



SIXTH EDITION

Project Management

THE MANAGERIAL PROCESS

Erik W. Larson | Clifford F. Gray

Project Management

The Managerial Process

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PROJECT MANAGEMENT: THE MANAGERIAL PROCESS, SIXTH EDITION

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This book is printed on acid-free paper.

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

ISBN 978-0-07-809659-4

MHID 0-07-809659-6

Managing Director: *Douglas Reiner*

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Media Project Manager: *Sivakumar Munuswamy*

Composer: *Aptara[®], Inc.*

Typeface: *10.5/12 Times New Roman MT Std*

Printer: *Quad/Graphics*

All credits appearing on page or at the end of the book are considered to be an extension of the copyright page.

Library of Congress Cataloging-in-Publication Data

Gray, Clifford F.

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

Gray.—Sixth edition.

pages cm

Previous editions published as: Project management : the managerial

process / Clifford F. Gray, Erik W. Larson.

ISBN 978-0-07-809659-4 (alk. paper)

1. Project management. 2. Time management. 3. Risk management. I. Larson, Erik W., 1952-

II. Title.

HD69.P75G72 2014

658.4'04—dc23

2013027472

The Internet addresses listed in the text were accurate at the time of publication. The inclusion of a website does not indicate an endorsement by the authors or McGraw-Hill Education, and McGraw-Hill Education does not guarantee the accuracy of the information presented at these sites.

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*“Man’s mind, once stretched by a new idea, never
regains its original dimensions.”*

Oliver Wendell Holmes, Jr.

To my family who have always encircled me with love and encouragement—my parents (Samuel and Charlotte), my wife (Mary), my sons and their wives (Kevin and Dawn, Robert and Sally) and their children (Ryan, Carly, Connor and Lauren).

C.F.G.

*“We must not cease from exploration and the end of all
exploring will be to arrive where we begin and to know
the place for the first time.”*

T. S. Eliot

To Ann whose love and support has brought out the best in me. And, to our girls Mary, Rachel, and Tor-Tor for the joy and pride they give me. Finally, to my muse, Neil, for the faith and inspiration he instills.

E.W.L

Preface

Our motivation in writing this text continues to be to provide a realistic, socio-technical view of project management. In the past, textbooks on project management focused almost exclusively on the tools and processes used to manage projects and not the human dimension. This baffled us since people not tools complete projects! While we firmly believe that mastering tools and processes is essential to successful project management, we also believe that the effectiveness of these tools and methods is shaped and determined by the prevailing culture of the organization and interpersonal dynamics of the people involved. Thus, we try to provide a holistic view that focuses on both of these dimensions and how they interact to determine the fate of projects.

The role of projects in organizations is receiving increasing attention. Projects are the major tool for implementing and achieving the strategic goals of the organization. In the face of intense, 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. It covers concepts and skills that are used by managers to propose, plan, secure resources, budget, and lead project teams to successful completions of their projects. The text should prove useful to students and prospective project managers in helping them 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 to be a valuable guide and reference when dealing with typical problems that arise in the course of a project. Managers will also find the text useful in understanding the role of projects in the missions of their organizations. Analysts will find the text useful in helping to explain the data needed for project implementation as well as the operations of inherited or purchased software. Members of the Project Management Institute will find the text is well structured to meet the needs of those wishing to prepare for PMP (Project Management Professional) or CAPM (Certified Associate in Project Management) certification exams. The text has in-depth coverage of the most critical topics found in PMI's *Project Management Body of Knowledge* (PMBOK). People at all levels in the organization assigned to work on projects will find the text useful not only in providing them with a rationale for the use of project management processes but also because of the insights they will gain on how to enhance their contributions to project success.

Our emphasis is not only on how the management process works, but more importantly, on *why* it works. The concepts, principles, and techniques are universally applicable. That is, the text does not specialize by industry type or project scope. Instead, the text is written for the individual who will be required to manage a variety of projects in a variety of different organizational settings. 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 engineering consultancy firms. At the same time, this approach will benefit organizations that carry out many small projects while the daily effort of delivering products or services continues.

Content

In this and other editions we continue to resist the forces that engender scope creep and focus only on essential tools and concepts that are being used in the real world. We have been guided by feedback from practitioners, teachers, and students. Some changes are minor and incremental, designed to clarify and reduce confusion. Other changes are significant. They represent new developments in the field or better ways of teaching project management principles. Below are major changes to the sixth edition.

- Computer exercises and MS Project examples have been updated to MS Project 2010, and 2013 including video tutorials to help students master the basics of MS Project.
- Terms and concepts have been updated to be consistent with the fifth edition of the *Project Management Body of Knowledge* (2013).
- The chapters on Agile Project Management and Careers in Project Management have been expanded.
- Chapter 6 utilizes a new example that clarifies the differences between free and total slack. Chapters 1, 2, 4, 5 and 14 have been updated.
- A description of the Activity on Arrow (AoA) method for calculating networks has been deleted from the text and is now available only in the Instructor's Manual.
- New student exercises and cases have been added to many chapters.
- The Blue Zuma computer exercise in Appendix 2 has been replaced by the new Red Zuma exercise.
- The Snapshot from Practice boxes feature a number of new examples of project management in action as well as new Research Highlights that continue to promote practical application of project management.
- The Instructor's Manual contains a listing of current YouTube videos that correspond to key concepts and Snapshots from Practice.

Overall the text addresses the major questions and issues the authors have encountered over their 60 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? How does one pursue a career in project management?

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.

Student Learning Aids

The text website (www.mhhe.com/larsongray6e) includes study outlines, online quizzes, PowerPoint slides, videos, Microsoft Project Video Tutorials and web links. The trial version of Microsoft Project software is included on its own CD-ROM free with the text.

Acknowledgments

We would like to thank Lacey McNeely for updating the Test Bank and Online Quizzes; Charlie Cook for revising the PowerPoint slides; Oliver F. Lehmann for providing access to PMBOK study questions; and Pinyarat Sirisomboonsuk for accuracy checking the text and Instructor's Resource Manual content.

Next, it is important to note that 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, John A. Drexler, Jim Moran, John Sloan, 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 are indebted to the reviewers of past editions who shared our commitment to elevating the instruction of project management. The reviewers include Paul S. Allen, Rice University; Denis F. Cioffi, George Washington University; Joseph D. DeVoss, DeVry University; Edward J. Glantz, Pennsylvania State University; Michael Godfrey, University of Wisconsin–Oshkosh; Robert Key, University of Phoenix; Dennis Krumwiede, Idaho State University; Nicholas C. Petruzzi, University of Illinois–Urbana/Champaign; William R. Sherrard, San Diego State University; S. Narayan Bodapati, Southern Illinois University at Edwardsville; Warren J. Boe, University of Iowa; Burton Dean, San Jose State University; Kwasi

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In the sixth edition we continue to commit to improving the text content and improving instruction of project management. We are grateful to those reviewers who provided helpful critiques and insights on the fifth edition, which helped us prepare this revision. The reviewers for the sixth edition include Victor Allen, Lawrence Technological University; Mark Angolia, East Carolina University; Alan Cannon, University of Texas at Arlington; Robert Cope, Southeastern Louisiana University; Kenneth DaRin, Clarkson University; Ron Darnell, Amberton University; Jay Goldberg, Marquette University; Mark Huber, University of Georgia; Marshall Issen, Clarkson University; Charles Lesko, East Carolina University; Lacey McNeely, Oregon State University; Donald Smith, Texas A&M University; Peter Sutanto, Prairie View A&M University; Jon Tomlinson, University of Northwestern Ohio. We thank you for your many thoughtful suggestions and for making our book better. Of course we accept responsibility for the final version of the text.

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 Prem Mathew and Ping-Hung Hsieh for their helpful advice and suggestions. We also wish to thank the many students who helped us at different stages of this project, most notably Neil Young, Saajan Patel, Katherine Knox, Dat Nguyen, Lacey McNeely and David Dempsey. Mary Gray deserves special credit for editing and working under tight deadlines on earlier editions. Special thanks go to Pinyarat (“Minkster”) Sirisomboonsuk for her help in preparing the last four editions.

Finally, we want to extend our thanks to all the people at McGraw-Hill/Higher Education for their efforts and support. First, we would like to thank Thomas Hayward and Wanda Zeman for providing editorial direction, guidance, and management of the book’s development for the sixth edition. And we would also like to thank Jane Mohr, Heather Ervolino, Nichole Birkenholz, Arpana Kumari, and Janean Utley for managing the final production, design, supplement, and media phases of the sixth edition.

Erik W. Larson
Clifford F. Gray

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 and contributions to projects.

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

Chapter-by-Chapter Revisions for the Sixth Edition

Chapter 1: Modern Project Management

- New Snapshot: *Project Management in Action 2013*.
- Makes stronger case for why project management is essential skill set for anyone's career.
- New Snapshot: *A Dozen Examples of Projects Given to Recent College Graduates*.

Chapter 2: Organization Strategy and Project Selection

- New Snapshot: *Does IBM's Watson's Jeopardy Project Represent a Change in Strategy?*
- New Snapshot: *HP's Strategy Revision*.
- Expanded discussion on the importance of project sponsors.
- Revamped description of how project risks are assessed during the proposal phase.
- New case: *Fund Raising Project Selection Case*.

Chapter 3: Organization: Structure and Culture

- New Snapshot: *Google-y*.
- New case: *Horizon Consulting*.

Chapter 4: Defining the Project

- A new central example of a Work Breakdown Structure (WBS).
- Discussion of Process Breakdown Structure (PBS).
- Inclusion of “power/interest” map for assessing stakeholders.

Chapter 5: Estimating Project Times and Costs

- New Snapshot: *Reducing Estimating Error*.
- Introduction to Reference Class Forecasting methodology.
- New case: *Post Graduation Adventure*.

Chapter 6: Developing a Project Schedule

- A new central example that clarifies the differences between free and total slack.
- A description of the Activity on Arrow (AoA) method for calculating networks has been deleted from the text and is now available only in the Instructor’s Manual.

Chapter 7: Managing Risk

- New Snapshot: *Playing Soccer in the Desert*.
- New case: *Sustaining Project Risk Management during Implementation*.

Chapter 8 Appendix 1: The Critical-Chain Approach

- New Snapshot: *Critical Chain Applied to Airplane Part Arrivals*.

Chapter 9: Reducing Project Duration

- New Snapshot: *Smartphone Wars*.

Chapter 10: Leadership: Being an Effective Project Manager

- New case: *The Blue Sky Project*.
- New ethical dilemmas mini-case: *Old Princeton Landing*.

Chapter 11: Managing Project Teams

- Expanded discussion on project vision.

Chapter 12: Outsourcing: Managing Interorganizational Relations

- New Snapshot: *The Boeing 787 Dreamliner*.
- New Snapshot: *U.S. Department of Defense’s Value Engineering Awards 2013*.
- New case: *Shell Case Fabricators*.

Chapter 15: International Projects

- More extensive discussion of financial risks associated with international projects.
- New Snapshot: *Project X–Namibia, Africa*.
- New exercise assessing relative safety of different countries.

Chapter 17: An Introduction to Agile Project Management

- Elaborates on the role of product owner in Scrum.
- Includes all the principles of Agile Manifesto.
- Introduces the use of Sprint and Release Burndown charts to monitor progress on Agile projects.
- Discusses the use of hybrid models that combine elements of Agile and Waterfall.

Chapter 18: Project Management Career Paths

- New Snapshot: *Ron Parker*.
- Discussion on how to take advantage of opportunities at a university to develop project management skills.
- Expanded discussion of the value of certification.
- New Snapshot: *Grooming the Next Generation at Intel*.

Appendix 2: Computer Project Exercises

- The Blue Zuma computer exercise in Appendix 2 has been replaced by a new Red Zuma exercise.
- A video tutorial that demonstrates step by step how to complete and answer the original Blue Zuma exercise is available online for students.

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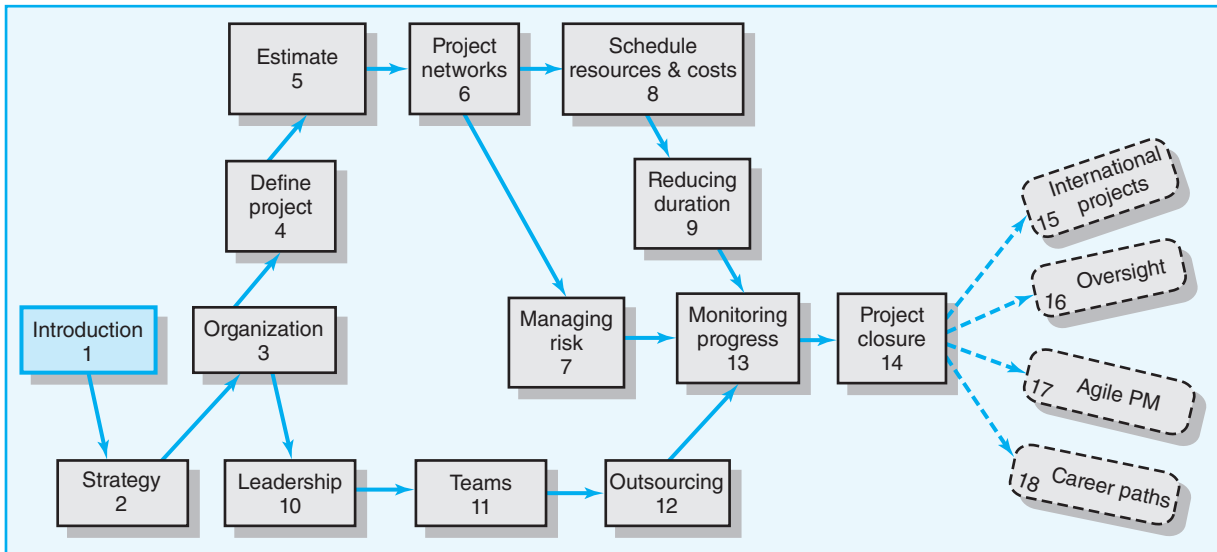
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Modern Project Management



Modern Project Management

- What Is a Project?
- Current Drivers of Project Management
- Project Governance
- Project Management Today—A Socio-Technical Approach
- Summary
- Text Overview

All of mankind's greatest accomplishments—from building the great pyramids to discovering a cure for polio to putting a man on the moon—began as a project.

This is a good time to be reading a book about project management. Business leaders and experts have proclaimed that project management is critical to sustainable economic growth. New jobs and competitive advantage are achieved by constant innovation, developing new products and services, and improving both productivity and quality of work. This is the world of project management. Project management provides people with a powerful set of tools that improves their ability to plan, implement, and manage activities to accomplish specific organizational objectives. But project management is more than just a set of tools; it is a results-oriented management style that places a premium on building collaborative relationships among a diverse cast of characters. Exciting opportunities await people skilled in project management.

The project approach has long been the style of doing business in the construction industry, U.S. Department of Defense contracts, and Hollywood as well as big consulting firms. Now project management has spread to all avenues of work. Today, project teams carry out everything from port expansions to hospital restructuring to upgrading information systems. They are creating next generation, fuel efficient vehicles, developing sustainable sources of energy, and exploring the farthest reaches of outer space. The impact of project management is most profound in the electronics industry, where the new folk heroes are young professionals whose Herculean efforts lead to the constant flow of new hardware and software products.

Project management is not limited to the private sector. Project management is also a vehicle for doing good deeds and solving social problems. Endeavors such as providing emergency aid to areas hit by natural disasters, devising a strategy for reducing crime and drug abuse within a city, or organizing a community effort to renovate a public playground would and do benefit from the application of modern project management skills and techniques.

Perhaps the best indicator of demand for project management can be seen in the rapid expansion of the Project Management Institute (PMI), a professional organization for project managers. PMI membership has grown from 93,000 in 2002 to more than 434,000 currently. See the PMI Snapshot from Practice, for information regarding professional certification in project management.

It's nearly impossible to pick up a newspaper or business periodical and not find something about projects. This is no surprise! Approximately \$2.5 trillion (about 25 percent of the U.S. gross national product) are spent on projects each year in the United States alone. Other countries are increasingly spending more on projects. Millions of people around the world consider project management the major task in their profession.

SNAPSHOT FROM PRACTICE

The Project Management Institute*



The Project Management Institute (PMI) was founded in 1969 as an international society for project managers. Today PMI has members from more than 180 countries and more than 424,600 members. PMI professionals come from virtually every major industry, including aerospace, automotive, business management, construction, engineering, financial services, information technology, pharmaceuticals, health care, and telecommunications.

PMI provides certification as a **Project Management Professional (PMP)**—someone who has documented sufficient project experience, agreed to follow the PMI code of professional conduct, and demonstrated mastery of the field of project management by passing a comprehensive examination. The number of people earning PMP status has grown dramatically in recent years. In 1996 there were fewer than 3,000 certified project management professionals. By June of 2013 there were more than 537,400 Professional credential holders.

Just as the CPA exam is a standard for accountants, passing the PMP exam may become the standard for project managers. Some companies are requiring that all their project managers be PMP certified. Moreover, many job postings are restricted to PMPs. Job seekers, in general, are finding that being PMP certified is an advantage in the marketplace.

PMI added a certification as a *Certified Associate in Project Management (CAPM)*. CAPM is designed for project team members and entry-level project managers, as well as qualified undergraduate and graduate students who want a credential to recognize their mastery of the project management body of knowledge. CAPM does not require the extensive project management experience associated with the PMP. For more details on PMP and CAPM, “Google” PMI to find the current Web site for the Project Management Institute.

*PMI Today, June 2013, p. 4

Most of the people who excel at managing projects never have the title of project manager. They include accountants, lawyers, administrators, scientists, contractors, public health officials, teachers, and community advocates whose success depends upon being able to lead and manage project work. For some, the very nature of their work is project driven. Projects may be cases for lawyers, audits for accountants, events for artists, and renovations for contractors. For others, projects may be a small, but critical part of their work. For example, a high school teacher who teaches four classes a day is responsible for coaching a group of students to compete in a national debate competition. A store manager who oversees daily operations is charged with developing an employee retention program. A sales account executive is given the additional assignment of team lead to launch daily deals into a new city. A public health official who manages a clinic is also responsible for organizing a Homeless Youth Connect event. For these and others, project management is not a title, but a critical job requirement. It is hard to think of a profession or a career path that would not benefit from being good at managing projects.

Not only is project management critical to most careers, the skill set is transferable across most businesses and professions. At its core, project management fundamentals are universal. The same project management methodology that is used to develop a new product can be adapted to create new services, organize events, refurbish aging operations, and so forth. In a world where it is estimated that each person is likely to experience three to four career changes, managing projects is a talent worthy of development.

SNAPSHOT FROM PRACTICE

A Dozen Examples of Projects Given to Recent College Graduates



1. Business information: Join a project team charged with installing new data security system.
2. Physical education: Design and develop a new fitness program for senior citizens that combines principles of yoga and aerobics.
3. Marketing: Execute a sales program for new home air purifier.
4. Industrial engineering: Manage a team to create a value chain report for every aspect of key product from design to customer delivery.
5. Chemistry: Develop a quality control program for organization's drug production facilities.
6. Management: Implement a new store layout design.
7. Pre-med neurology student: Join project team linking mind mapping to an imbedded prosthetic that will allow blind people to function near normally.
8. Sports communication: Join Olympic project team that will promote women's sport products for the 2016 Games in Reo de Janeiro, Brazil.
9. Systems engineer: Become a project team member of a project to develop data mining of medical papers and studies related to drug efficacy.
10. Accounting: Work on an audit of a major client.
11. Public health: Research and design a medical marijuana educational program.
12. English: Create a web-based user manual for new electronics product.



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The significance of project management can also be seen in the classroom. Twenty years ago major universities offered one or two classes in project management, primarily for engineers. Today, most universities offer multiple sections of project management classes, with the core group of engineers being supplemented by business students majoring in marketing, management information systems

(MIS), and finance, as well as students from other disciplines such as oceanography, health sciences, computer sciences, and liberal arts. These students are finding that their exposure to project management is providing them with distinct advantages when it comes time to look for jobs. More and more employers are looking for graduates with project management skills. See the nearby Snapshot from Practice for examples of projects given to recent college graduates. The logical starting point for developing these skills is understanding the uniqueness of a project and of project managers.

What Is a Project?

What do the following headlines have in common?

- Millions watch Olympic Opening Ceremony
- Citywide WiFi system set to go live
- Hospitals respond to new Health Care Reforms
- Apple's new iPhone hits the market
- City receives stimulus funds to expand light rail system

All of these events represent projects.



© Lars Baron/Getty Images

The Project Management Institute provides the following definition of a project:

A **project** is a temporary endeavor undertaken to create a unique product, service, or result.

Like most organizational effort, the major goal of a project is to satisfy a customer's need. Beyond this fundamental similarity, the characteristics of a project help

differentiate it from other endeavors of the organization. The major characteristics of a project are as follows:

1. An established objective.
2. A defined life span with a beginning and an end.
3. Usually, the involvement of several departments and professionals.
4. Typically, doing something that has never been done before.
5. Specific time, cost, and performance requirements.

First, projects have a defined objective—whether it is constructing a 12-story apartment complex by January 1 or releasing version 2.0 of a specific software package as quickly as possible. This singular purpose is often lacking in daily organizational life in which workers perform repetitive operations each day.

Second, because there is a specified objective, projects have a defined endpoint, which is contrary to the ongoing duties and responsibilities of traditional jobs. In many cases, individuals move from one project to the next as opposed to staying in one job. After helping to install a security system, an IT engineer may be assigned to develop a database for a different client.

Third, unlike much organizational work that is segmented according to functional specialty, projects typically require the combined efforts of a variety of specialists. Instead of working in separate offices under separate managers, project participants, whether they be engineers, financial analysts, marketing professionals, or quality control specialists, work closely together under the guidance of a project manager to complete a project.

The fourth characteristic of a project is that it is nonroutine and has some unique elements. This is not an either/or issue but a matter of degree. Obviously, accomplishing something that has never been done before, such as building a electric automobile or landing two mechanical rovers on Mars, requires solving previously unsolved problems and breakthrough technology. On the other hand, even basic construction projects that involve established sets of routines and procedures require some degree of customization that makes them unique.

Finally, specific time, cost, and performance requirements bind projects. Projects are evaluated according to accomplishment, cost, and time spent. These triple constraints impose a higher degree of accountability than you typically find in most jobs. These three also highlight one of the primary functions of project management, which is balancing the trade-offs between time, cost, and performance while ultimately satisfying the customer.

What a Project Is Not Projects should not be confused with everyday work. A project is not routine, repetitive work! Ordinary daily work typically requires doing the same or similar work over and over, while a project is done only once; a new product or service exists when the project is completed. Examine the list in Table 1.1 that compares routine, repetitive work and projects. Recognizing the difference is important because too often resources can be used up on daily operations which may not contribute to longer range organization strategies that require innovative new products.

Program versus Project In practice the terms project and program cause confusion. They are often used synonymously. A **program** is a group of related projects

TABLE 1.1
Comparison of
Routine Work with
Projects

Routine, Repetitive Work	Projects
Taking class notes	Writing a term paper
Daily entering sales receipts into the accounting ledger	Setting up a sales kiosk for a professional accounting meeting
Responding to a supply-chain request	Developing a supply-chain information system
Practicing scales on the piano	Writing a new piano piece
Routine manufacture of an Apple iPod	Designing an iPod that is approximately 2 × 4 inches, interfaces with PC, and stores 10,000 songs
Attaching tags on a manufactured product	Wire-tag projects for GE and Wal-Mart

designed to accomplish a common goal over an extended period of time. Each project within a program has a project manager. The major differences lie in scale and time span.

Program management is the process of *managing* a group of ongoing, interdependent, related *projects* in a coordinated way to achieve strategic objectives. For example, a pharmaceutical organization could have a program for curing cancer. The cancer program includes and coordinates *all* cancer projects that continue over an extended time horizon (Gray, 2011). Coordinating all cancer projects under the oversight of a cancer team provides benefits not available from managing them individually. This cancer team also oversees the selection and prioritizing of cancer projects that are included in their special “Cancer” portfolio. Although each project retains its own goals and scope, the project manager and team are also motivated by the higher program goal. Program goals are closely related to broad strategic organization goals.

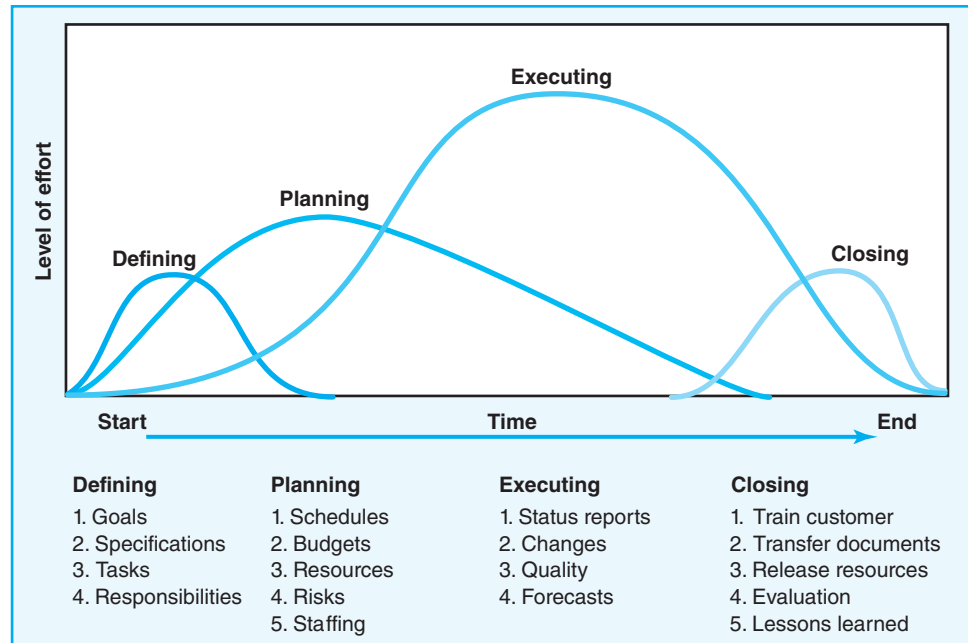
The Project Life Cycle

Another way of illustrating the unique nature of project work is in terms of the **project life cycle**. Some project managers find it useful to use the project life cycle as the cornerstone for managing projects. The life cycle recognizes that projects have a limited life span and that there are predictable changes in level of effort and focus over the life of the project. There are a number of different life-cycle models in project management literature. Many are unique to a specific industry or type of project. For example, a new software development project may consist of five phases: definition, design, code, integration/test, and maintenance. A generic cycle is depicted in Figure 1.1.

The project life cycle typically passes sequentially through four stages: defining, planning, executing, and delivering. The starting point begins the moment the project is given the go-ahead. Project effort starts slowly, builds to a peak, and then declines to delivery of the project to the customer.

1. **Defining stage:** Specifications of the project are defined; project objectives are established; teams are formed; major responsibilities are assigned.
2. **Planning stage:** The level of effort increases, and plans are developed to determine what the project will entail, when it will be scheduled, whom it will benefit, what quality level should be maintained, and what the budget will be.

FIGURE 1.1
Project Life Cycle



3. **Executing stage:** A major portion of the project work takes place—both physical and mental. The physical product is produced (a bridge, a report, a software program). Time, cost, and specification measures are used for control. Is the project on schedule, on budget, and meeting specifications? What are the forecasts of each of these measures? What revisions/changes are necessary?
4. **Closing stage:** Closing includes three activities: delivering the project product to the customer, redeploying project resources, and post-project review. Delivery of the project might include customer training and transferring documents. Redeployment usually involves releasing project equipment/materials to other projects and finding new assignments for team members. Post-project reviews include not only assessing performance but also capturing lessons learned.

In practice, the project life cycle is used by some project groups to depict the timing of major tasks over the life of the project. For example, the design team might plan a major commitment of resources in the defining stage, while the quality team would expect their major effort to increase in the latter stages of the project life cycle. Because most organizations have a portfolio of projects going on concurrently, each at a different stage of each project's life cycle, careful planning and management at the organization and project levels are imperative.

The Project Manager

At first glance project managers perform the same functions as other managers. That is, they plan, schedule, motivate, and control. However, what makes them