growth in educational opportunities through post-secondary schools offering "short courses"—schools such as DeVry Institute, and ITT. In addition, short courses were offered by colleges and community colleges concentrating on both part-time and full-time education for individuals already in the work force. An exemplar of this approach is the University of Phoenix.

Communications from some instructors in these institutions told us that they would like a textbook that was shorter and focused more directly on the "technical" aspects of project management than those currently available. They were willing to forego most of the theoretical aspects of management, particularly if such were not directly tied to practice. Their students, who were not apt to take advanced course work in project management, had little use for understanding the historical development of the field. For example, they felt no need to read about the latest academic research on the management

of knowledge-based projects in a manufacturing environment. Finally, instructors asked for increased use of project management application software, though they added that they did not want a replacement for the many excellent "step-by-step" and "computing-for-dummies" types of books that were readily available. They wanted the emphasis to be on managing projects, and not on managing project management software.

These requests sounded sensible to us, and we have tried to write such a book.

ORGANIZATION AND CONTENT

With few exceptions, both readers and instructors are most comfortable with project management texts that are organized around the project life cycle, and this book is so organized. In Chapter 1 we start by defining a project and differentiating project management from general management. After discussing the project life cycle, we briefly cover project selection. We feel strongly that project managers who understand why a project was selected by senior management also understand the firm's objectives for the project. Understanding those things, we know, will be of value in making the inevitable trade-offs between time, budget, and the specified output of the project.

Chapter 2 is devoted to the various roles the project manager must play and to the skills required to play them effectively. In addition, we cover the various ways in which projects can be organized. The nature of project teams, including multidisciplinary teams, and the behavioral aspects of projects are also discussed.

Project and risk planning, budgeting, and scheduling are covered in Chapters 3 to 5. Planning the project initiates our discussion in Chapter 3, where we introduce the work breakdown structure and other planning aids such as the RACI matrix, and end with a thorough discussion and illustration of risk management planning. Project budgeting is then described in Chapter 4 where we introduce the use of simulation through software such as Crystal Ball® to analyze financial risk. Risk analysis using Oracle's Crystal Ball® 11.1 (CB) simulations is demonstrated in several chapters with detailed instructions on building and solving simulation models. Software is used throughout the book, where relevant, to illustrate the use and power of such software to aid in managing projects. Chapter 4 also includes a helpful mathematical model for improving cost estimates, or any other numerical estimates used in planning projects. Chapter 5 initially uses standard manual methods for building project schedules, and Microsoft Project® 2010 (MSP) is then demonstrated for doing the same thing.

Chapter 6 deals with resource allocation problems in a multiproject setting. A major section of this chapter is devoted to the insights of E. Goldratt in his book *Critical Chain*.* Chapter 7 concerns monitoring and controlling the project, especially through the use of earned value analysis, which is covered in detail. The final chapter deals with auditing, evaluating, and terminating projects.

Interest in risk management has grown rapidly in recent years, but the subject gets only minimal attention in most introductory level project management textbooks. We deal with risk throughout this book, introducing methods of risk management and analysis where relevant to the subject at hand. For example, simulation is used in Chapter 4 for solving a project budgeting problem, in Chapter 5 on a scheduling problem, and in Chapter 6 for examining the impact of a generally accepted assumption about probabilistic project schedules that is usually false, and also to test the usually false assumption that multitasking is an efficient way to improve productivity.

We are certainly aware that no text on project management could be structured to reflect the chaos that seems to surround some projects throughout their lives, and a

*Goldratt, E. M. *Critical Chain*. Great Barrington, MA: North River, 1997.

large majority of projects now and then. The organization of this book reflects a tidiness and sense of order that is nonexistent in reality. Nonetheless, we make repeated references to the technical, interpersonal, and organizational glitches that impact the true day-to-day life of the project manager.

PEDAGOGY

The book includes several pedagogical aids. The end-of-chapter material includes *Review Questions* that focus on the textual material. *Discussion Questions* emphasize the implications and applications of ideas and techniques covered in the text. Where appropriate, there are *Problems* that are primarily directed at developing skills in the technical areas of project management as well as familiarizing the student with the use of relevant software.

In addition to the above, we have included *Incidents for Discussion* in the form of caselettes. In the main, these caselettes focus on one or more elements of the chapter to which they are appended. Several of them, however, require the application of concepts and techniques covered in earlier chapters so that they also serve an integrative function.

More comprehensive cases are also appended to each chapter. A special set of these, beginning in Chapter 3, is associated with the *same* project, which continues on through the following chapters—the planning, building, and marketing of an assisted living facility for people whose state of health makes it difficult for them to live independently, but who are not yet ill enough to require nursing home care. Each chapter is followed by a continuation of this case calling upon the ideas and methods covered in that chapter. With all these cases, integration with material in other chapters is apt to be required.

We include Learning Objectives for each chapter but instead of putting them at the beginning of the chapter, we have added them to the Instructors' Manual. Many teachers feel that their students should have the Learning Objectives as they begin each chapter. Many don't. Many teachers like to use their own LOs. Many do not like to use LOs because they feel that students focus solely on the listed objectives and ignore everything else. Given our LOs in the Instructor's Manual, each teacher may opt for his or her own notion on the matter.

We have used Excel® spreadsheets where appropriate throughout the book. Microsoft Office® is widely available, and with few exceptions students and professional project managers are familiar with its operation. A free 60-day trial edition of Microsoft Project 2010® is available with each new copy of the book through the contact information below. It will run on Microsoft's Windows 8® as well as several earlier versions of Windows®. Note that Microsoft has changed their policy and no longer offers a 120-day trial, *only a 60-day trial*. Please be sure to plan your course accordingly. Additionally, Microsoft Project 2010® software is available through Dreamspark Premium, an annual membership program that provides the easiest and most inexpensive way for universities to make the latest Microsoft software available in labs, classrooms, and on student PCs. Through Wiley's partnership with Microsoft, software available via Dreamspark Premium is provided at no charge to qualifying departments upon adoption.

Contact your Wiley representative (click on "Who's My Rep" at www.Wiley.com) when you have selected a Wiley textbook to adopt. Schools must qualify, and some restrictions do apply, so please contact your Wiley representative about this opportunity. Once qualified, your department will be awarded membership, and you, your colleagues, and the students in your courses can begin downloading the software from a remote hosting server.

Microsoft and Wiley are working together to make obtaining software for your department easy for you. E-mail us at MOAC@wiley.com for details or call 1-888-764-7001. For more information about the Dreamspark Premium program, go to www.dreamspark.com.

Microsoft Project®, which is included in Dreamspark Premium, was chosen because it is a competent piece of software that is used by a large majority of all project management software users. While Project 2010® is available for free with the adoption of this text, schools and professionals with access to earlier versions are not at a disadvantage. Almost all the relevant commands are the same in all versions, and the standard printouts are very similar. One exception is found in the case of earned value calculations and reports. There are slight variations among versions, and some vary slightly from the Project Management Institute standards. The differences are easily handled and are explained in Chapter 7. With this exception, we do not differentiate between the versions and refer to them all as Microsoft Project (MSP).

Each copy of the text comes packaged with a registration card, which professors and students can use to download a free trial edition of Oracle's Crystal Ball® 11.1. For those professors using an e-book version of the text, instructions for accessing Crystal Ball (CB)® are posted on the Instructor Companion web site for the text. If you have questions, please contact your local Wiley sales rep. We have demonstrated in Chapters 4, 5, and 6 some of the problems where the use of statistical decision models and simulation can be very helpful in understanding and managing risk. Detailed instructions are given. In addition, a number of the end-of-chapter problems have been rewritten to adapt them for solution by Crystal Ball®. These can be found in the *Instructor's Manual* along with added instructions for use of the software. Crystal Ball® was chosen because it works seamlessly with Excel® and is user friendly. As is true with MSP, earlier versions of Crystal Ball® use the same basic commands as version 11.1, but the later version has a new instructional ribbon. Outputs are not significantly changed. Version 11.1 runs on Windows 8® and earlier versions of Windows®. We will not differentiate between different versions of Crystal Ball®.

Because this text is oriented toward practice, not research, the end-of-chapter bibliographies reflect our notions of minimal requirements. We have included several works that are classics in their fields—quite irrespective of the date of their publication. West Churchman's 1979 book on the "systems approach" is still one of the most thoughtful and readable works on that subject. Herzberg's 1968 *Harvard Business Review* article on motivation was written long before many of our readers were born, but is a widely reprinted seminal article on the subject. While most of our citations date from the past 10 or 15 years, we have tried to cite the best, the original, and the readable in preference to the most recent.

As we have noted elsewhere, projects have failed because the project manager attempted to manage the software rather than the project. We feel strongly that students and professionals should learn to use the basic project management techniques by hand—and only then turn to software for relief from their manual efforts.

As is true with any textbook, we have made some assumptions about both the students and professionals who will be reading this book. We assume that they have all had some elementary training in management, or have had equivalent experience. We also assume that, as managers, they have some slight acquaintance with the fundamentals of accounting, behavioral science, finance, and statistics. We even assume that they have forgotten most of the statistics they once learned; therefore, we have included an appendix on relevant elementary statistics and probability as a memory refresher.

WHAT'S NEW

Both students and instructors have been generous and kind with their comments on the first four editions of this book. They have given us very useful suggestions and feedback such as proposing that we integrate the material on Crystal Ball® directly

into the chapters where it is used, which we have done. In this edition we have also tried to improve the flow of material and have moved some topics around a bit to achieve this. First, we moved the extensive Crystal Ball® simulation description out of the introductory Chapter 1 and into the budgeting Chapter 4 to illustrate how to simulate costs to evaluate budget risks. And we moved the discussion of risk management earlier, from Chapter 4 to the project planning Chapter 3, since risk pervades all the aspects of project planning, and especially scope, time, and cost. To make room for the risk discussion in Chapter 3, we moved the discussion of multidisciplinary teams to Chapter 2, which seems to be a better fit for the topic also.

Reviewers also asked us to comment about how budgets and activity expediting are actually handled in practice, so we checked many practice-oriented magazines and journals and then queried some project managers we knew. The result is a few paragraphs in Chapters 4 on budgeting and Chapter 6 on resource allocation describing the vagaries and real-world dynamics project managers commonly face in these areas.


Trade-Offs


Risk


Best Practice


PMBOK Guide

To further improve the student's perspective of project management from the view of project managers in actual practice, we describe their situation throughout the text as one of constantly making trade-offs between not only the three main goals of scope, time, and cost but also risk and other implied ancillary goals such as organizational improvement, strategic goals, and future opportunities. To highlight these areas where we talk about trade-offs and risk, we have added new icons to the book margins where important discussion on these topics appears. We have also added a new icon to indicate areas of discussion that we believe exemplify "best practice" in the project management field. And we have expanded our references to locations in PMBOK® that discuss the topic at hand for those who are also studying for the Project Management Professional® (PMP) or other certification exams offered by the Project Management Institute.

Last, we added a large number of additional problems and mini-cases to the appropriate chapters where reviewers asked for them. We also added another simulation example in Chapter 5 to illustrate costs in a network. We also reduced our discussion on some topics that reviewers suggested, such as the design structure matrix.

SUPPLEMENTS

The *Instructor's Manual* will provide assistance to the project management instructor in the form of answers/solutions to the questions, problems, incidents for discussion, and end-of-chapter cases. This guide will also reference relevant Harvard Business School type cases and readings, teaching tips, and other pedagogically helpful material. Wiley maintains a web site for this and other books. The address is *www.wiley.com/college/mantel*. The site contains an electronic version of the *Instructor's Manual*, an extensive set of PowerPoint slides, sample course outlines, and test questions to test student understanding.

ACKNOWLEDGMENTS

There is no possible way to repay the scores of project managers and students who have contributed to this book, often unknowingly. The professionals have given us ideas about how to manage projects, and students have taught us how to teach project management. We are grateful beyond our ability to express it.

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C • H • A • P • T • E • R

1

The World of Project Management

Once upon a time there was a heroine project manager. Her projects were never late. They never ran over budget. They always met contract specifications and invariably satisfied the expectations of her clients. And you know as well as we do, anything that begins with "Once upon a time . . ." is just a fairy tale.

This book is not about fairy tales. Throughout these pages we will be as realistic as we know how to be. We will explain project management practices that we know will work. We will describe project management tools that we know can help the project manager come as close as Mother Nature and Lady Luck will allow to meeting the expectations of all who have a stake in the outcome of the project.

1.1 WHAT IS A PROJECT?

Why this emphasis on project management? The answer is simple: Daily, organizations are asked to accomplish work activities that do not fit neatly into business-as-usual. A software group may be asked to develop an application program that will access U.S. government data on certain commodity prices and generate records on the value of commodity inventories held by a firm; the software must be available for use on April 1. The Illinois State Bureau for Children's Services may require an annually updated census of all Illinois resident children, aged 17 years or younger, living with an illiterate single parent; the census must begin in 18 months. A manufacturer initiates a process improvement project to offset higher energy costs.

Note that each work activity is *unique* with a specific *deliverable* aimed at meeting a *specific need or purpose*. These are *projects*. The routine issuance of reports on the value of commodity inventories, the routine counseling of single parents on nurturing their offspring, the day-to-day activities associated with running a machine in a factory—these are not projects. The difference between a project

and a *nonproject* is not always crystal clear. For almost any precise definition, we can point to exceptions. At base, however, projects are unique, have a specific deliverable, and have a specific due date. Note that our examples have all those characteristics. The Project Management Institute (PMI) defines in its *Project Management Body of Knowledge (PMBOK Guide)*, 5th edition, a project as "A temporary endeavor undertaken to create a unique product, service, or result" (Project Management Institute, 2013).

Projects vary widely in size and type. The writing of this book is a project. The reorganization of Procter & Gamble (P&G) into a global enterprise is a project, or more accurately a program, a large integrated set of projects. The construction of a fly-in fishing lodge in Manitoba, Canada, is a project. The organization of "Cat-in-the-Hat Day" so that Mrs. Payne's third grade class can celebrate Dr. Suess's birthday is also a project.

Both the hypothetical projects we mentioned earlier and the real-world projects listed just above have the same characteristics. They are unique, specific, and have desired completion dates. They all qualify as projects under the PMI's definition. They have an additional characteristic in common—they are multidisciplinary. They require input from people with different kinds of knowledge and expertise. This multidisciplinary nature of projects means that they tend to be complex, that is, composed of many interconnected elements and requiring input from groups outside the project. The various areas of knowledge required for the construction of the fly-in fishing lodge are not difficult to imagine. The knowledge needed for globalization of a large conglomerate like P&G is quite beyond the imagination of any one individual and requires input from a diversified group of specialists. Working as a team, the specialists investigate the problem to discover what information, skills, and knowledge are needed to accomplish the overall task. It may take weeks, months, or even years to find the correct inputs and understand how they fit together.

A secondary effect of using multidisciplinary teams to deal with complex problems is conflict. Projects are characterized by conflict. As we will see in later chapters, the project schedule, budget, and specifications conflict with each other. The needs and desires of the client conflict with those of the project team, the senior management of the organization conducting the project and others who may have a less direct stake in the project. Some of the most intense conflicts are those between members of the project team. Much more will be said about this in later chapters. For the moment, it is sufficient to recognize that projects and conflict are often inseparable companions, an environment that is unsuitable and uncomfortable for conflict avoiders.

It is also important to note that projects do not exist in isolation. They are often parts of a larger entity or program, just as projects to develop a new engine and an improved suspension system are parts of the program to develop a new automobile. The overall activity is called a program. Projects are subdivisions of programs. Likewise, projects are composed of *tasks*, which can be further divided into *subtasks* that can be broken down further still. The purpose of these subdivisions is to allow the project to be viewed at various levels of detail. The fact that projects are typically parts of larger organizational programs is important for another reason, as is explained in Section 1.5.

Finally, it is appropriate to ask, "Why projects?" The reason is simple. We form projects in order to fix the responsibility and authority for the achievement of an organizational goal on an individual or small group when the job does not clearly fall within the definition of routine work.

Trends in Project Management

Many recent developments in project management are being driven by quickly changing global markets, technology, and education. Global competition is putting pressure on prices, response times, and product/service innovation. Computer and telecommunication technology, along with rapidly expanding higher education across the world allows the use of project management for types of projects and in regions where these sophisticated tools had never been considered before. The most important of these recent developments are covered in this book.

Achieving Strategic Goals There has been a growing use of projects to achieve an organization's strategic goals, and existing major projects are screened to make sure that their objectives support the organization's strategy and mission. Projects that do not have clear ties to the strategy and mission are not approved. A discussion of this is given in Section 1.6, where the Project Portfolio Process is described.

Achieving Routine Goals On the other hand, there has also been a growing use of project management to accomplish routine departmental tasks, normally handled as the usual work of functional departments; e.g., routine machine maintenance. Middle management has become aware that projects are organized to accomplish their performance objectives within their budgets and deadlines. As a result, artificial deadlines and budgets are created to accomplish specific, though routine, departmental tasks—a process called "projectizing."

Improving Project Effectiveness A variety of efforts are being pursued to improve the process and results of project management, whether strategic or routine. One well-known effort is the creation of a formal Project Management Office (PMO, see Section 2.5) in many organizations that takes responsibility for many of the administrative and specialized tasks of project management. Another effort is the evaluation of an organization's project management "maturity," or skill and experience in managing projects (discussed in Section 7.5). This is often one of the responsibilities of the PMO. Another responsibility of the PMO is to educate project managers about the *ancillary goals* of the organization (Section 8.1), which automatically become a part of the goals of every project whether the project manager knows it or not. Achieving better control over each project through the use of phase gates (Sections 7.1 and 7.4), earned value (Section 7.3), critical ratios (Section 7.4), and other such techniques is also a current trend.

Virtual Projects With the rapid increase in globalization of industry, many projects now involve global teams whose members operate in different countries and different time zones, each bringing a unique set of talents to the project. These are known as virtual projects because the team members may never physically meet before the team is disbanded and another team reconstituted. Advanced telecommunications and computer technology allow such virtual projects to be created, do their work, and complete their project successfully (see Section 2.1).

Quasi-Projects Led by the demands of the information technology/systems departments, project management is now being extended into areas where the project's objectives are not well understood, time deadlines unknown, and/or budgets undetermined. This ill-defined type of project is extremely difficult to conduct and to date has often resulted in setting an artificial due date and budget, and then specifying project objectives to meet those limits. However, new tools for these quasi-projects are now being developed—prototyping, phase-gating, and others—to help these projects achieve results that satisfy the customer in spite of the unknowns.

A project, then, is a temporary endeavor undertaken to create a unique product or service. It is specific, timely, usually multidisciplinary, and typically conflict ridden. Projects are parts of overall programs and may be broken down into tasks, subtasks, and further if desired. Current trends in project management include achieving strategic goals, achieving routine goals, improving project effectiveness, virtual projects, and quasi-projects.

1.2 PROJECT MANAGEMENT VS. GENERAL MANAGEMENT

As is shown in Table 1-1, project management differs from general management largely because projects differ from what we have referred to as "nonprojects." The naturally high level of conflict present in projects means that the project manager (PM) must have special skills in conflict resolution. The fact that projects are unique means that the PM must be creative and flexible, and have the ability to adjust rapidly to changes. When managing nonprojects, the general manager tries to "manage by exception." In other words, for nonprojects almost everything is routine and is handled routinely by subordinates. The manager deals only with the exceptions. For the PM, almost everything is an exception.

Major Differences


PMBOK Guide

Certainly, general management's success is dependent on good planning. For projects, however, planning is much more carefully detailed and project success is absolutely dependent on such planning. The project plan is the result of integrating all information about a project's deliverables, generally referred to as the "scope" of the project, and its targeted date of completion. "Scope" has two meanings. One is "product scope," which defines the performance requirements of a project, and "project scope," which details the work required to deliver the product scope (see Chapter 5, p. 105 of PMBOK, 2013). To avoid confusion, we will use the term scope to mean "product scope" and will allow the work, resources, and time needed by the project to deliver the product scope to the customer to be defined by the project's plan (discussed in detail in Chapter 3). Therefore, the scope and due date of the project determine its plan, that is, its budget, schedule, control, and evaluation. Detailed planning is critically important. One should not, of course, take so much time planning that nothing ever gets done, but careful planning is a major contributor to project success. Project planning is discussed in Chapter 3 and is amplified throughout the rest of this book.

Table 1-1 Comparison of Project Management and General Management

Dimension	***Project Management***	***General Management***
Type of Work Activity	Unique	Routine
Management Approach	Ability to adapt to change	Manage by exception
Planning	Critical	Important
Budgeting	Start from scratch, multiple budget periods	Modify budget from previous budget period
Sequence of Activities	Must be determined	Often predetermined
Location of Work	Crosses organizational units	Within an organizational unit
Managerial Hierarchy	Informal	Well defined

Project budgeting differs from standard budgeting, not in accounting techniques, but in the way budgets are constructed. Budgets for nonprojects are primarily modifications of budgets for the same activity in the previous period. Project budgets are newly created for each project and often cover several "budget periods" in the future. The project budget is derived directly from the project plan that calls for specific activities. These activities require resources, and such resources are the heart of the project budget. Similarly, the project schedule is also derived from the project plan.

In a nonproject manufacturing line, the sequence in which various things are done is set when the production line is designed. The sequence of activities often is not altered when new models are produced. On the other hand, each project has a schedule of its own. Previous projects with deliverables similar to the one at hand may provide a rough template for the current project, but its specific schedule will be determined by the time required for a specific set of resources to do the specific work that must be done to achieve each project's specific scope by the specific date on which the project is due for delivery to the client. As we will see in later chapters, the special requirements associated with projects have led to the creation of special managerial tools for budgeting and scheduling.

The routine work of most organizations takes place within a well-defined structure of divisions, departments, sections, and similar subdivisions of the total unit. The typical project cannot thrive under such restrictions. The need for technical knowledge, information, and special skills almost always requires that departmental lines be crossed. This is simply another way of describing the multidisciplinary character of projects. When projects are conducted side-by-side with routine activities, chaos tends to result—the nonprojects rarely crossing organizational boundaries and the projects crossing them freely. These problems and recommended actions are discussed at greater length in Chapter 2.

Even when large firms establish manufacturing plants or distribution centers in different countries, a management team is established on site. For projects, "globalization" has a different meaning. Individual members of project teams may be spread across countries, continents, and oceans, and speak several different languages. Some project team members may never even have a face-to-face meeting with the project manager, though transcontinental and intercontinental video meetings combining telephone and computer are common.

The discussion of structure leads to consideration of another difference between project and general management. In general management, there is a reasonably well defined managerial hierarchy. Superior-subordinate relationships are known, and lines of authority are clear. In project management this is rarely true. The PM may be relatively low in the hierarchical chain of command. This does not, however, reduce his or her responsibility of completing a project successfully. Responsibility without the authority of rank or position is so common in project management as to be the rule, not the exception.

Negotiation

With little legitimate authority, the PM depends on negotiation skills to gain the cooperation of the many departments in the organization that may be asked to supply technology, information, resources, and personnel to the project. The parent organization's standard departments have their own objectives, priorities, and personnel. The project is not their responsibility, and the project tends to get the leftovers, if any, after the departments have satisfied their own need for resources. Without any real command authority, the PM must negotiate for almost everything the project needs.

It is important to note that there are three different types of negotiation, *win-win* negotiation, *win-lose* negotiation, and *lose-lose* negotiation. When you negotiate the

purchase of a car or a home, you are usually engaging in win-lose negotiation. The less you pay for a home or car, the less profit the seller makes. Your savings are the other party's losses—win-lose negotiation. This type of negotiation is never appropriate when dealing with other members of your organization. If you manage to "defeat" a department head and get resources or commitments that the department head did not wish to give you, imagine what will happen the next time you need something from this individual. The PM simply cannot risk win-lose situations when negotiating with other members of the organization.

Lose-lose negotiation occurs when one party is unwilling to assert his or her position aggressively while at the same time resists cooperating with the other party. This often occurs in situations where one or both of the parties are conflict avoiders. When one party is not willing to help the other party achieve his or her objective and at the same time is unwilling to pursue his or her own objectives, the end result is that both parties lose.

Within the organization, win-win negotiation is mandatory. In essence, in win-win negotiation both parties must try to understand what the other party needs. The problem you face as a negotiator is how to help other parties meet their needs in return for their help in meeting the needs of your project. When negotiation takes place repeatedly between the same individuals, win-win negotiation is the only sensible procedure. PMs spend a great deal of their time negotiating. General managers spend relatively little. Skill at win-win negotiating is a requirement for successful project managing (see Fisher and Ury, 1983; Jandt, 1987; and Raiffa, 1982).

One final point about negotiating: Successful win-win negotiation often involves taking a synergistic approach by searching for the "third alternative." For example, consider a product development project focusing on the development of a new printer. A design engineer working on the project suggests adding more memory to the printer. The PM initially opposes this suggestion, feeling that the added memory will make the printer too costly. Rather than rejecting the suggestion, however, the PM tries to gain a better understanding of the design engineer's concern.

Based on their discussion, the PM learns that the engineer's purpose in requesting additional memory is to increase the printer's speed. After benchmarking the competition, the design engineer feels the printer will not be competitive as it is currently configured. The PM explains his fear that adding the extra memory will increase the cost of the printer to the point that it also will no longer be cost competitive. Based on this discussion the design engineer and PM agree that they need to search for another (third) alternative that will increase the printer's speed without increasing its costs. A couple of days later, the design engineer identifies a new ink that can simultaneously increase the printer's speed and actually lower its total and operating costs.

Project management differs greatly from general management. Every project is planned, budgeted, scheduled, and controlled as a unique task. Unlike nonprojects, projects are often multidisciplinary and usually have considerable need to cross departmental boundaries for technology, information, resources, and personnel. Crossing these boundaries tends to lead to intergroup conflict. The development of a detailed project plan based on the scope and due date of the project is critical to the project's success.

Unlike their general management counterparts, project managers have responsibility for accomplishing a project, but little or no legitimate authority to command the required resources from the functional departments. The PM must be skilled at win-win negotiation to obtain these resources.

1.3 WHAT IS MANAGED? THE THREE GOALS OF A PROJECT

The performance of a project is measured by three criteria. Is the project on time or early? Is the project on or under budget? Does the project deliver the agreed-upon specification to the satisfaction of the customer? Figure 1-1 shows the three goals of a project. The performance of the project and the PM is measured by the degree to which these goals are achieved.

One of these goals, the project's specifications or "scope," is set primarily by the client (although the client agrees to all three when contracting for the project). It is the client who must decide what capabilities are required of the project's deliverables—and this is what makes the project unique. Some writers insist that "quality" is a separate and distinct goal of the project along with time, cost, and scope. We do not agree because we consider quality an inherent part of the project specifications.

If we did not live in an uncertain world in which best made plans often go awry, managing projects would be relatively simple, requiring only careful planning. Unfortunately, we do not live in a predictable (*deterministic*) world, but one characterized by chance events (*uncertainty*). This ensures that projects travel a rough road. Murphy's law seems as universal as death and taxes, and the result is that the most skilled planning is upset by uncertainty. Thus, the PM spends a great deal of time adapting to unpredicted change. The primary method of adapting is to trade-off one objective for another. If a construction project falls behind schedule because of bad weather, it may be possible to get back on schedule by adding resources—in this case, probably labor using overtime and perhaps some additional equipment. If the budget cannot be raised to cover the additional resources, the PM may have to negotiate with the client for a later delivery date of the building. If neither cost nor schedule can be negotiated, the client may be willing to cut back on some of the features in the building in order to allow the project to finish on time and budget (e.g., substituting carpet for tile in some of the spaces). As a final alternative, the contractor may have to "swallow" the added costs (or pay a penalty for late delivery) and accept lower profits.


Trade-Offs

This example illustrates a fundamental point. Namely, managing the trade-offs among the three project goals is in fact the primary role of the project manager. Furthermore, managing these trade-offs in the most effective manner requires that the

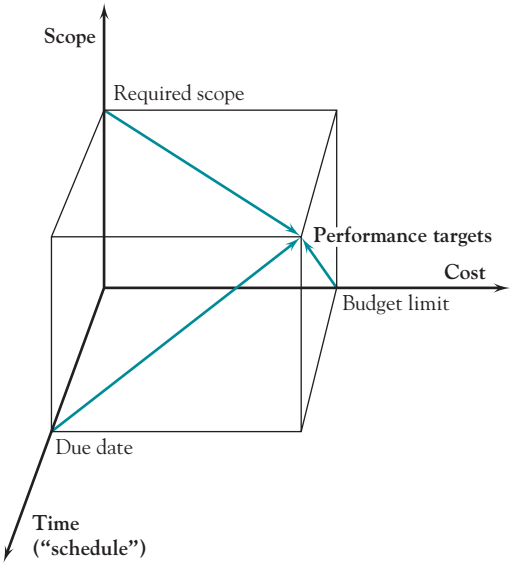

Figure 1-1 Scope, cost, and time project performance targets.

project manager have a clear understanding of how the project supports broader organizational goals. Thus, the organization's overall strategy is the most important consideration for managing the trade-offs that will be required among the three project goals.

All projects are always carried out under conditions of uncertainty. Well-tested software routines may not perform properly when integrated with other well-tested routines. A chemical compound may destroy cancer cells in a test tube—and even in the bodies of test animals—but may kill the host as well as the cancer. Where one cannot find an acceptable way to deal with a problem, the only alternative may be to stop the project and start afresh to achieve the desired deliverables.

As we note throughout this book, projects are all about uncertainty. Therefore, in addition to effectively managing trade-offs, effective project management requires an ability to deal with uncertainty. The time required to complete a project, the availability and costs of key resources, the timing of solutions to technological problems, a wide variety of macroeconomic variables, the whims of a client, the actions taken by competitors, even the likelihood that the output of a project will perform as expected, all these exemplify the uncertainties encountered when managing projects. While there are actions that may be taken to reduce the uncertainty, no actions of a PM can ever eliminate it.

As Hatfield (2008) points out, projects are complex and include interfaces, interdependencies, and many assumptions, any or all of which may turn out to be wrong. Also, projects are managed by people, which adds to the uncertainty. Gale (2008a) reminds us that the uncertainties include everything from legislation that can change how we do business, to earthquakes and other "acts of God." Therefore, in today's turbulent business environment, effective decision making is predicated on an ability to manage the ambiguity that arises while we operate in a world characterized by uncertain information. (Risk management is discussed in Chapter 11 of the PMBOK, 5th ed., 2013.)


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The first step in managing risk is to identify these potentially uncertain events and the likelihood that any or all may occur. This is called *risk analysis*. Different managers and organizations approach this problem in different ways. Gale advises expecting the unexpected; some managers suggest considering those things that keep one awake at night. Many organizations keep formal lists, a "risk register," and use their Project Management Office (PMO, discussed in Chapter 2) to maintain and update the list of risks and approaches that have been successful in the past in dealing with specific risks. This information is then incorporated into the firm's business-continuity and disaster-recovery plans. Every organization should have a well-defined process for dealing with risk, and we will discuss this issue at greater length in Chapter 3, Section 3.5. At this point we simply overview risk analysis.


Risk


Best Practice

The essence of risk analysis is to make estimates or assumptions about the probability distributions associated with key parameters and variables and to use analytic decision models or Monte Carlo simulation models based on these distributions to evaluate the desirability of certain managerial decisions. Real-world problems are usually large enough that the use of analytic models is very difficult and time consuming. With modern computer software, simulation is not difficult.

A mathematical model of the situation is constructed, and a simulation is run to determine the model's outcomes under various scenarios. The model is run (or replicated) repeatedly, starting from a different point each time based on random choices of values from the probability distributions of the input variables. Outputs of the model are used to construct statistical distributions of items of interest to decision makers, such as costs, profits, completion dates, or return on investment. These distributions are the *risk profiles* of the outcomes associated with a decision. Risk profiles can be analyzed by the manager when considering a decision, along with many other factors such

as strategic concerns, behavioral issues, fit with the organization, cost and scheduling issues, and so on.


Risk

Thus we observe that in addition to managing trade-offs, another critical aspect of project management is managing uncertainty or risk. In fact, managing risk is actually tightly coupled with managing the three traditional goals of project management. For example, the more uncertainty the project manager faces, the greater the risk that the project will go over budget, finish late, and/or not meet its original scope. However, beyond these rather obvious relationships, there is also a more subtle connection. In particular, project risk represents a fourth trade-off opportunity at the project manager's disposal. For example, the project's budget can be increased in order to collect additional data that in turn will reduce the uncertainty related to how long it will take to complete the project. Likewise, the project's deadline can be reduced, but this will increase the uncertainty about whether it will be completed on time.

As a result of the relationship between uncertainty and the three traditional project goals, we adopt the view in this book that managing uncertainty is a fourth goal of project management. Thus, the primary role of the project manager is to effectively manage the trade-offs between cost, time, scope, and risk.


Trade-Offs

In the past, it was popular to label technical uncertainties as "technological risk." This is not very helpful, however, because it is not the technology that is uncertain. We can, in fact, do almost anything we wish, excepting perhaps faster-than-light travel and perpetual motion. What is uncertain is not technological success, but rather how much it will cost and how long it will take to reach success.


Trade-Offs

Most of the trade-offs PMs make are reasonably straightforward if the organization's strategy is well understood and trade-offs are discussed during the planning, budgeting, and scheduling phases of the project. Usually they involve trading time and cost, but if we cannot alter either the schedule or the budget, the specifications of the project may be altered or additional risk accepted. Frills on the finished product may be foregone, capabilities not badly needed may be compromised. From the early stages of the project, it is the PM's duty to know which elements of project performance are sacrosanct.

One final comment on this subject: Projects must have some flexibility. Again, this is because we do not live in a deterministic world. Occasionally, a senior manager (who does not have to manage the project) presents the PM with a document precisely listing a set of deliverables, a fixed budget, and a firm schedule. This is failure in the making for the PM. Unless the budget is overly generous, the schedule overlong, and the deliverables easily accomplished, the system is, as mathematicians say, "overdetermined." If Mother Nature so much as burps, the project will fail to meet its rigid parameters. A PM cannot be successful without flexibility to manage the trade-offs.

Projects have four interrelated objectives: to (1) meet the budget, (2) finish on schedule, (3) generate deliverables that satisfy the client, and (4) to minimize risks. Because we live in an uncertain world, as work on the project proceeds, unexpected problems are bound to arise. These chance events will threaten the project's schedule or budget or scope. The PM must now decide how to trade off one project goal against another (e.g., to stay on schedule by assigning extra resources to the project may mean it will run over the predetermined budget). If the schedule, budget, and scope are rigidly predetermined, the project is probably doomed to failure unless the preset schedule and budget are overly generous or the difficulty in meeting the specifications has been seriously overestimated.